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Wolfgang Klemmstein



**Lernen ohne  
Sprachbarrieren  
Techn. Mathematik  
Metall**

Schülerausgabe

Deutsche Gesellschaft  
für Technische Zusammenarbeit  
(GTZ) GmbH

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# **Lernen ohne Sprachbarrieren**

Technische Mathematik Metall

Deutsche Gesellschaft  
für Technische Zusammenarbeit  
(GTZ) GmbH, Eschborn  
Federal Republic of Germany

Sonderausgabe für Projekte  
der Gewerblichen Berufsausbildung  
in Ländern der Dritten Welt

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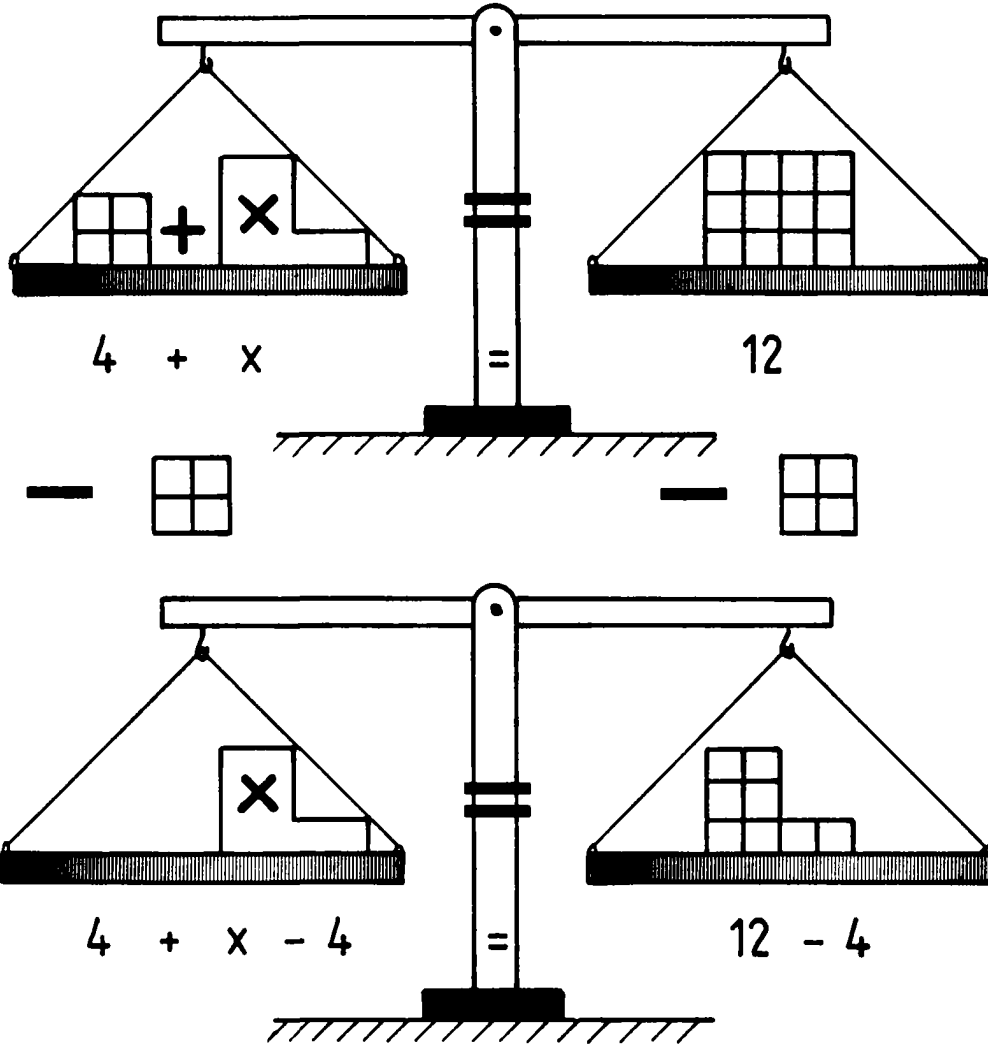
**Informationsblätter  
Information sheets  
Fiches d'information  
Hojas informativas**

**Arbeitsblätter  
Work sheets  
Fiches de problèmes  
Hojas de trabajo**

1.1  
2.1  
3.1 .2  
4.1  
5.1  
6.1  
7.1  
8.1  
9.1  
10.1  
11.1 .2  
12.1  
13.1  
14.1 .2  
15.1  
16.1  
17.1  
18.1  
19.1  
20.1  
21.1 .2  
22.1  
23.1  
24.1  
25.1 .2  
26.1 .2  
27.1  
28.1  
29.1  
30.1  
31.1 .2 .3  
32.1 .2  
33.1 .2 .3  
34.1  
35.1 .2 .3  
36.1  
37.1 .2  
38.1 .2  
39.1 .2  
40.1 .2  
41.1 .2  
42.1 .2  
43.1

1.2  
2.2  
3.3  
4.2  
5.2  
6.2  
7.2 .3  
8.2  
9.2  
10.2 .3  
11.3 .4  
12.2  
13.2  
14.3  
15.2  
16.2  
17.2  
18.2 .3  
19.2  
20.2  
21.3 .4  
22.2 .3  
23.2  
24.2  
25.3 .4  
26.3 .4 .5  
27.2  
28.2  
29.2 .3  
30.2  
31.4 .5  
32.3 .4  
33.4 .5  
34.2  
35.4 .5  
36.2 .3  
37.3 .4  
38.3  
39.3 .4  
40.3 .4  
41.3 .4  
42.3 .4  
43.2





1.

$$x + 17 = 61$$

$$x = ?$$

$$x + 17 = 61$$

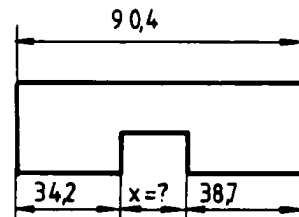
$$x = 61 - 17$$

$$\underline{x = 44}$$

Test:

$$\underline{\underline{x = 8}}$$

2.



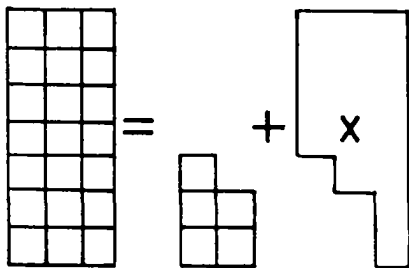
$$34,2\text{mm} + x + 38,7\text{mm} = 90,4\text{mm}$$

$$x = 90,4\text{mm} - 34,2\text{mm} - 38,7\text{mm}$$

$$\underline{\underline{x = 17,5\text{mm}}}$$

a)

$x = ?$



$x =$

$$c) x = 1 - 8 - 2p$$

b)

$x = ?$

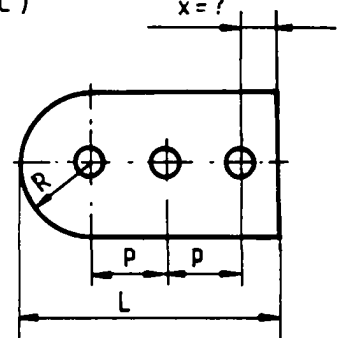
$$25 + x = 40$$

$x =$

$$b) x = 15$$

c)

$x = ?$



$x =$

$$a) x = 16$$

①

a)  $48 - x = 19$  ;  $x = ?$

b)  $1,5 = 4,83 - x$  ;  $x = ?$

a)

$x = \boxed{\phantom{000}}$

b)

$x = \boxed{\phantom{000}}$

②

a)  $30,48 - 12,44 - x = 9,92$   
 $x = ?$

b)  $x - 13,64 - 12,8 = 96,4$   
 $x = ?$

a)

$x = \boxed{\phantom{000}}$

b)

$x = \boxed{\phantom{000}}$

③

a)  $4x + 12 = 32$  ;  $x = ?$

b)  $80 - 2x = 68$  ;  $x = ?$

a)

$x = \boxed{\phantom{000}}$

b)

$x = \boxed{\phantom{000}}$

④

a)  $420 - 44,28 = 280,1 + 1$   
 $l = ?$

b)  $100,2 - L = 88,6$   
 $L = ?$

a)

$l = \boxed{\phantom{000}}$

b)

$L = \boxed{\phantom{000}}$

⑤

a)  $\frac{5''}{8} + x = \frac{9''}{12}$  ;  $x = ?$

b)  $42\frac{3}{4}\text{ft} - x = 39\frac{2}{3}\text{ft}$ ;  $x = ?$

a)

$x = \boxed{\phantom{000}}$

b)

$x = \boxed{\phantom{000}}$  ft

⑥

a)  $422,82\text{mm} - 2x = 311\text{mm}$   
 $x = ?$

b)  $x - 39,9\text{mm} = 60,21\text{mm}$   
 $x = ?$

a)

$x = \boxed{\phantom{000}}$  mm

b)

$x = \boxed{\phantom{000}}$  mm

⑦

a)  $\frac{d_1}{2} + \frac{d_2}{2} = a$  ;  $d_1 = ?$

b)  $V = V_1 - V_2 + V_3$  ;  $V_3 = ?$

a)  $d_1 =$

$\boxed{\phantom{000}}$

b)  $V_3 =$

$\boxed{\phantom{000}}$

⑧

a)  $a = \frac{d_1}{2} + d_2 + \frac{d_3}{2}$

$d_2 = ?$

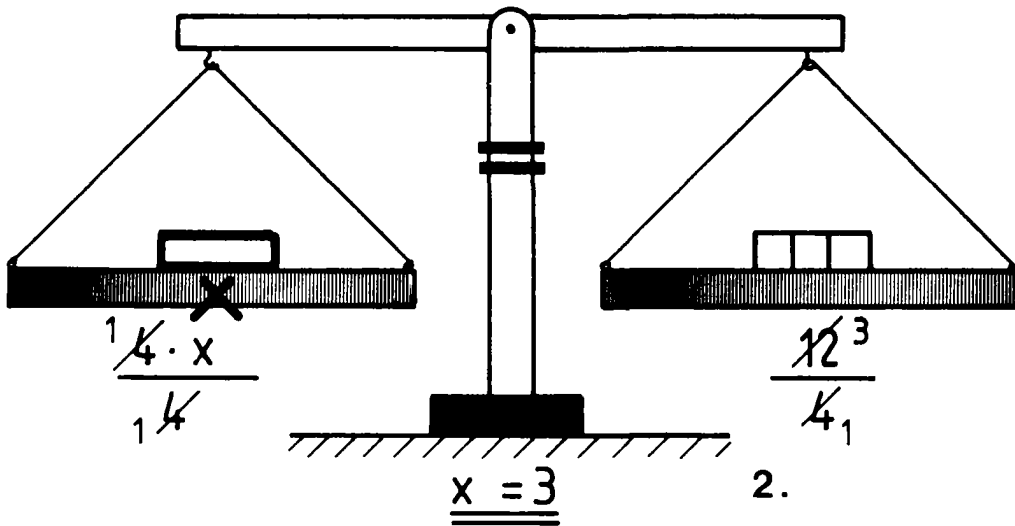
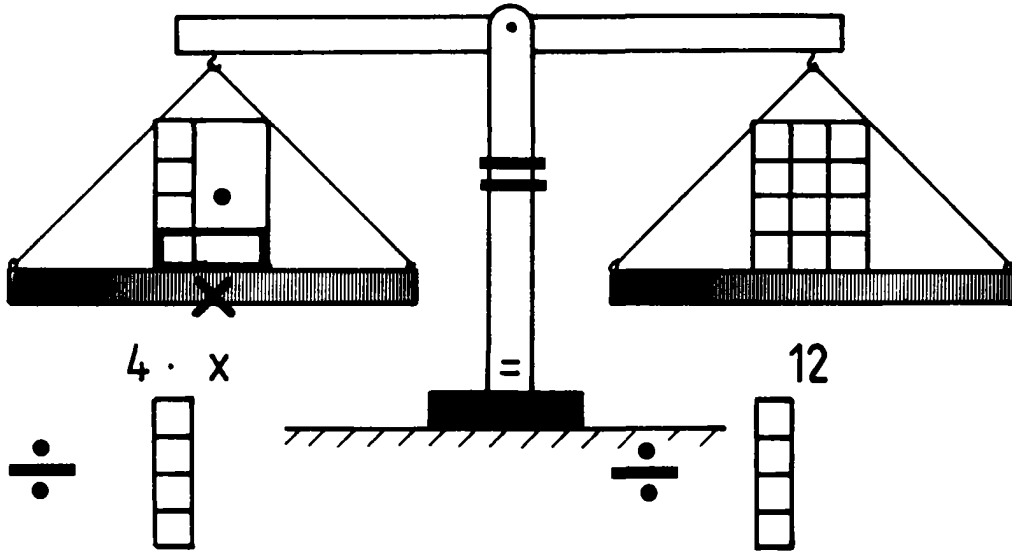
b)  $A = A_1 + A_2 - A_3$  ;  $A_3 = ?$

a)  $d_2 =$

$\boxed{\phantom{000}}$

b)  $A_3 =$

$\boxed{\phantom{000}}$



1.

$$15 \cdot x = 75$$

$$x = ?$$

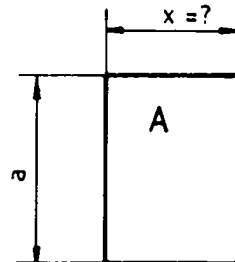
$$15x = 75$$

$$x = \frac{75}{15}$$

$$x = 5$$

Test:

2.

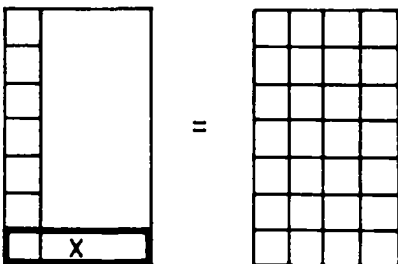


$$A = a \cdot x$$

$$A = a \cdot x$$

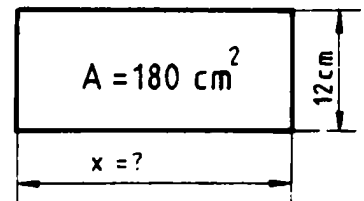
$$a \cdot x = A$$

$$x = \frac{A}{a}$$

 a)  $x = ?$ 

 b)  $x = ?$ 

$$27 \cdot x = 45$$

c)


 $x =$ 


 c)  $x = 15 \text{ cm}$ 
 $x =$ 


 b)  $x = 1,67$ 
 $x =$ 


cm

 a)  $x = 4$

①

a)  $\frac{5}{3}x = 12$  ;  $x = ?$

b)  $9 = \frac{4x}{18}$  ;  $x = ?$

a)

$x = \boxed{\phantom{000}}$

b)

$x = \boxed{\phantom{000}}$

②

a)  $120 = \frac{4 \cdot 12}{x}$  ;  $x = ?$

b)  $\frac{5}{x} = \frac{12}{18}$  ;  $x = ?$

a)

$x = \boxed{\phantom{000}}$

b)

$x = \boxed{\phantom{000}}$

③

a)  $100 = \frac{20 \cdot h}{3}$  ;  $h = ?$

b)  $300 = \frac{A_m \cdot 50}{3}$  ;  $A_m = ?$

a)

$h = \boxed{\phantom{000}}$

b)

$A_m = \boxed{\phantom{000}}$

④

a)  $628 = \frac{d \cdot 3 \cdot 14}{2}$  ;  $d = ?$

b)  $\frac{1}{v_1} = \frac{5}{36}$  ;  $v_1 = ?$

a)

$d = \boxed{\phantom{000}}$

b)

$v_1 = \boxed{\phantom{000}}$

⑤

a)  $v = d \cdot \pi \cdot n$  ;  $n = ?$

b)  $s = m \cdot z \cdot \pi$  ;  $m = ?$

a)  $n = \boxed{\phantom{000}}$

b)  $m = \boxed{\phantom{000}}$

⑥

a)  $F \cdot 2\pi \cdot r = F_{ax} \cdot P$  ;  $r = ?$

b)  $i = \frac{z_2 \cdot z_4}{z_1 \cdot z_3}$  ;  $z_1 = ?$

a)  $r = \boxed{\phantom{000}}$

b)  $z_1 = \boxed{\phantom{000}}$

⑦

a)  $\frac{a}{b} = \frac{h}{1}$  ;  $b = ?$

b)  $W = \frac{F \cdot s}{t}$  ;  $F = ?$

a)  $b = \boxed{\phantom{000}}$

b)  $F = \boxed{\phantom{000}}$

⑧

a)  $a = \frac{m}{2} (z_1 + z_2)$  ;  $m = ?$

b)  $A = \frac{a + b}{2} \cdot h$  ;  $a = ?$

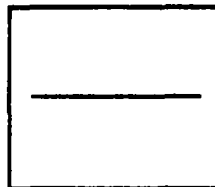
a)  $m = \boxed{\phantom{000}}$

b)  $a = \boxed{\phantom{000}}$

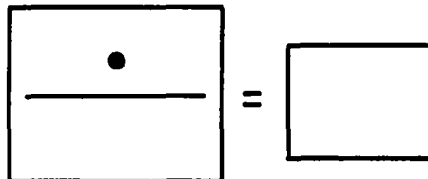
1.



2.

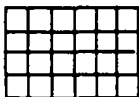
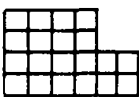


3.



Test :

a)


 —  \$

 —  \$

b)



— 4 t



— ? t

c)

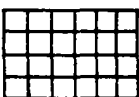


— 480 kg



— ? kg

1.


 —  \$

 —  t

 —  kg

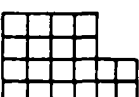
2.


 —  \$

 —  t

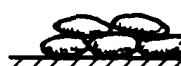
 —  kg

3.


 —  \$

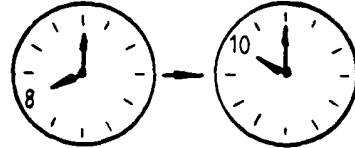
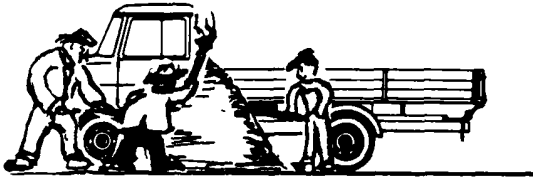
 =  \$

 —  t

 =  t

 —  kg

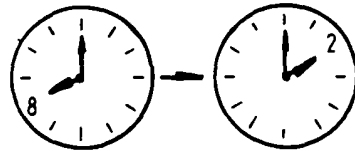
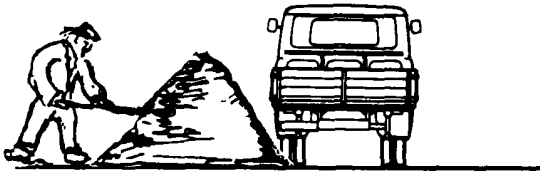
 =  kg

1.



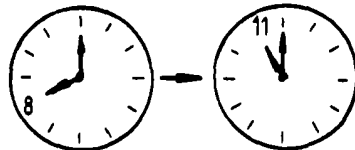
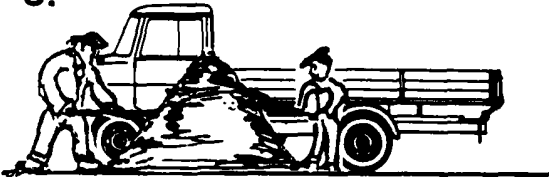
$$= 2h$$

2.



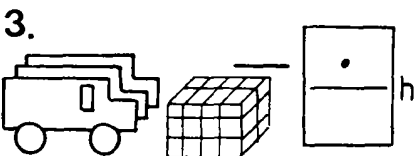
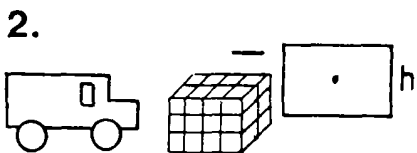
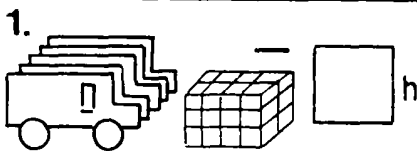
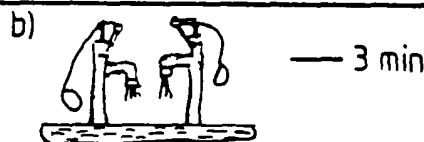
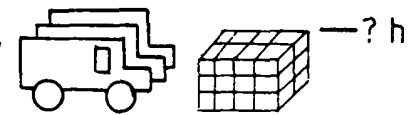
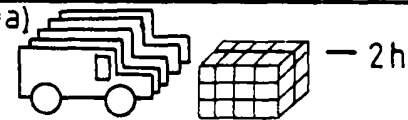
$$= 2 \cdot 3 = 6h$$

3.



$$= \frac{6}{2} = 3h$$

Test:



$$= \underline{\quad} h$$

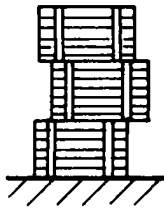
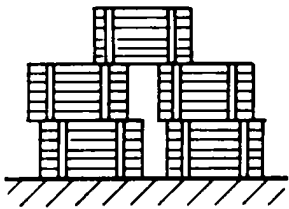
$$= \underline{\quad} min$$

$$= \underline{\quad} h$$

1

200 kg

? kg

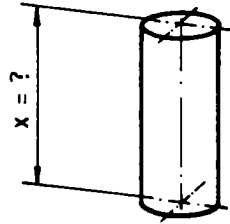
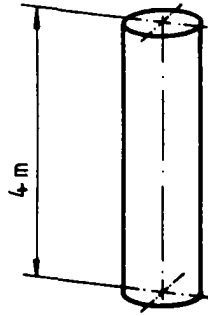


kg

2

42 kg

32 kg



x =  m

3



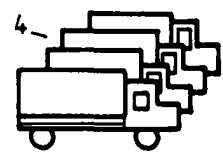
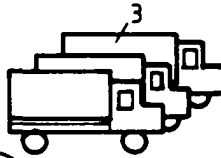
900 km



x = ?

x =  km

4



=



h

5

? t

6

9

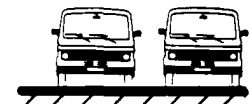


t

6



=



2000 h

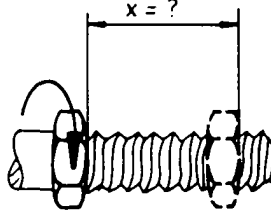
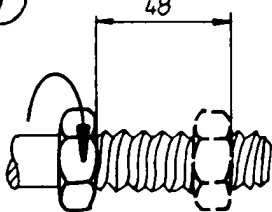
? h

h

7

48

x = ?

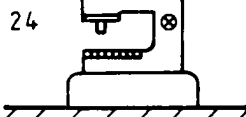
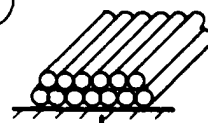


32

36

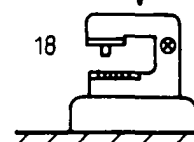
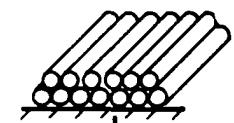
x =  mm

8



24

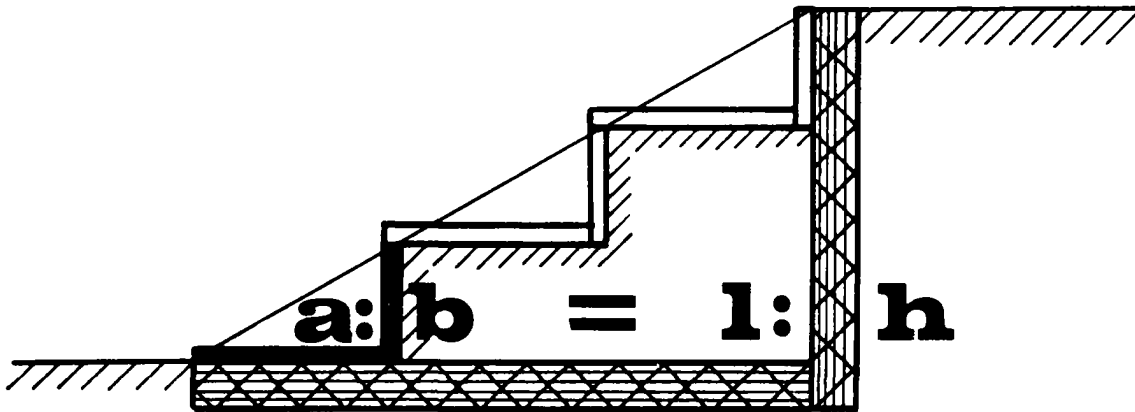
42 h



18

? h

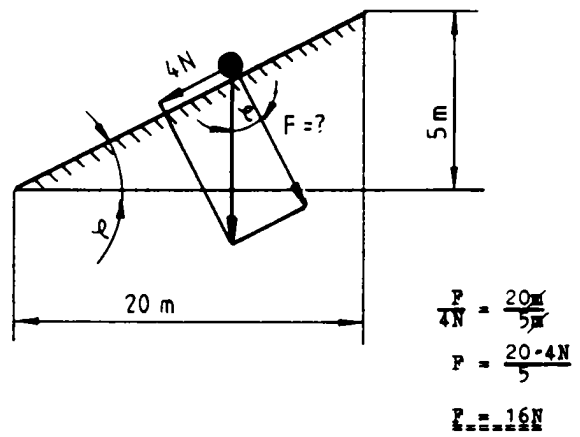
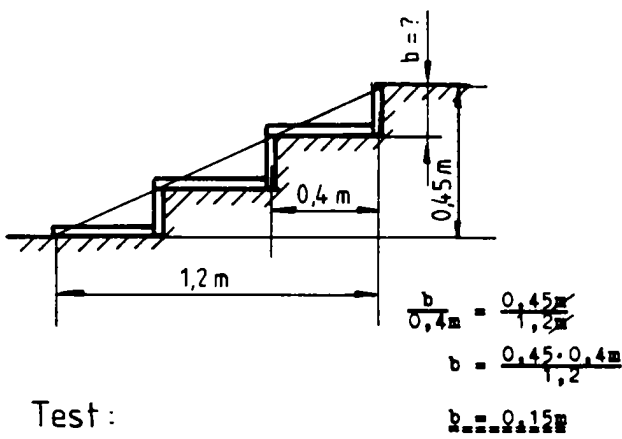
h



$$\frac{a}{b} = \frac{l}{h}$$

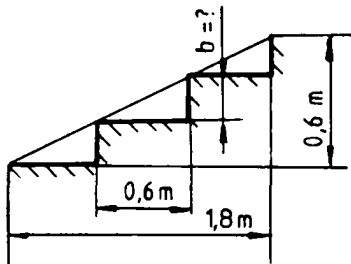
1.

2.



Test:

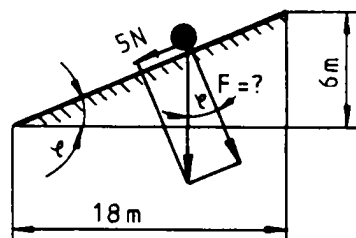
a)



$b = \boxed{\phantom{000}} \text{ m}$

 c)  $b = 3,75\text{ m}$ 

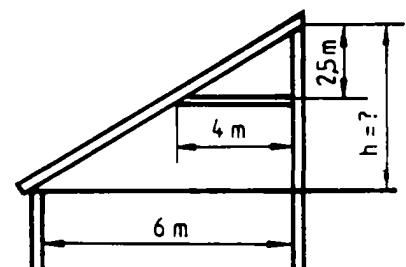
b)



$F = \boxed{\phantom{000}} \text{ N}$

 b)  $F = 15\text{ N}$ 

c)

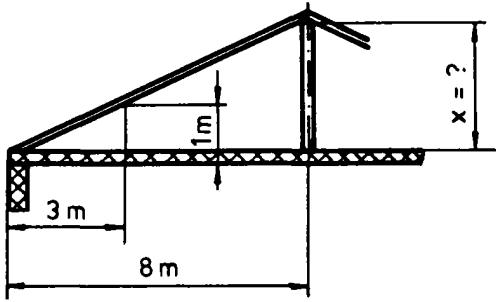


$h = \boxed{\phantom{000}} \text{ m}$

 a)  $h = 0,2\text{ m}$

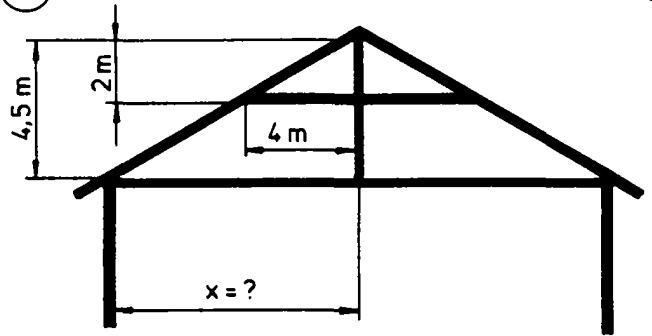


1



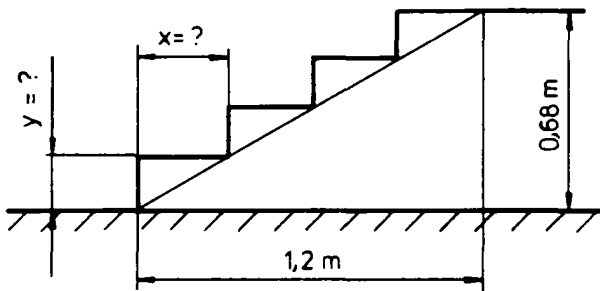
$x = \text{[ ]} \text{ m}$

2



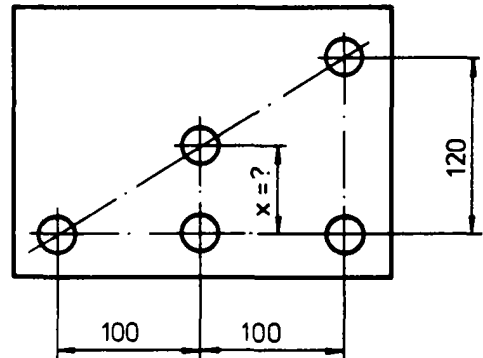
$x = \text{[ ]} \text{ m}$

3



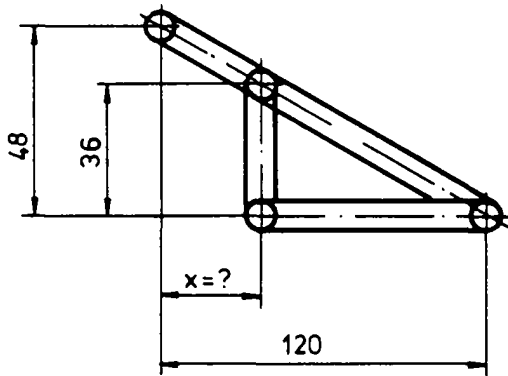
$x = \text{[ ]} \text{ m} \quad y = \text{[ ]} \text{ m}$

4



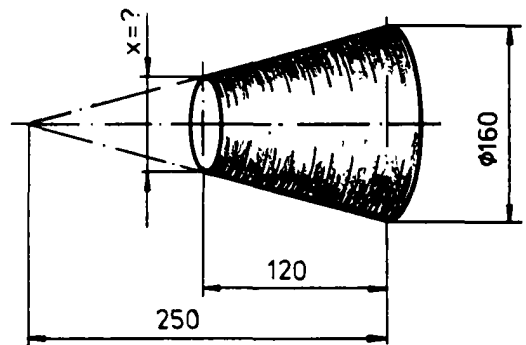
$x = \text{[ ]} \text{ mm}$

5



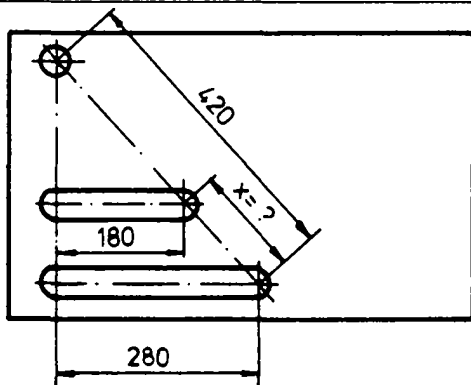
$x = \text{[ ]} \text{ mm}$

6



$x = \text{[ ]} \text{ mm}$

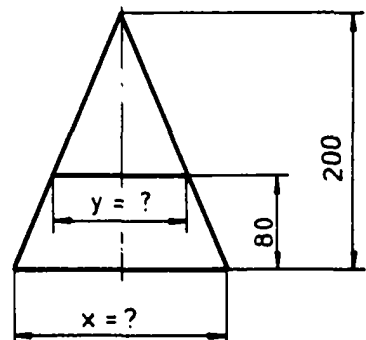
7



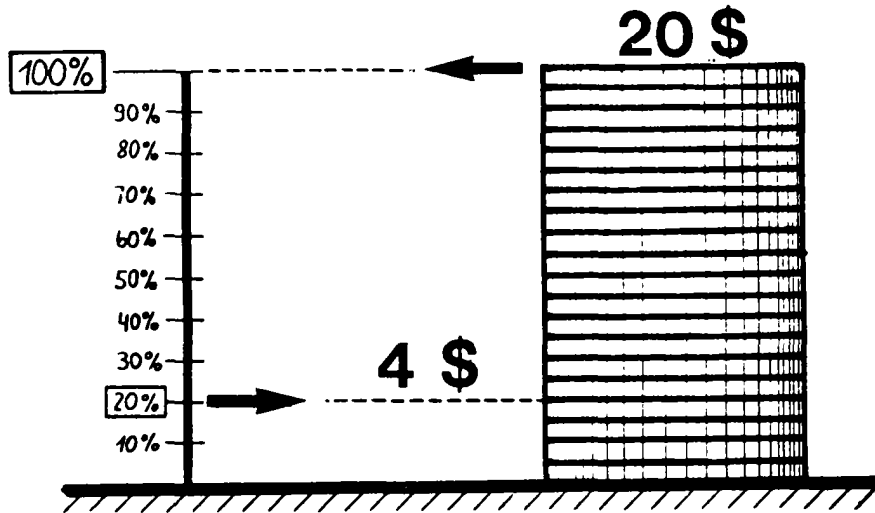
$x = \text{[ ]} \text{ mm}$

8

$\frac{x}{200} = \frac{1}{2}$



$x = \text{[ ]} \text{ mm} ; y = \text{[ ]} \text{ mm}$



$$100\% \hat{=} 20 \$$$

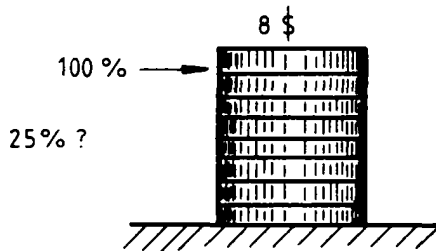
$$20\% \hat{=} x \$$$

---


$$100\% \hat{=} 20 \$$$

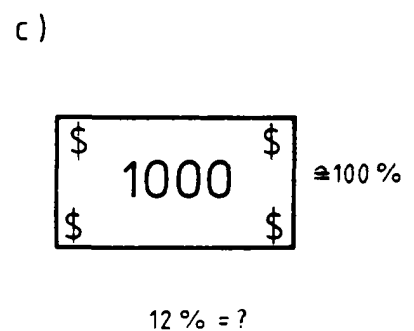
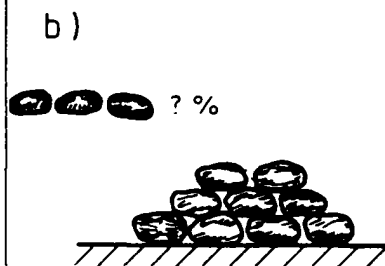
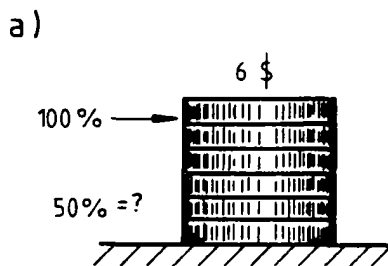
$$1\% \hat{=} \frac{20}{100} = 0,2 \$$$

$$20\% \hat{=} 0,2 \cdot 20 = 4 \$$$



$$\begin{array}{l} 100\% \hat{=} 8 \$ \\ 25\% \hat{=} x \$ \\ \hline 100\% \hat{=} 8 \$ \\ 1\% \hat{=} \frac{8}{100} \$ \\ 25\% \hat{=} \frac{8 \cdot 25}{100} \$ \\ 25\% \hat{=} 2 \$ \end{array}$$

Test:

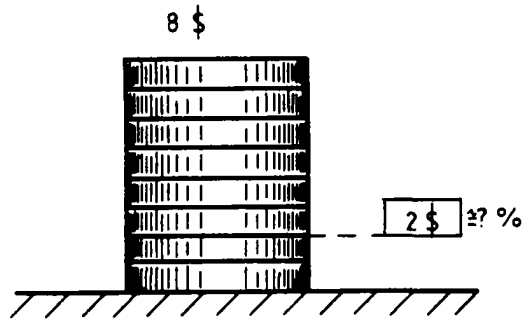


50%  $\hat{=}$   \$

3  $\hat{=}$   %

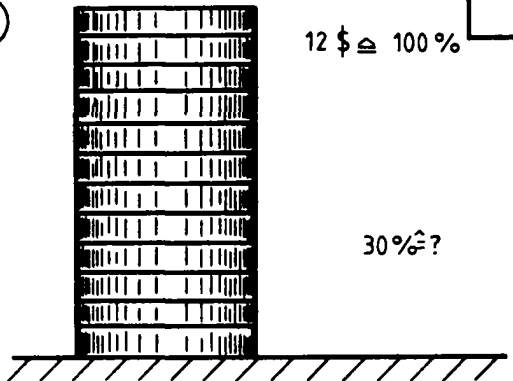
12%  $\hat{=}$   \$

1



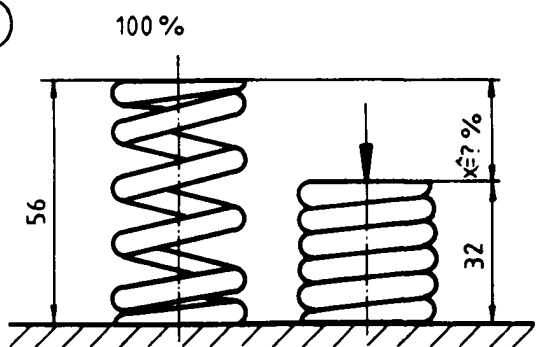
2 \$  $\hat{=}$   %

2



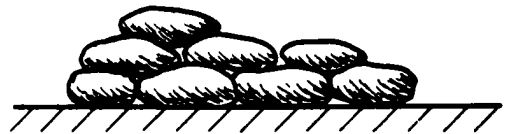
30%  $\hat{=}$   \$

3



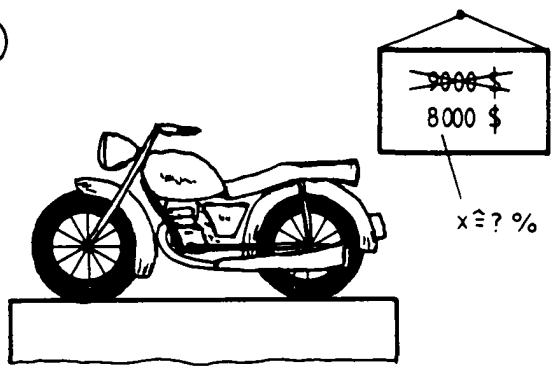
x  $\hat{=}$   %

4



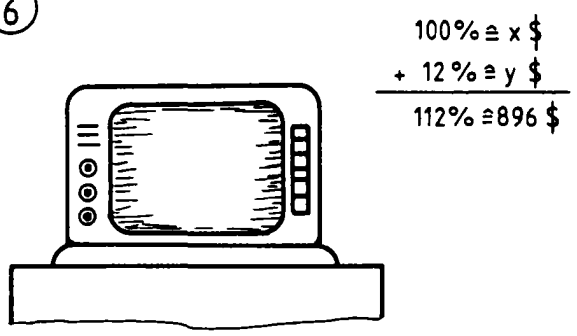
25%  $\hat{=}$

5



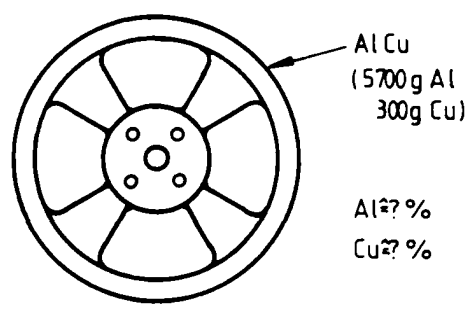
x  $\hat{=}$   %

6



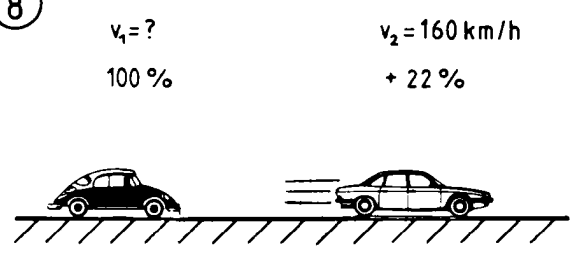
x  $\hat{=}$   \$ ; y  $\hat{=}$   \$

7

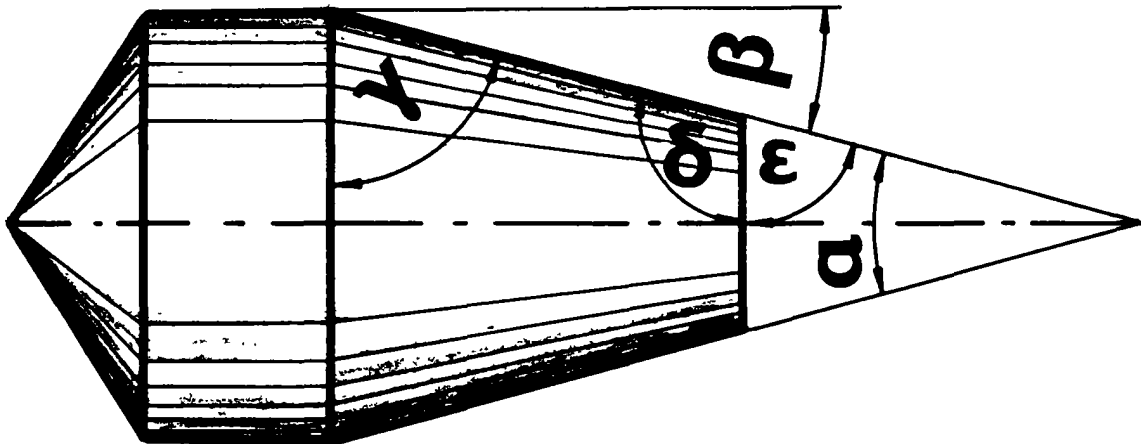


Al  $\hat{=}$   % ; Cu  $\hat{=}$   %

8



v\_1 =  km/h



$\beta =$	
$\beta + \gamma =$	°
$\gamma =$	
$\delta + \epsilon =$	°
$\gamma + \frac{\alpha}{2} =$	°

Test:

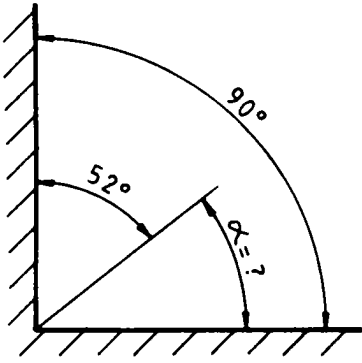
<p>a)</p>	<p>b)</p>	<p>c)</p>
$\delta =$ <input style="width: 80px;" type="text"/> °	$\alpha =$ <input style="width: 80px;" type="text"/> ° $\beta =$ <input style="width: 80px;" type="text"/> °	$\alpha =$ <input style="width: 80px;" type="text"/> ° $\beta =$ <input style="width: 80px;" type="text"/> °
$\gamma =$ <input style="width: 80px;" type="text"/> °	$\gamma =$ <input style="width: 80px;" type="text"/> °	$\gamma =$ <input style="width: 80px;" type="text"/> °

a)  $\delta = 120^\circ, \alpha = 60^\circ, \gamma = 30^\circ$

b)  $\alpha = 80^\circ, \beta = 100^\circ, \gamma = 40^\circ$

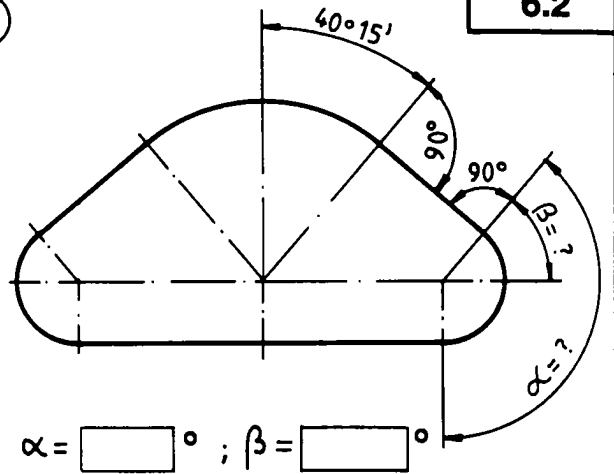
c)  $\alpha = 101^\circ, \beta = 79^\circ$

1



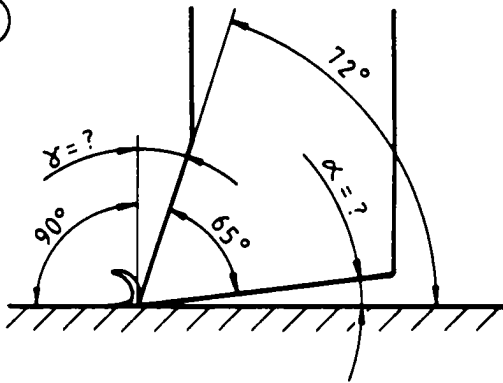
$\alpha = \boxed{\phantom{00}}^\circ$

2



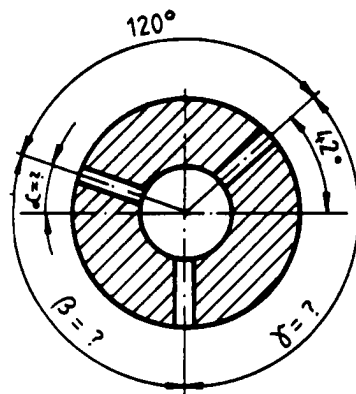
$\alpha = \boxed{\phantom{00}}^\circ ; \beta = \boxed{\phantom{00}}^\circ$

3



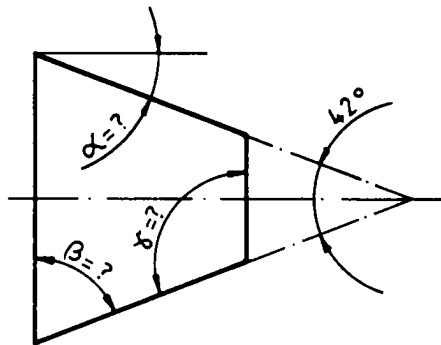
$\alpha = \boxed{\phantom{00}}^\circ ; \gamma = \boxed{\phantom{00}}^\circ$

4



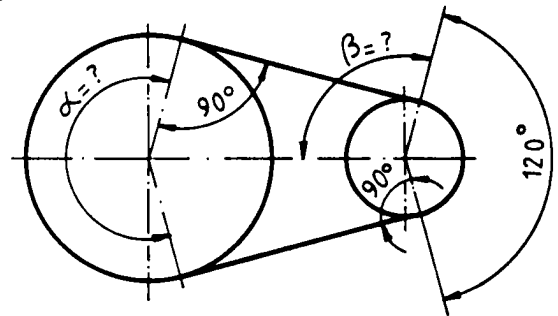
$\alpha = \boxed{\phantom{00}}^\circ ; \beta = \boxed{\phantom{00}}^\circ ; \gamma = \boxed{\phantom{00}}^\circ$

5



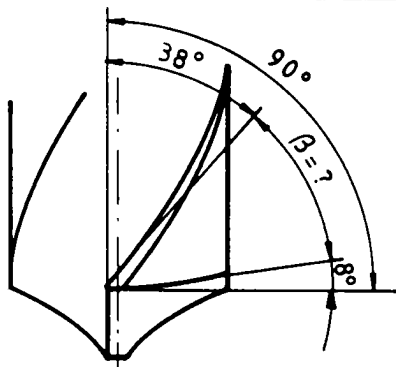
$\alpha = \boxed{\phantom{00}}^\circ ; \beta = \boxed{\phantom{00}}^\circ ; \gamma = \boxed{\phantom{00}}^\circ$

6



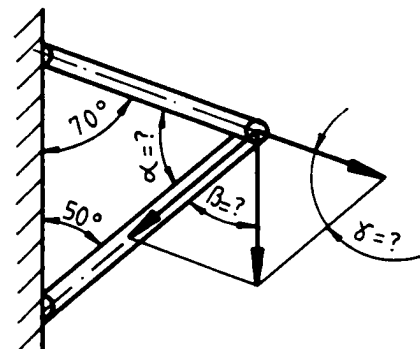
$\alpha = \boxed{\phantom{00}}^\circ ; \beta = \boxed{\phantom{00}}^\circ$

7

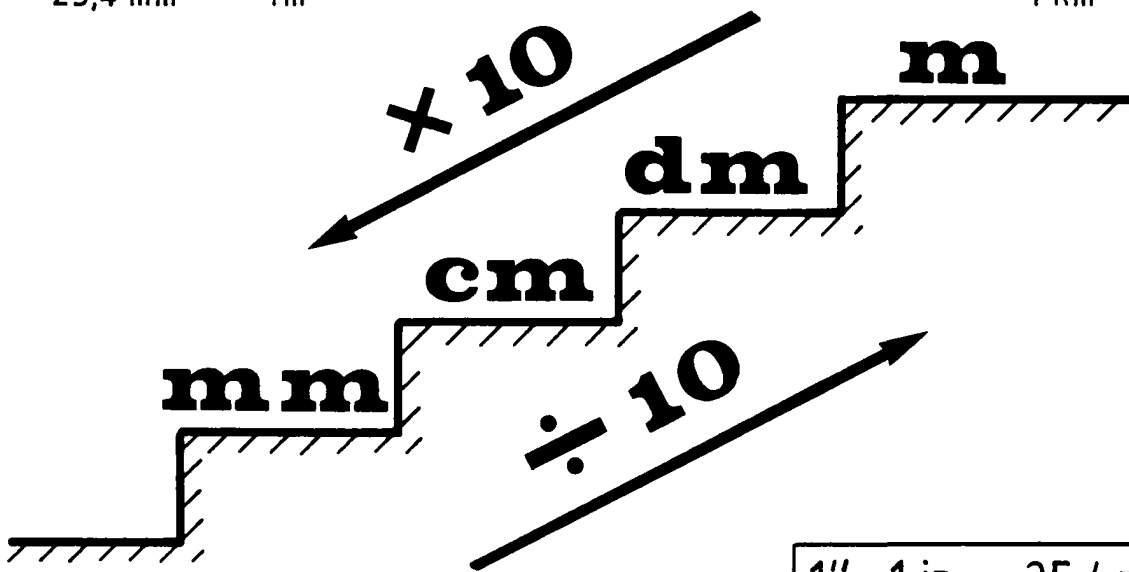
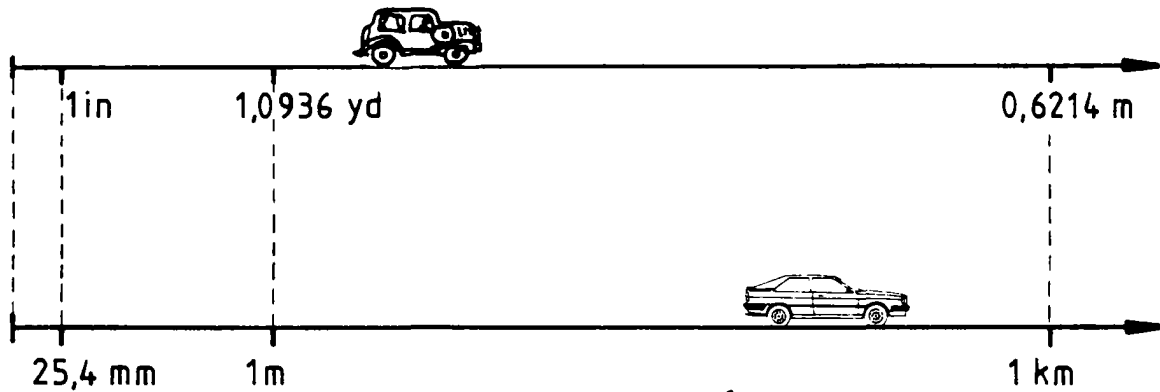


$\beta = \boxed{\phantom{00}}^\circ$

8



$\alpha = \boxed{\phantom{00}}^\circ ; \beta = \boxed{\phantom{00}}^\circ ; \gamma = \boxed{\phantom{00}}^\circ$



1" = 1 in = 25,4 mm

1 m =  dm =  cm =  mm

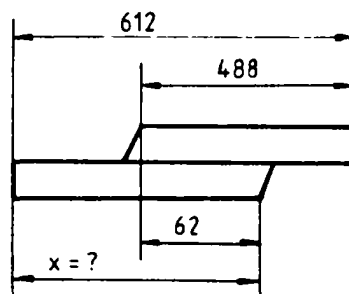
Test:

a)

	in	mm	cm
1.		22,225	
2.	$\frac{3}{4}$		
3.	$\frac{5}{8}$		

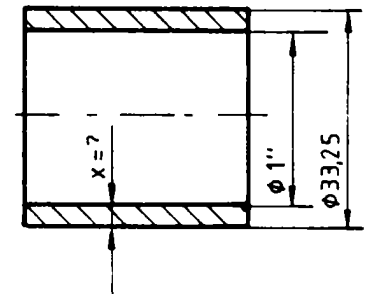
$1. \frac{7}{8} \text{ in} = 2,2225 \text{ cm} = 22,225 \text{ mm}$   
 $2. \frac{3}{4} \text{ in} = 1,905 \text{ cm} = 19,05 \text{ mm}$   
 $3. \frac{5}{8} \text{ in} = 1,5875 \text{ cm} = 15,875 \text{ mm}$

b)



x =  mm

c)



x =  mm

b) x = 186 mm

c) x = 3,925 mm

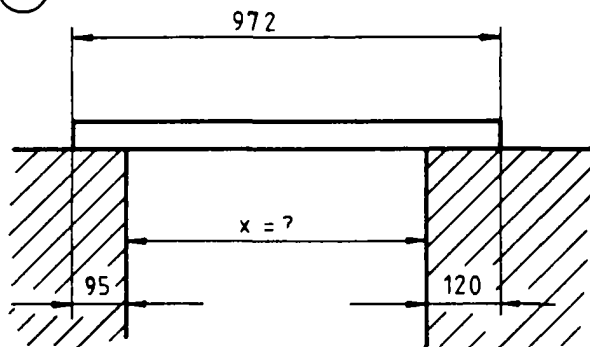
1

	mm	cm	dm	m
a)		80		
b)	4000			
c)			1,2	
d)				0,2

2

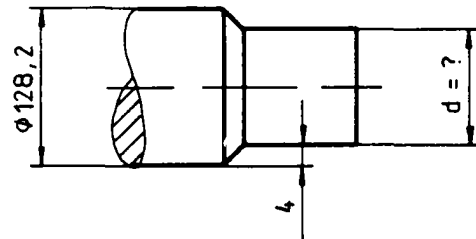
	in	ft	mm
a)		2	
b)	$\frac{3}{8}$		
c)		$1\frac{1}{2}$	
d)	$\frac{3}{4}$		
e)	4		

3



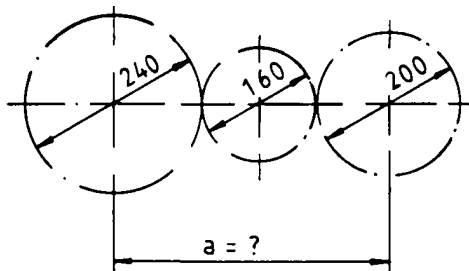
x =  mm

4



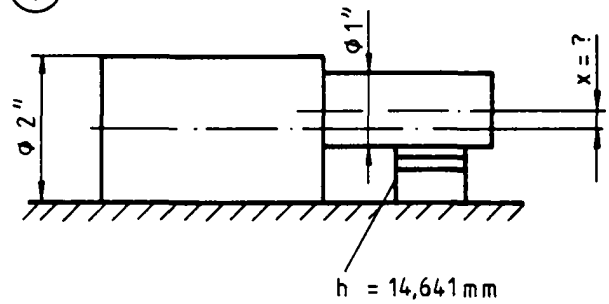
d =  mm

5



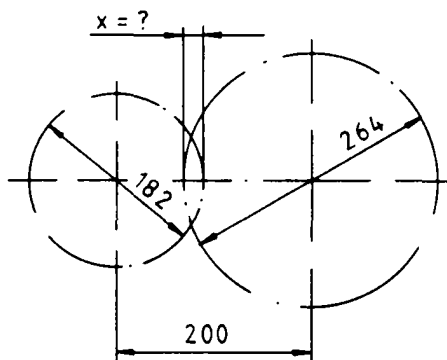
a =  mm

6



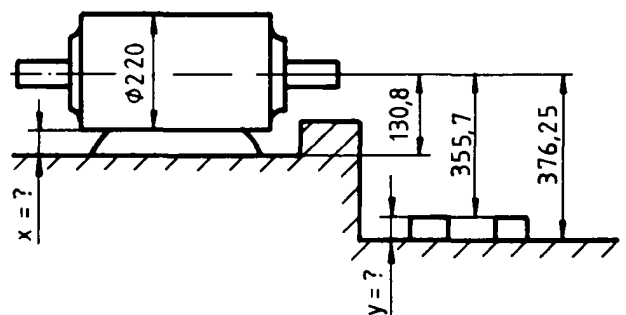
x =  mm

7



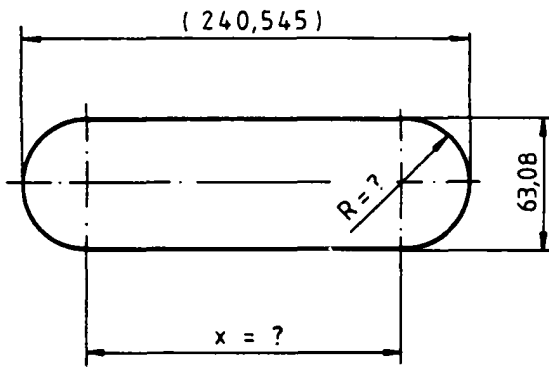
x =  mm

8



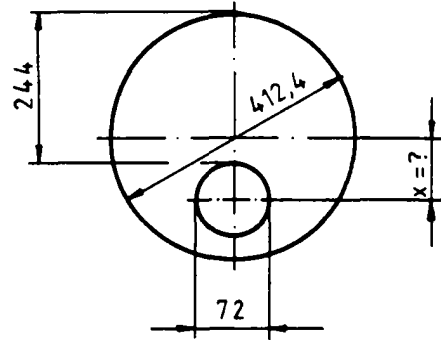
x =  mm ; y =  mm

9



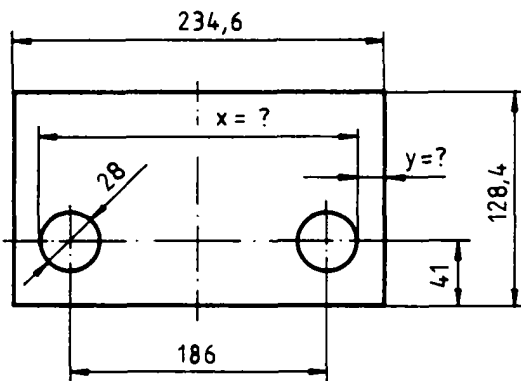
x =  mm ; R =  mm

10



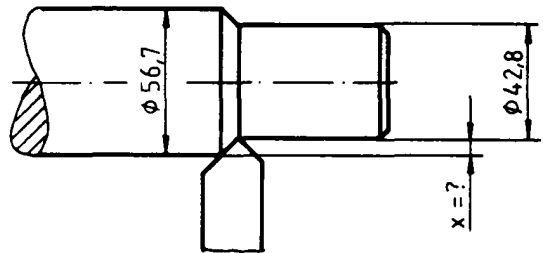
x =  mm

11



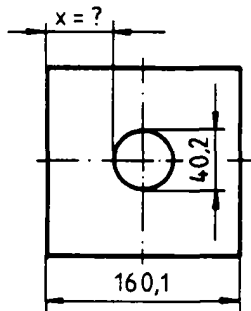
x =  mm ; y =  mm

12



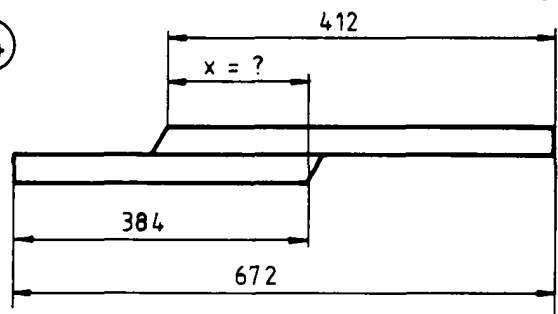
x =  mm

13



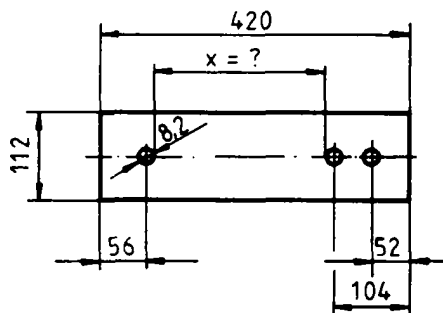
x =  mm

14



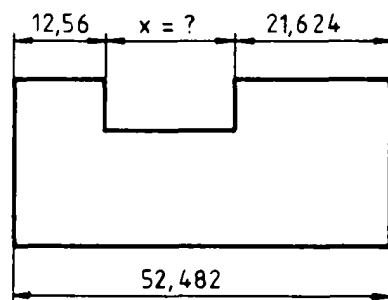
x =  mm

15



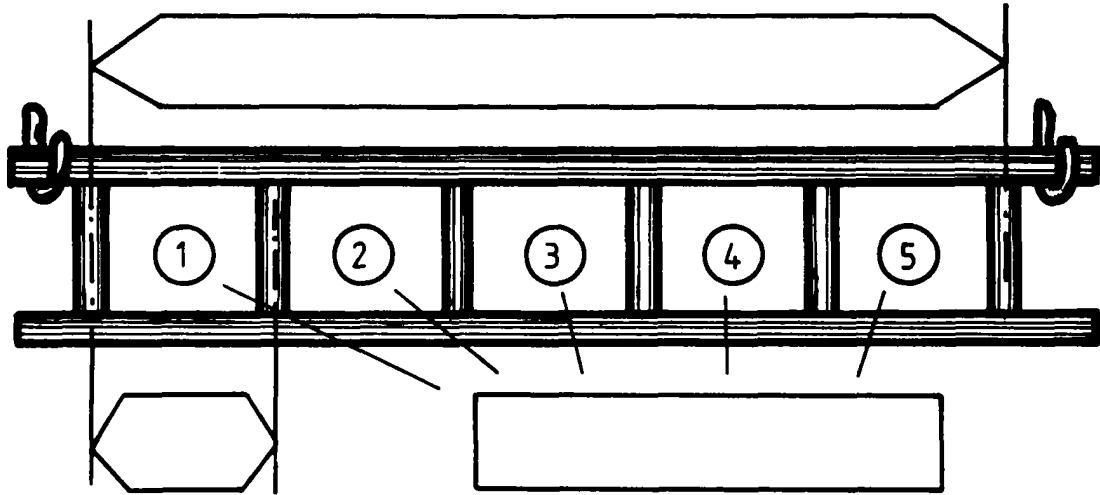
x =  mm

16



x =  mm

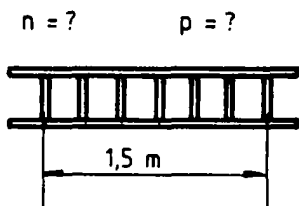




= ×

**L = ·**

1.



$$n = 6$$

$$L = p \cdot n$$

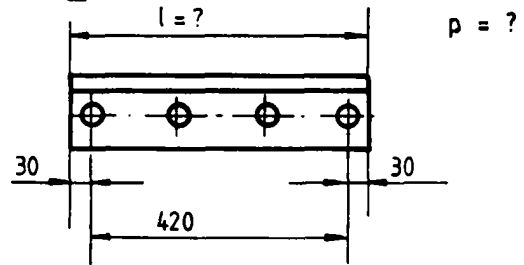
$$p = \frac{L}{n}$$

$$p = \frac{1,5\text{m}}{6}$$

$$p = 0,25\text{m}$$

Test:

2.



$$L = p \cdot n$$

$$p = \frac{L}{n}$$

$$p = \frac{420\text{mm}}{3}$$

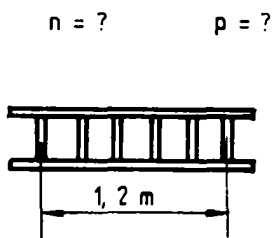
$$p = 140\text{mm}$$

$$l = L + 2 \cdot 30\text{mm}$$

$$l = 420\text{mm} + 60\text{mm}$$

$$l = 480\text{mm}$$

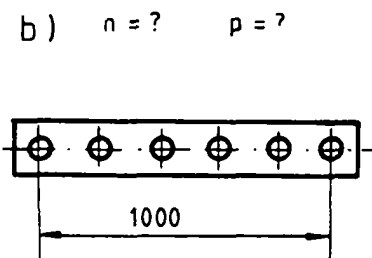
a)



n =

p =  mm

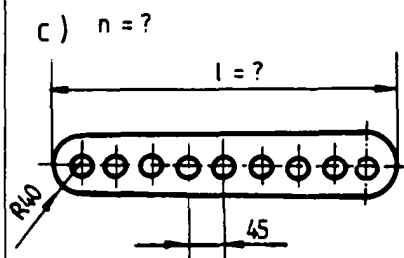
b)



n =

p =  mm

c)

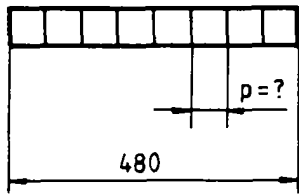


n =

l =  mm

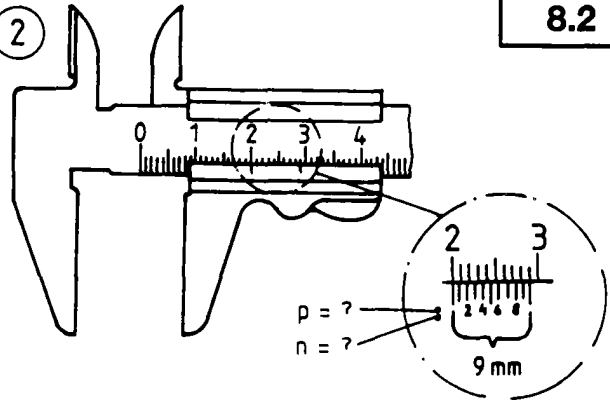
1

$n = ?$



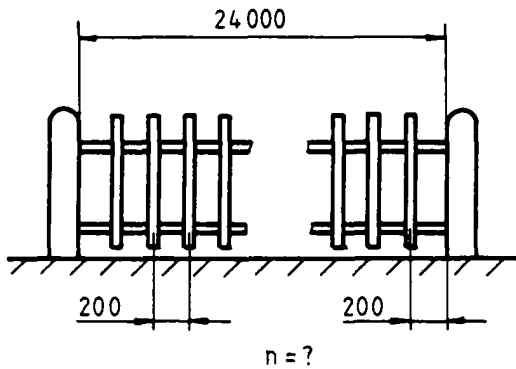
$p = \text{[ ] mm} ; n = \text{[ ]}$

2



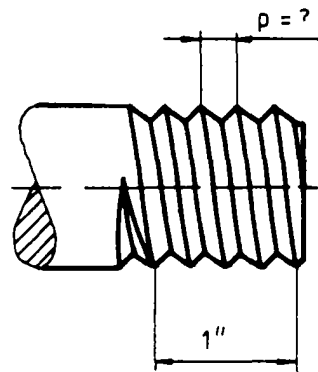
$p = \text{[ ] mm} ; n = \text{[ ]}$

3



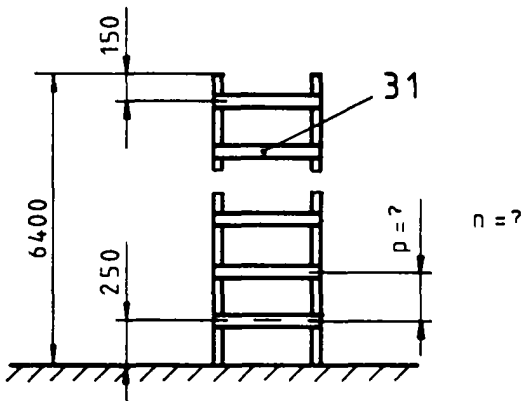
$n = \text{[ ]}$

4



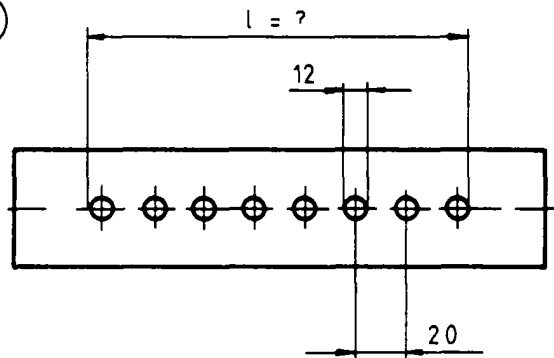
$p = \text{[ ] mm}$

5



$n = \text{[ ]} ; p = \text{[ ] mm}$

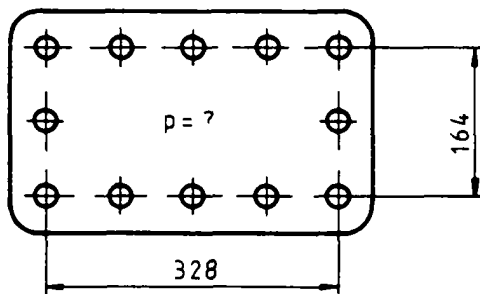
6



$l = \text{[ ] mm}$

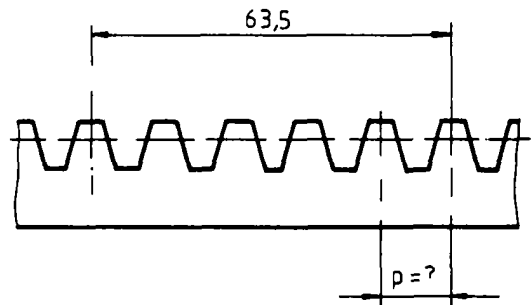
7

$n = ?$

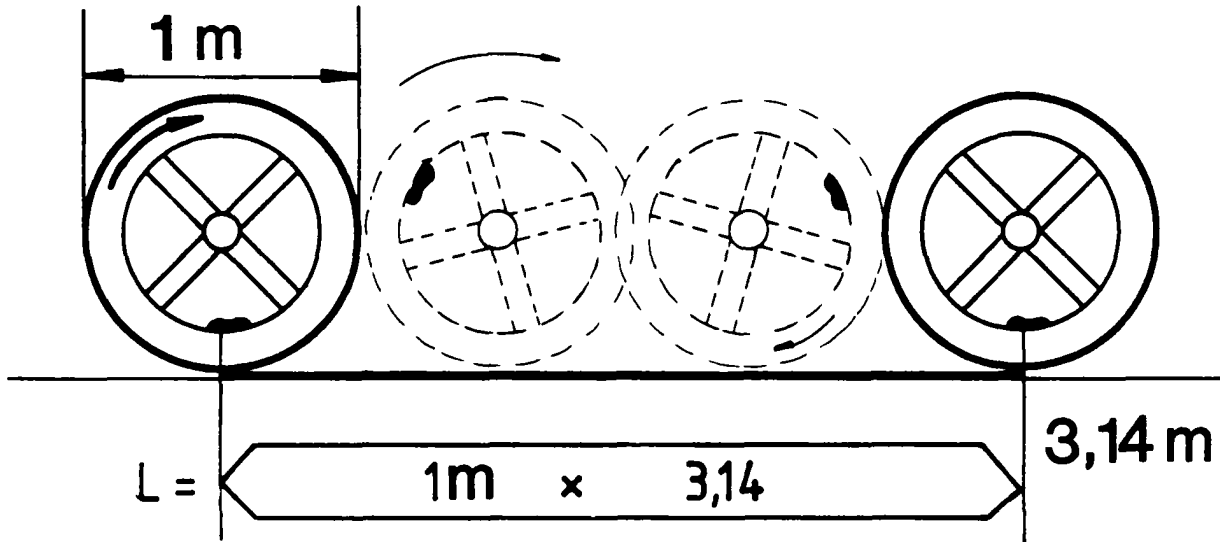


$p = \text{[ ] mm} ; n = \text{[ ]}$

8

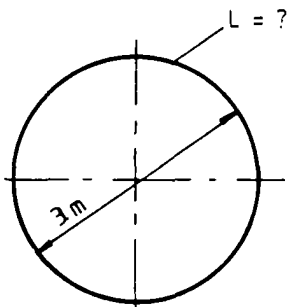


$p = \text{[ ] mm} ; p = \text{[ ] ''}$



$L = \cdot$

1.

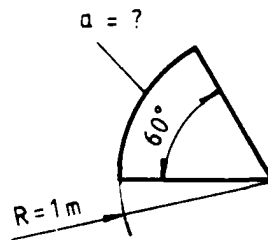


$$L = d \cdot \pi$$

$$L = 3\text{m} \cdot 3,14$$

$$L = 9,42\text{m}$$

2.



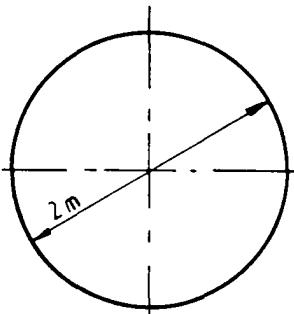
$$L = d \cdot \pi \cdot \frac{60^\circ}{360^\circ}$$

$$L = 2\text{m} \cdot 3,14 \cdot \frac{60^\circ}{360^\circ}$$

$$L = 1,047\text{m}$$

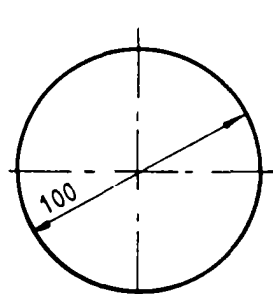
Test:

a)



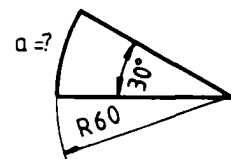
$L = \boxed{\phantom{000}} \text{ m}$

b)



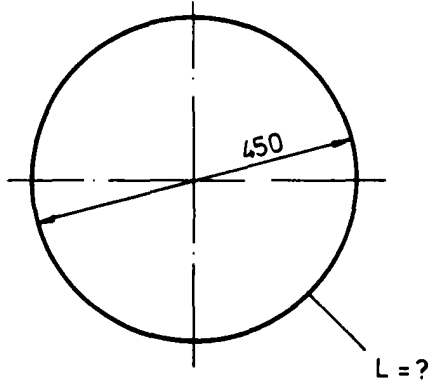
$L = \boxed{\phantom{000}} \text{ mm}$

c)



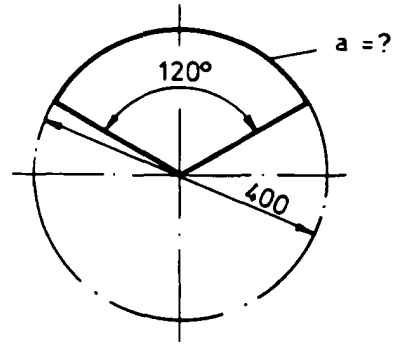
$a = \boxed{\phantom{000}} \text{ mm}$

1



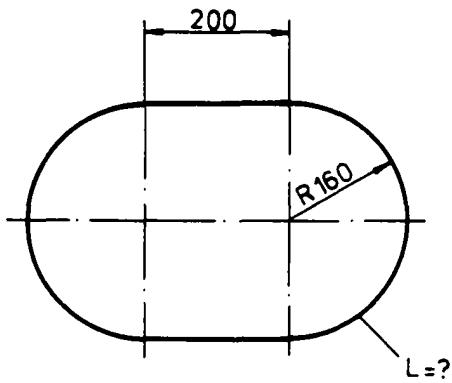
L =  mm

2



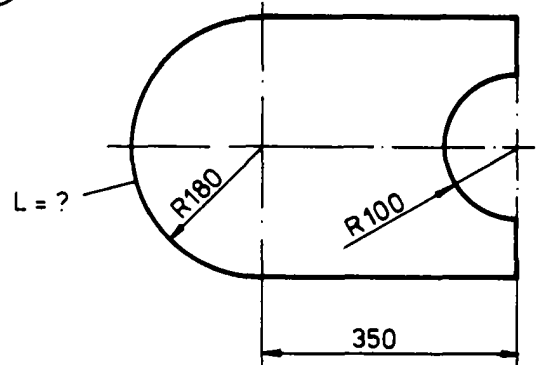
a =  mm

3



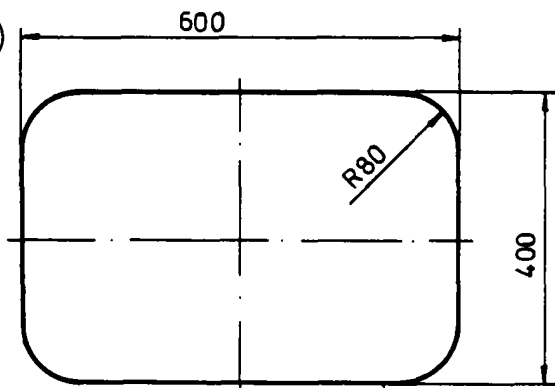
L =  mm

4



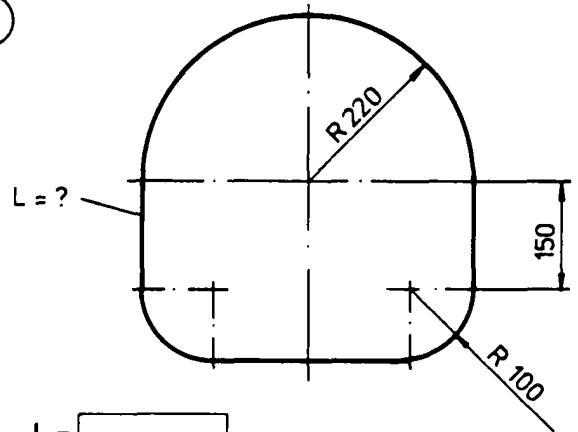
L =  mm

5



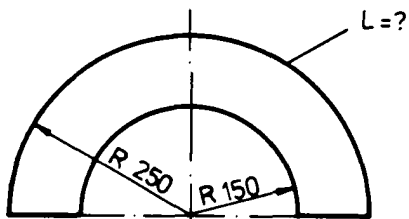
L =  mm

6



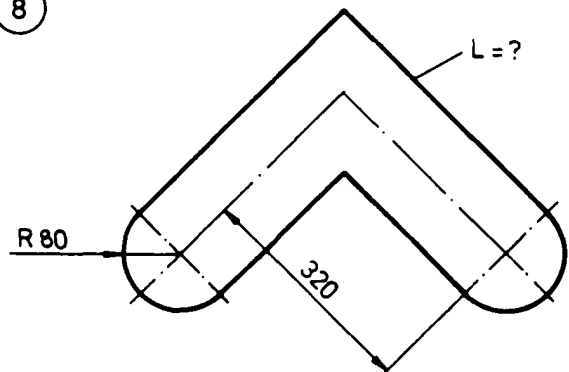
L =  mm

7

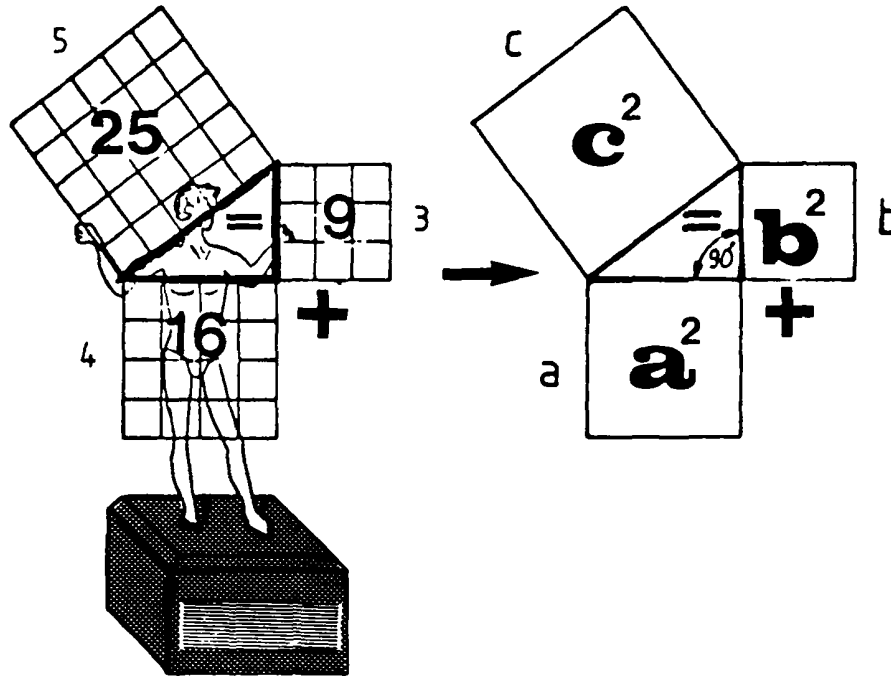


L =  mm

8

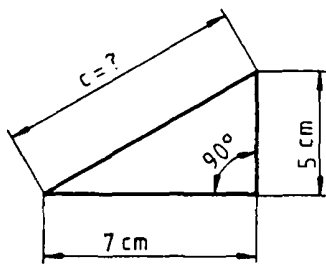


L =  mm



$$c^2 = a^2 + b^2$$

1.



$$c^2 = 5^2 + 7^2$$

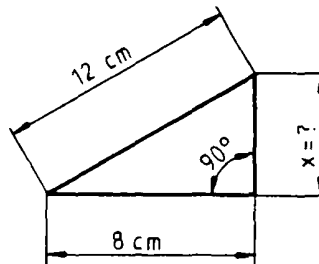
$$c = \sqrt{5^2 + 7^2}$$

$$c = \sqrt{25 + 49}$$

$$c = \sqrt{74}$$

$$c = 8,6 \text{ cm}$$

2.



$$12^2 = 8^2 + x^2$$

$$x^2 = 12^2 - 8^2$$

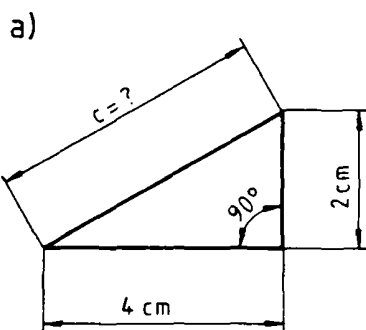
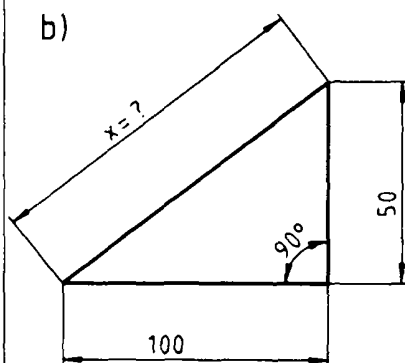
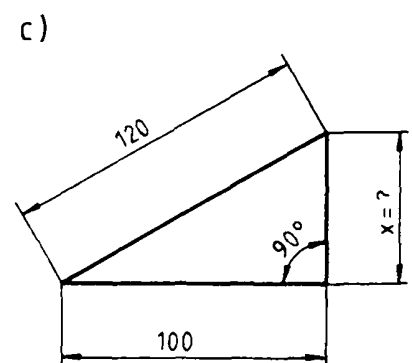
$$x = \sqrt{12^2 - 8^2}$$

$$x = \sqrt{144 - 64}$$

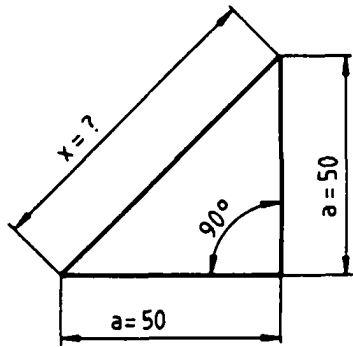
$$x = \sqrt{80}$$

$$x = 8,9 \text{ cm}$$

Test:


 $c = \quad \text{cm}$ 

 $x = \quad \text{mm}$ 

 $x = \quad \text{mm}$

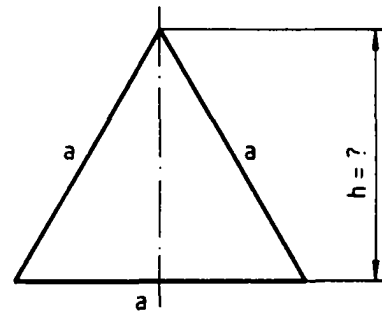
1



$x =$   mm

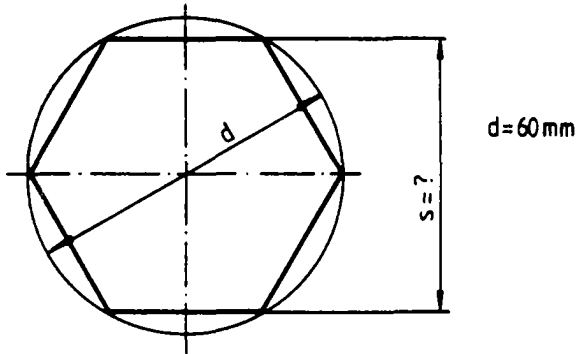
2

$a = 40$  mm



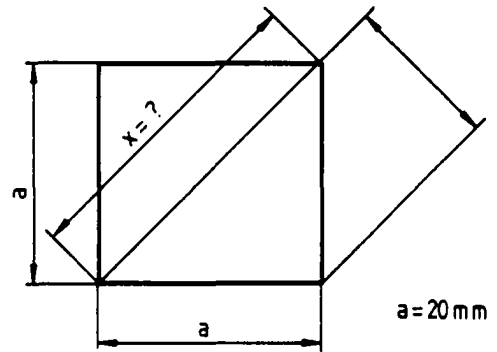
$h =$   mm

3



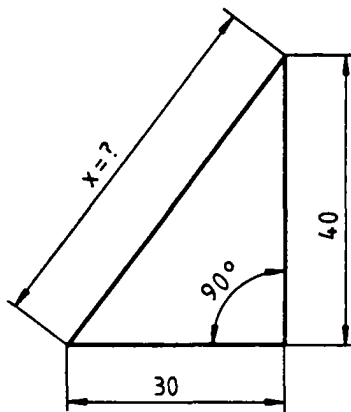
$s =$   mm

4



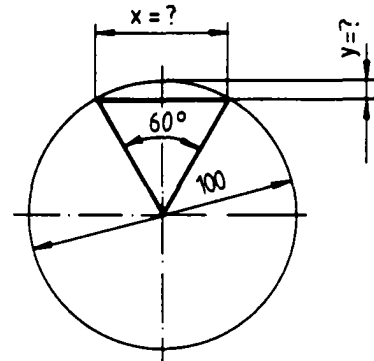
$x =$   mm;  $y =$   mm

5



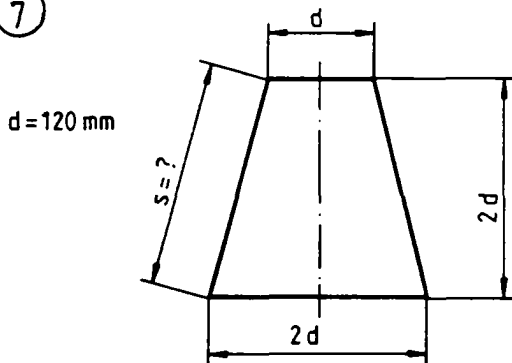
$x =$   mm

6



$x =$   mm;  $y =$   mm

7

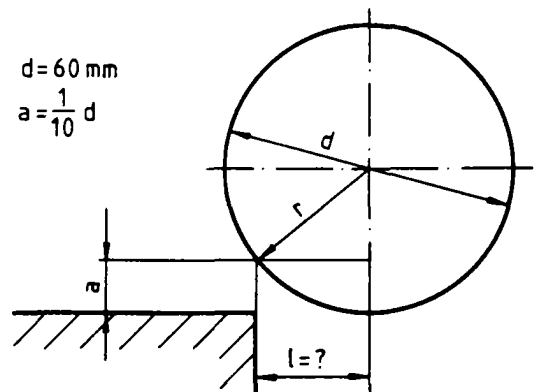


$d = 120$  mm

$s =$   mm

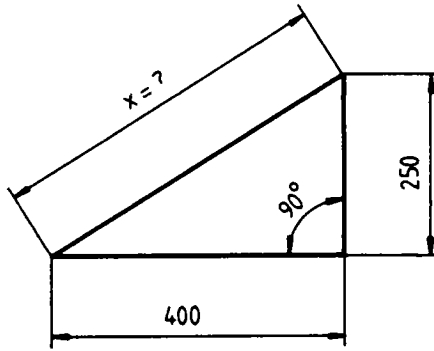
8

$d = 60$  mm  
 $a = \frac{1}{10} d$



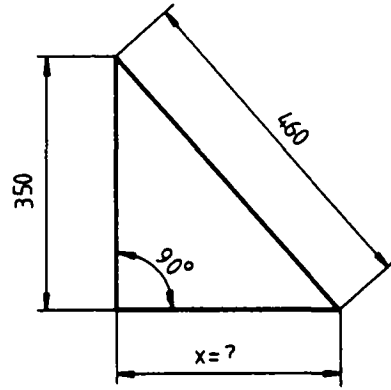
$l =$   mm

9



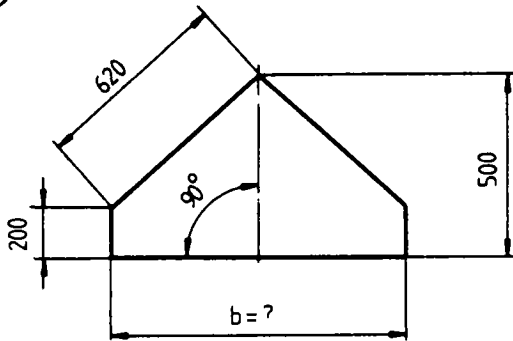
$x =$   mm

10



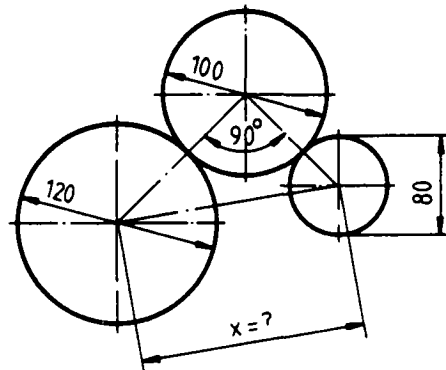
$x =$   mm

11



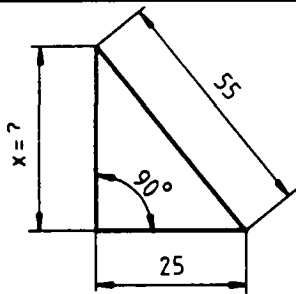
$b =$   mm

12



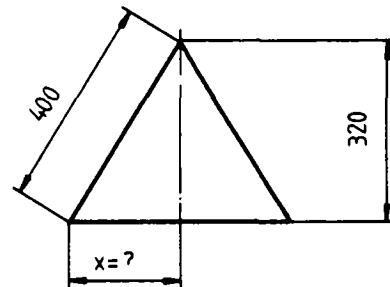
$x =$   mm

13



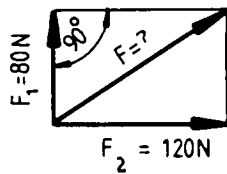
$x =$   mm

14



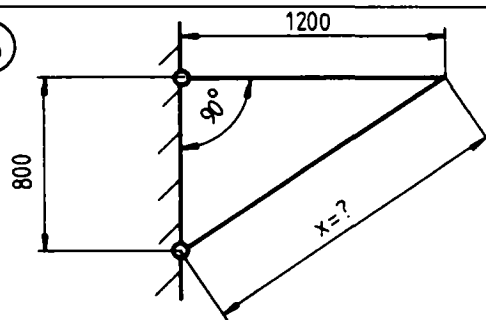
$x =$   mm

15

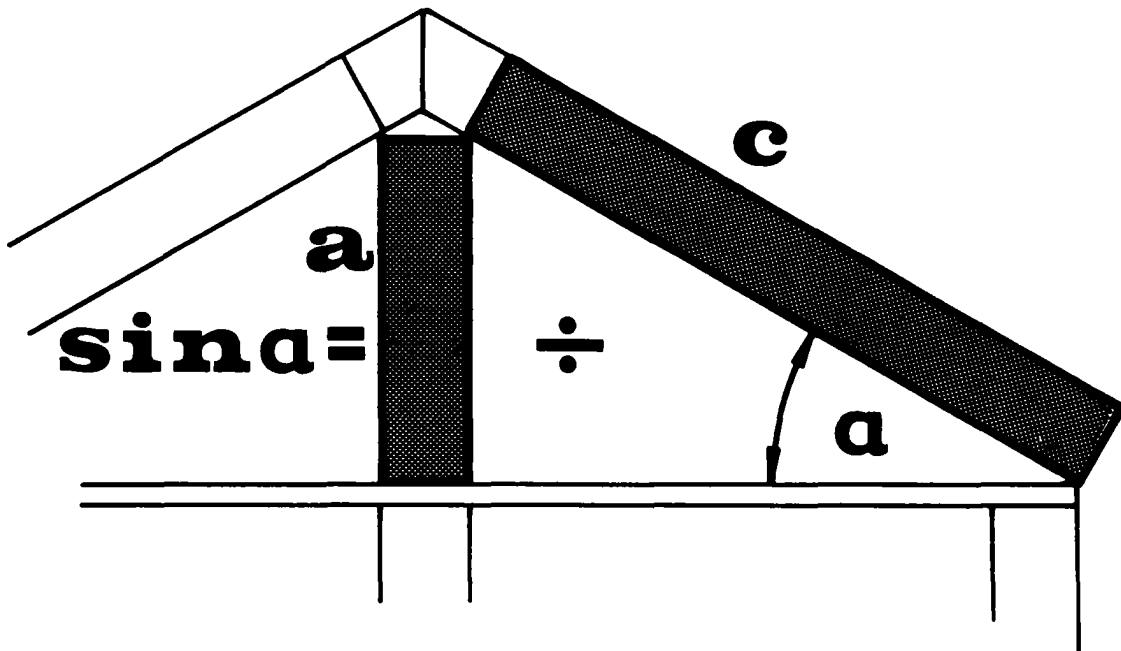


$F =$   N

16

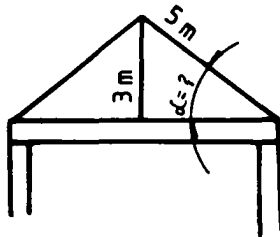


$x =$   mm



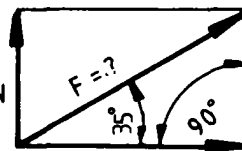
**sin α = \_\_\_\_\_**

1.



$\sin \alpha = \frac{3}{5}$   
 $\sin \alpha = 0,6$   
 $\alpha = 36,87^\circ$

2.

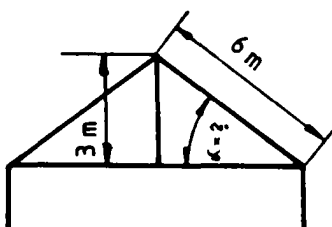


$F = 50\text{N}$

$\sin 35^\circ = \frac{50\text{N}}{F}$   
 $F = \frac{50\text{N}}{\sin 35^\circ}$   
 $F = 87,2\text{N}$

Test:

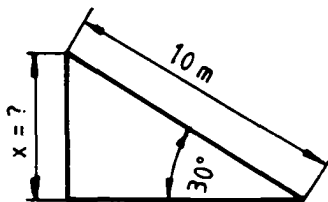
a)



$\alpha = \text{[ ]}^\circ$

$\sin \alpha = \frac{3}{6}$

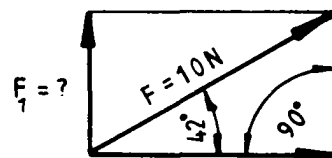
b)



$x = \text{[ ]} \text{ m}$

$\sin 30^\circ = \frac{x}{10}$

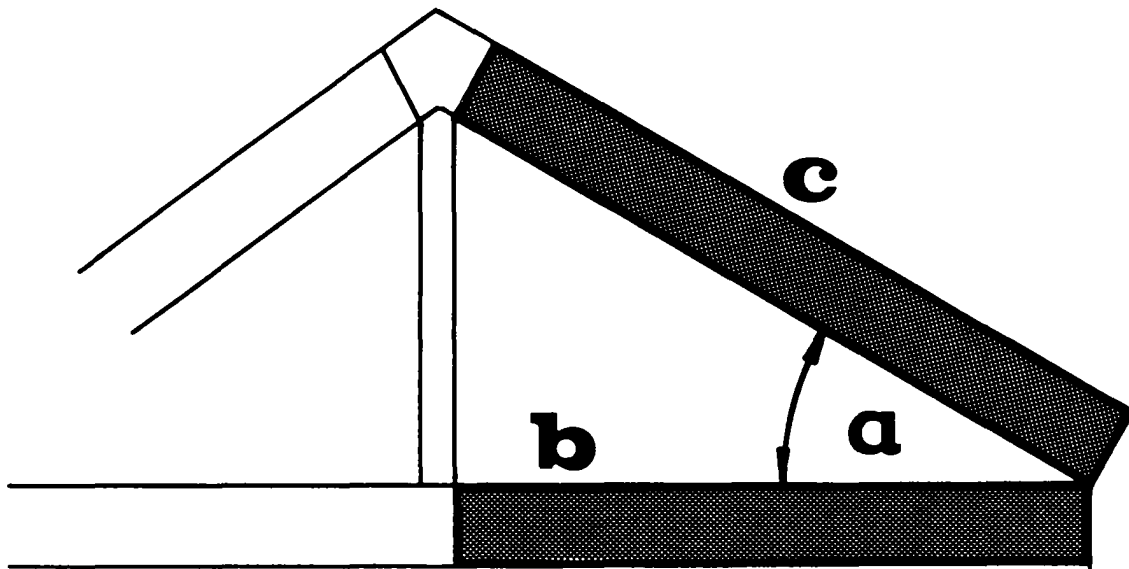
c)



$F_1 = \text{[ ]} \text{ N}$

$\sin 42^\circ = \frac{10}{F_1}$



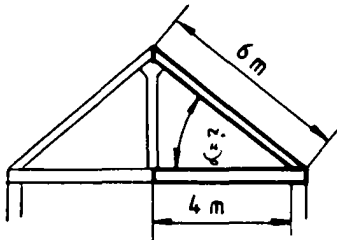


**cosa = \_\_\_\_\_**

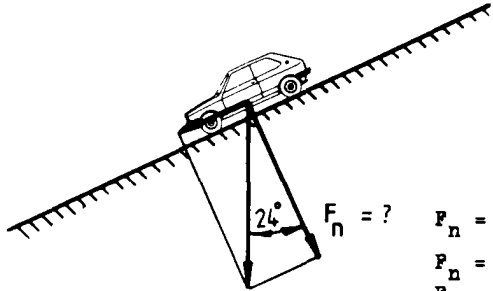
**cosa = \_\_\_\_\_**

1.

2.



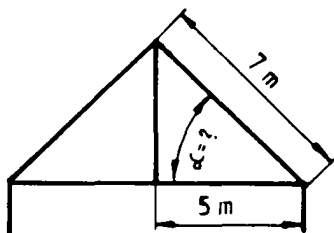
$\cos \alpha = \frac{4m}{6m}$   
 $\cos \alpha = 0,6667$   
 $\alpha = 48,2^\circ$



$G = 8000 \text{ N}$   
 $F_n = ?$   
 $F_n = G \cdot \cos 24^\circ$   
 $F_n = 8000 \text{ N} \cdot \cos 24^\circ$   
 $F_n = 7308 \text{ N}$

Test:

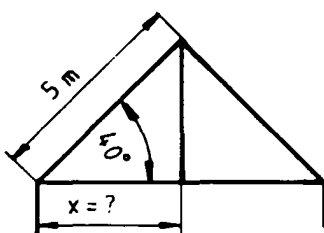
a)



$\alpha = \text{[ ]}^\circ$

$N \cdot 1826 = \frac{N}{2} (\circ)$

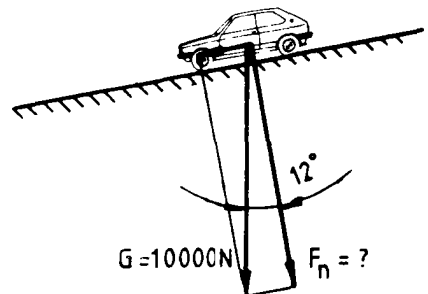
b)



$x = \text{[ ]} \text{ m}$

$\cos 40^\circ = x (9)$

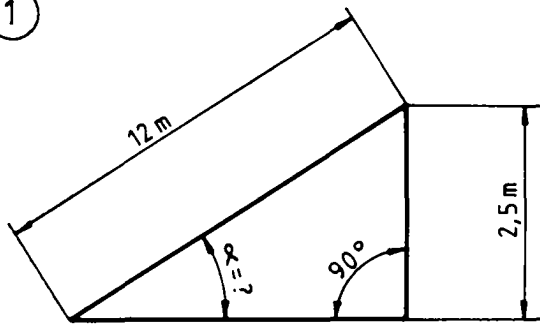
c)



$F_n = \text{[ ]} \text{ N}$

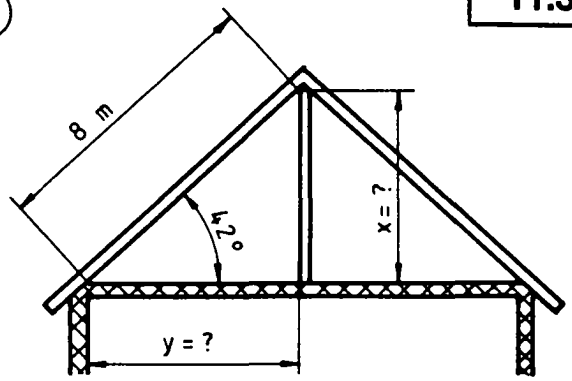
$\cos 12^\circ = \frac{F_n}{10000} (8)$

1



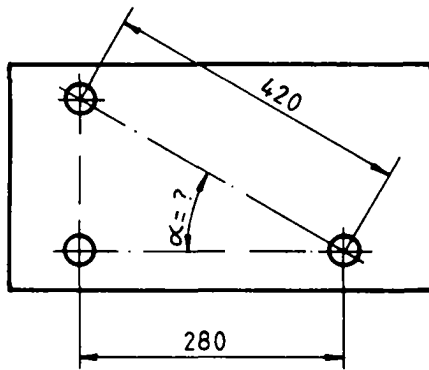
$\alpha = \text{[ ]}^\circ$

2



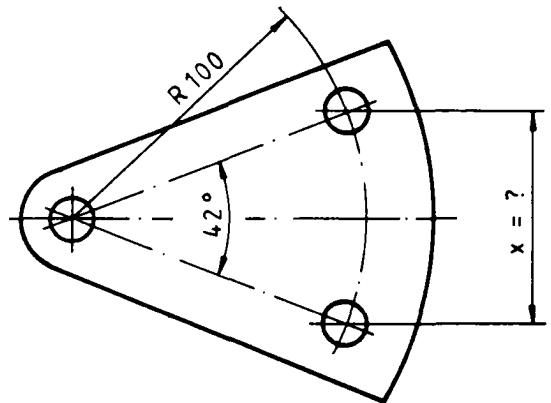
$x = \text{[ ]} \text{ m} ; y = \text{[ ]} \text{ m}$

3



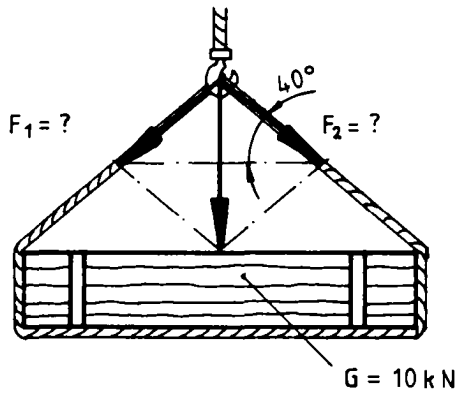
$\alpha = \text{[ ]}^\circ$

4



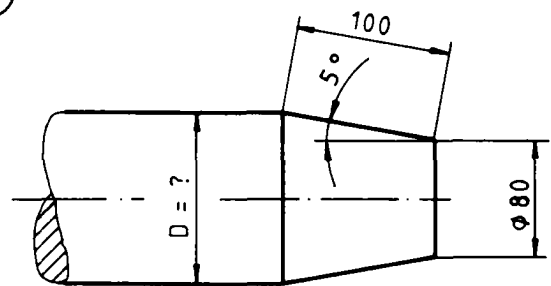
$x = \text{[ ]} \text{ mm}$

5



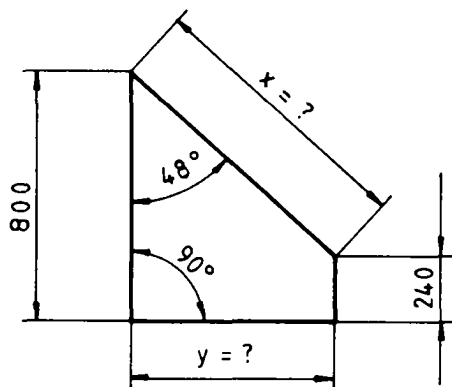
$F_1 = \text{[ ]} \text{ kN} ; F_2 = \text{[ ]} \text{ kN}$

6



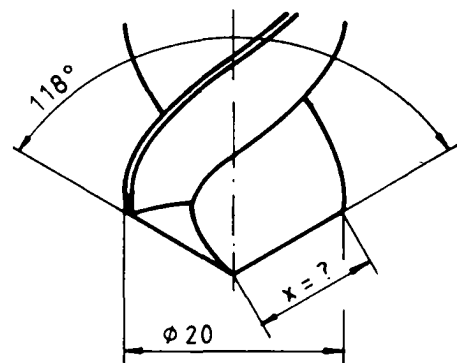
$D = \text{[ ]} \text{ mm}$

7



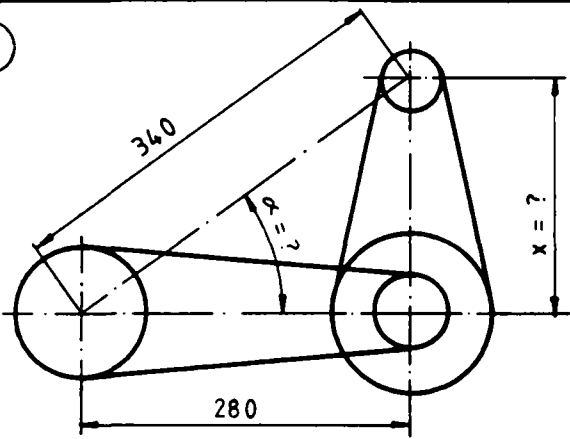
$x = \text{[ ]} \text{ mm} ; y = \text{[ ]} \text{ mm}$

8



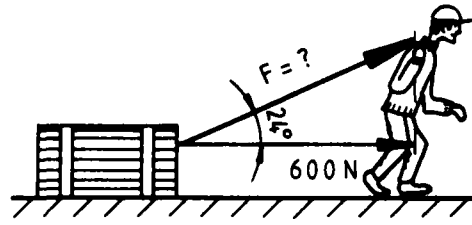
$x = \text{[ ]} \text{ mm}$

9



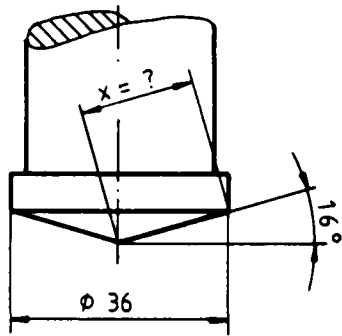
$\alpha = \text{[ ]}^\circ$  ;  $x = \text{[ ]}$  mm

10



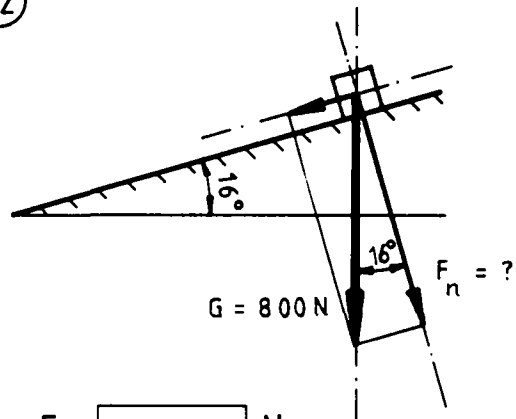
$F = \text{[ ]}$  N

11



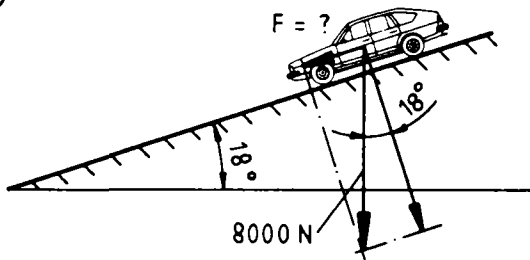
$x = \text{[ ]}$  mm

12



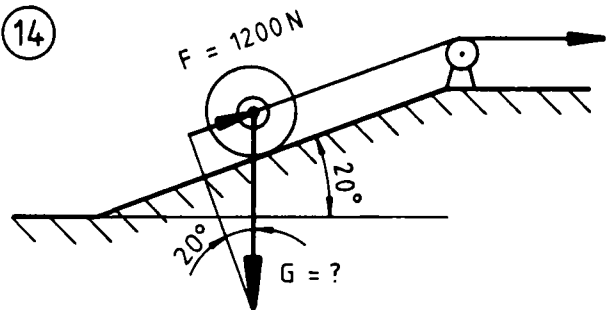
$F_N = \text{[ ]}$  N

13



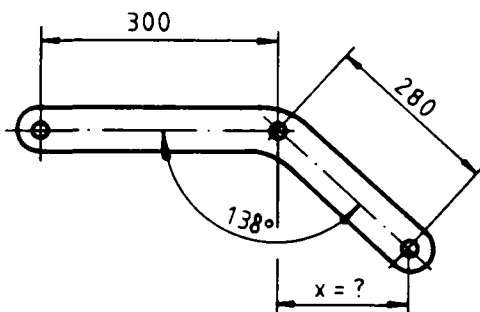
$F = \text{[ ]}$  N

14



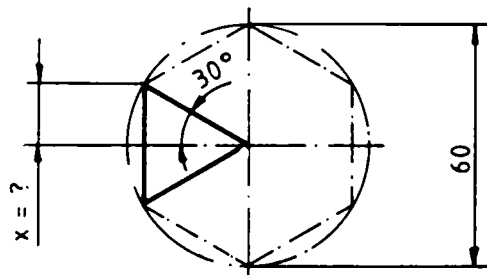
$G = \text{[ ]}$  N

15

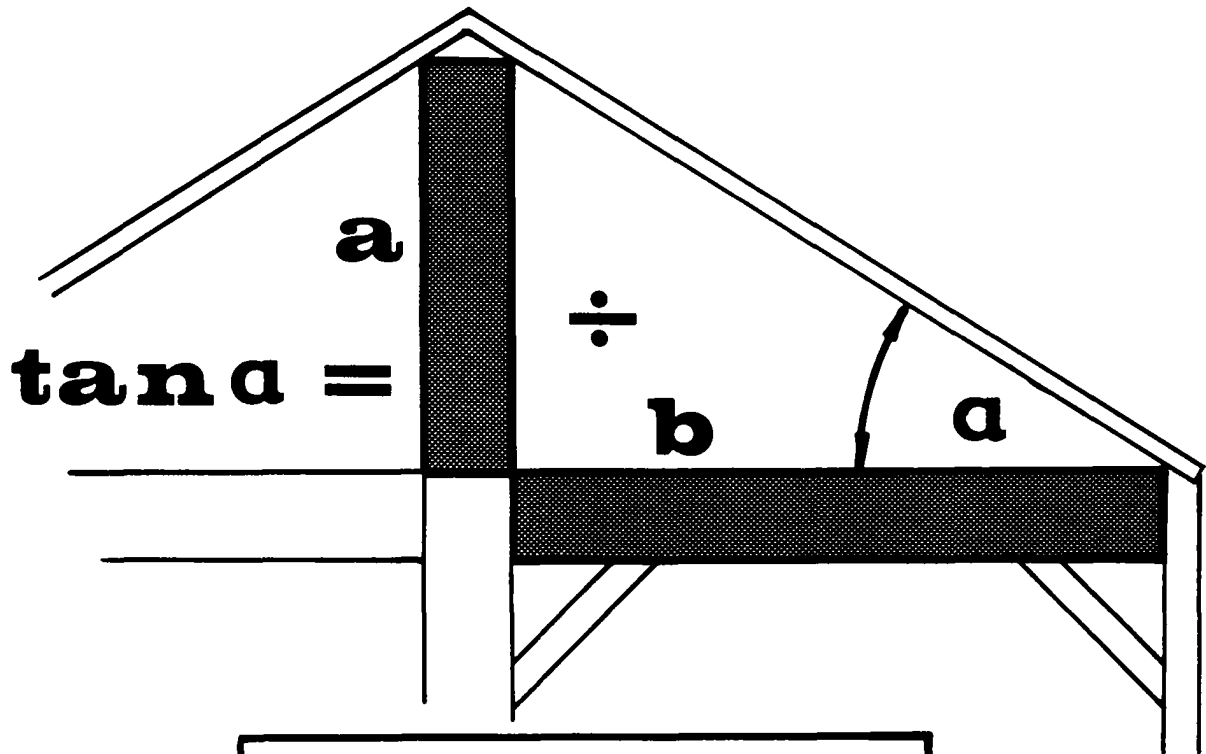


$x = \text{[ ]}$  mm

16

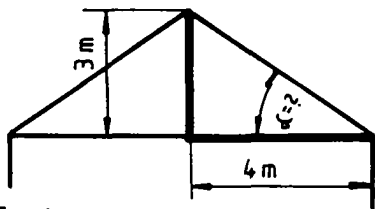


$x = \text{[ ]}$  mm



**tan α = —**

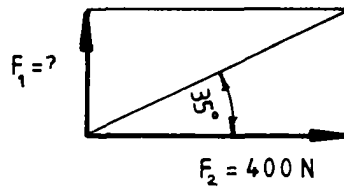
1.



Test:

$\tan \alpha = \frac{3}{4}$   
 $\tan \alpha = 0,75$   
 $\alpha = 36,87^\circ$

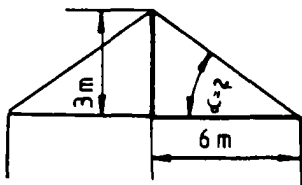
2.



$\tan 35^\circ = \frac{F_1}{F_2}$

$F_1 = F_2 \cdot \tan 35^\circ$   
 $F_1 = 400 \text{ N} \cdot \tan 35^\circ$   
 $F_1 = 280 \text{ N}$

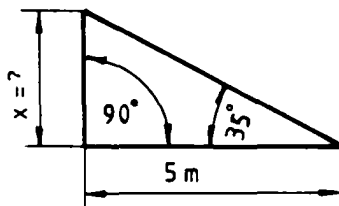
a)



$\alpha = \text{[ ]}^\circ$

α = 26,1°

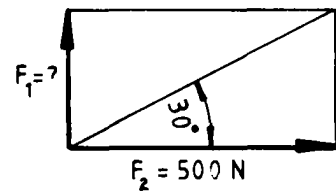
b)



$x = \text{[ ]} \text{ m}$

x = 3,5 m

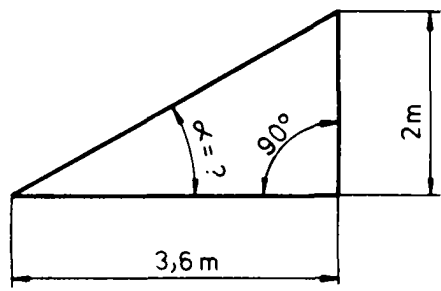
c)



$F_1 = \text{[ ]} \text{ N}$

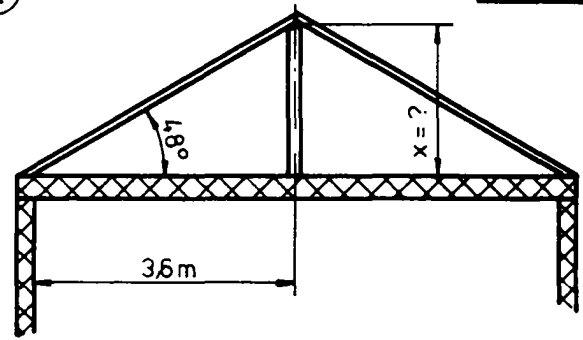
F1 = 260 N

1



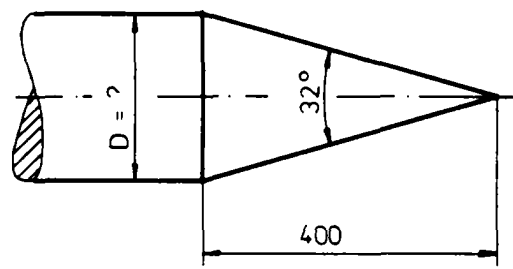
$\alpha = \text{[ ]}^\circ$

2



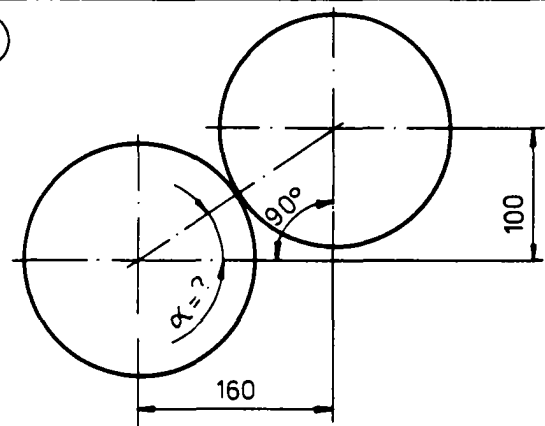
$x = \text{[ ]} \text{ m}$

3



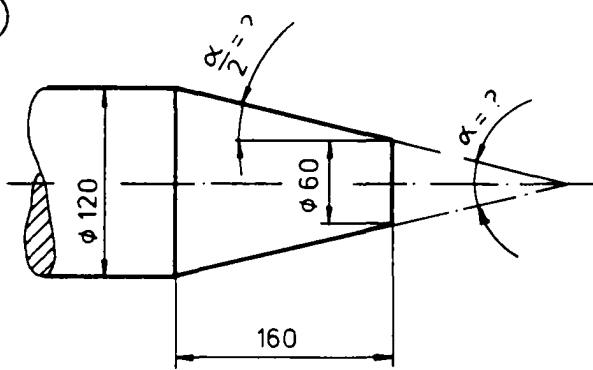
$D = \text{[ ]} \text{ mm}$

4



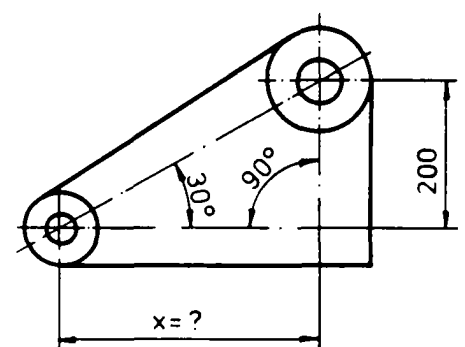
$\alpha = \text{[ ]}^\circ$

5



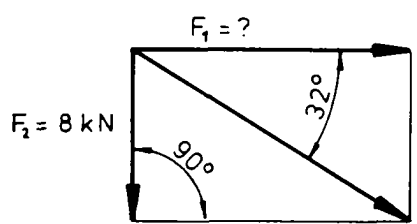
$\frac{\alpha}{2} = \text{[ ]}^\circ \quad \alpha = \text{[ ]}^\circ$

6



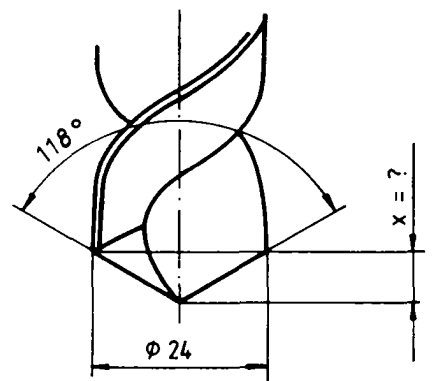
$x = \text{[ ]} \text{ mm}$

7

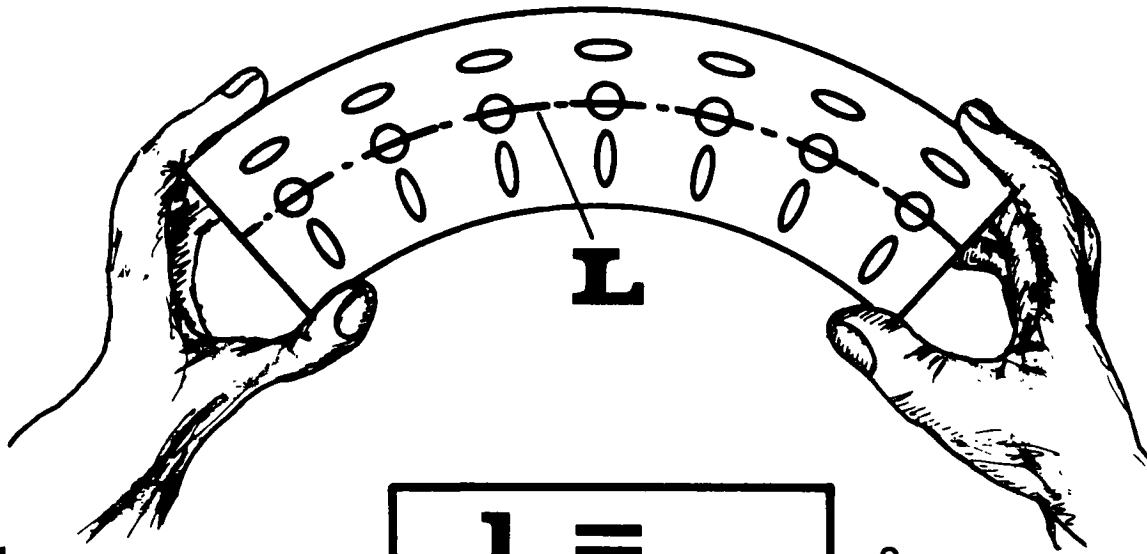
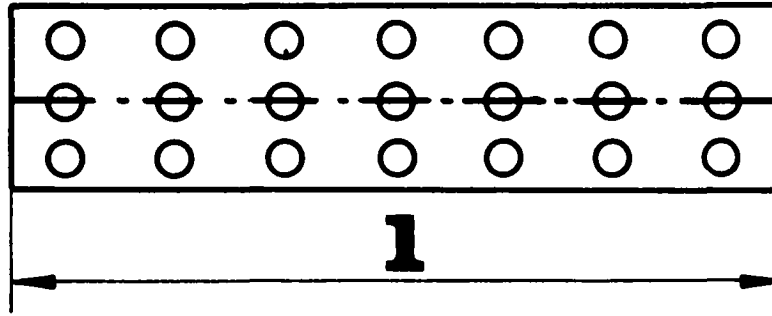


$F_1 = \text{[ ]} \text{ kN}$

8



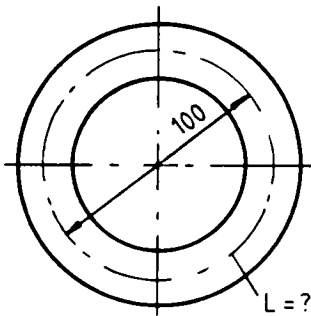
$x = \text{[ ]} \text{ mm}$



**l =**

1.

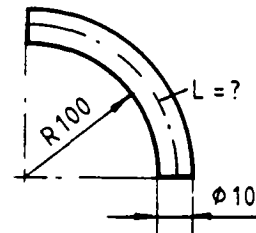
2.



$$L = d \cdot \pi$$

$$L = 100\text{mm} \cdot 3,14$$

$$L = 314\text{mm}$$

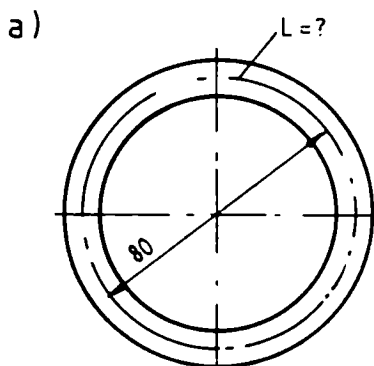


$$L = \frac{d \cdot \pi}{4}$$

$$L = \frac{210\text{mm} \cdot 3,14}{4}$$

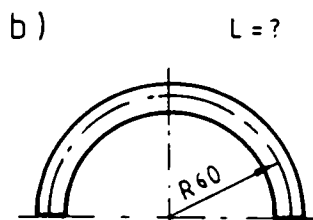
$$L = 164,85\text{mm}$$

Test :



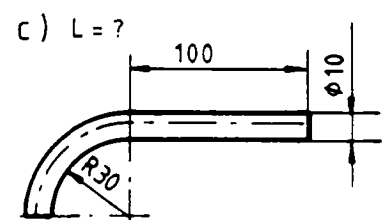
L =  mm

c) L = 154,95mm



L =  mm

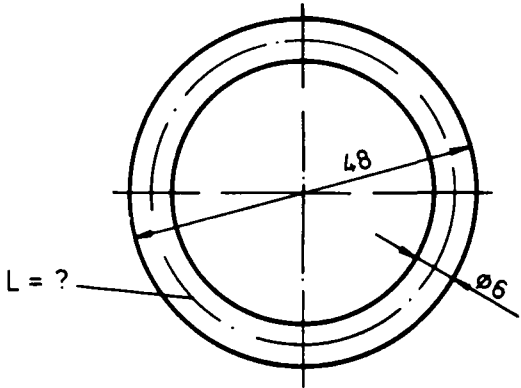
b) L = 188,4mm



L =  mm

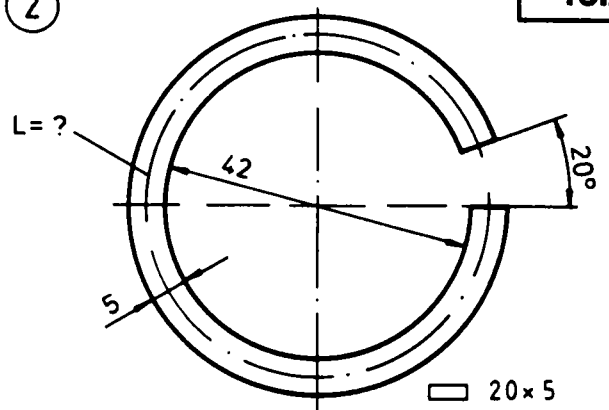
a) L = 251,2mm

1



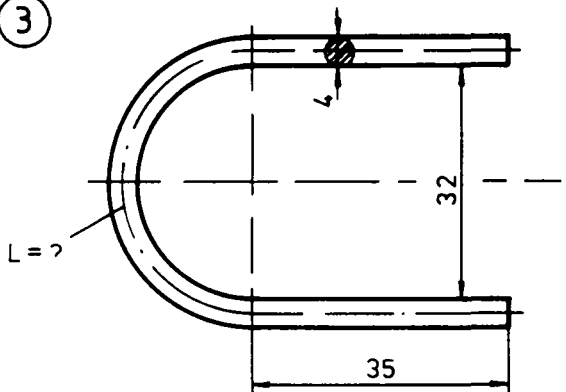
L =  mm

2



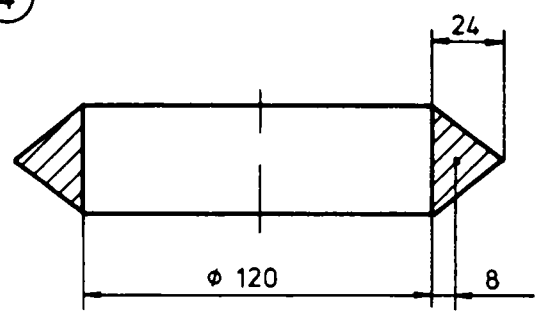
L =  mm

3



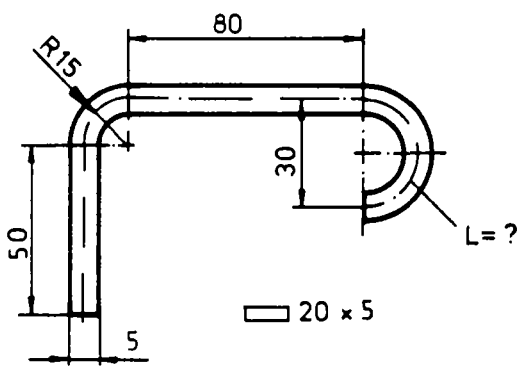
L =  mm

4



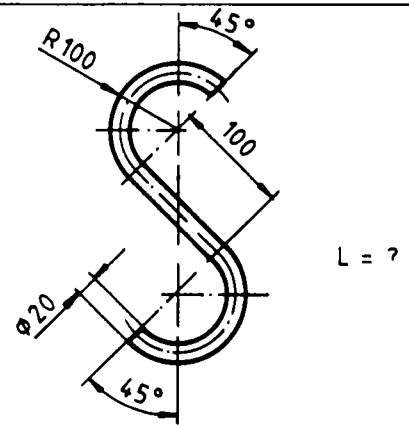
L =  mm

5



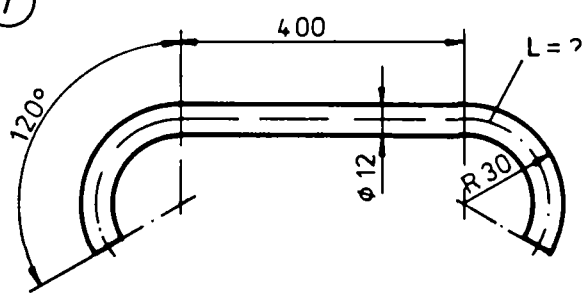
L =  mm

6



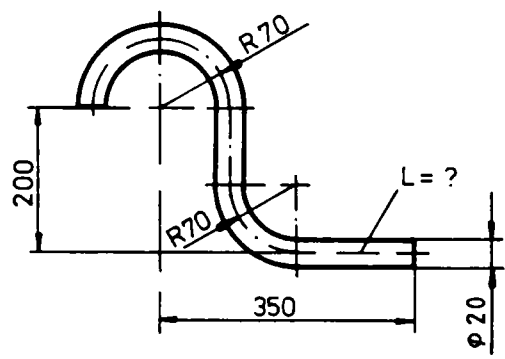
L =  mm

7

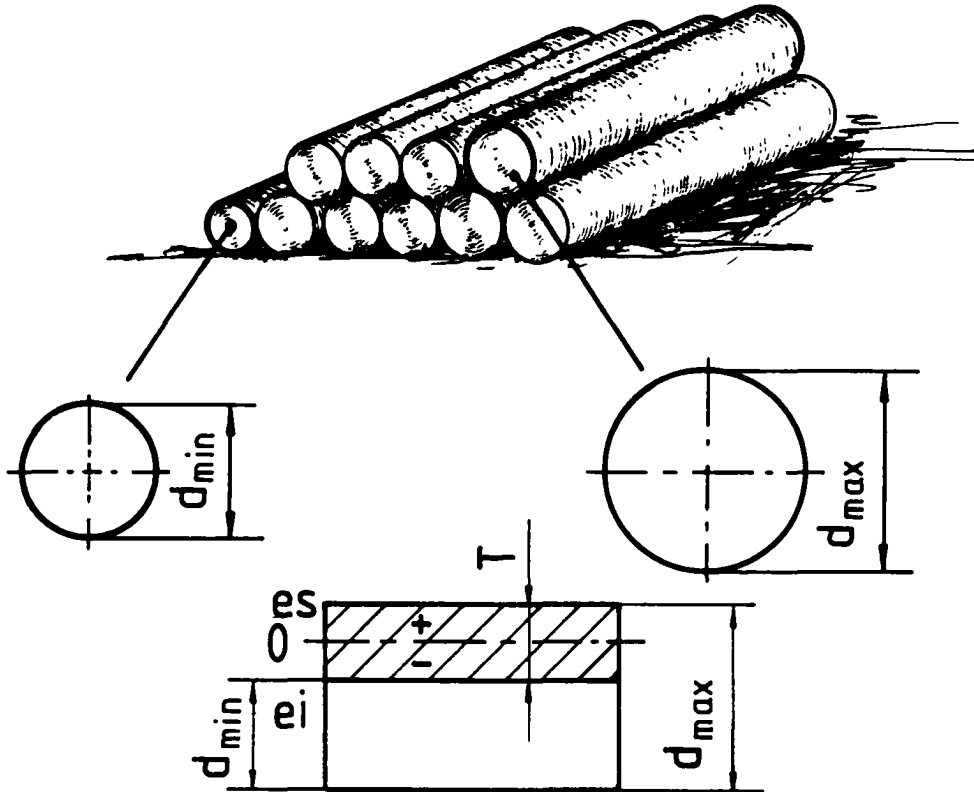


L =  mm

8

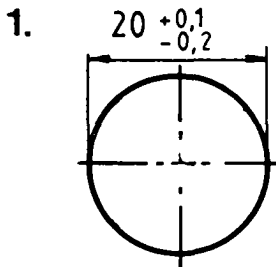


L =  mm



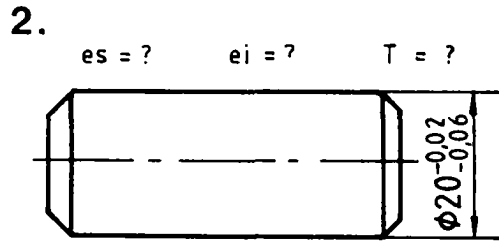
$$T = e - e$$

$$T = d - d$$



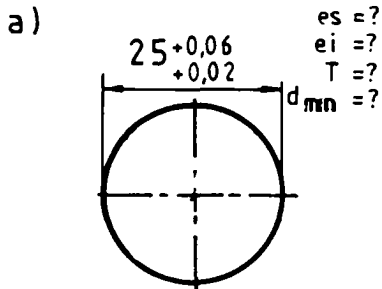
$$\begin{aligned}
 es &= ? \\
 ei &= ? \\
 T &= ? \\
 d_{\min} &= ? \\
 es &= 0,1 \text{ mm} \\
 ei &= -0,2 \text{ mm} \\
 T &= es - ei \\
 T &= 0,1 \text{ mm} - (-0,2) \text{ mm} \\
 T &= 0,3 \text{ mm}
 \end{aligned}$$

Test:  $d_{\min} = 19,8 \text{ mm}$



$$\begin{aligned}
 es &= ? & ei &= ? & T &= ? \\
 es &= -0,02 \text{ mm} & T &= es - ei \\
 ei &= -0,06 \text{ mm} & T &= -0,02 \text{ mm} - (-0,06) \text{ mm} \\
 T &= 0,04 \text{ mm}
 \end{aligned}$$

b)  $es = 0,2 \text{ mm}$   
 $ei = -0,2 \text{ mm}$   
 $T = 0,4 \text{ mm}$   
 $d_{\min} = 29,8 \text{ mm}$



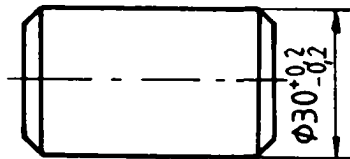
$$\begin{aligned}
 es &= ? \\
 ei &= ? \\
 T &= ? \\
 d_{\min} &= ?
 \end{aligned}$$

a)  $es = 0,06 \text{ mm}$   
 $ei = 0,02 \text{ mm}$   
 $T = 0,04 \text{ mm}$   
 $d_{\min} = 25,02 \text{ mm}$

es =  mm; ei =  mm

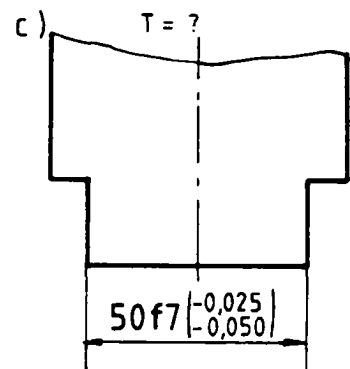
T =  mm;  $d_{\min}$  =  mm

b)  $es = ?$   $ei = ?$   
 $T = ?$   $d_{\min} = ?$



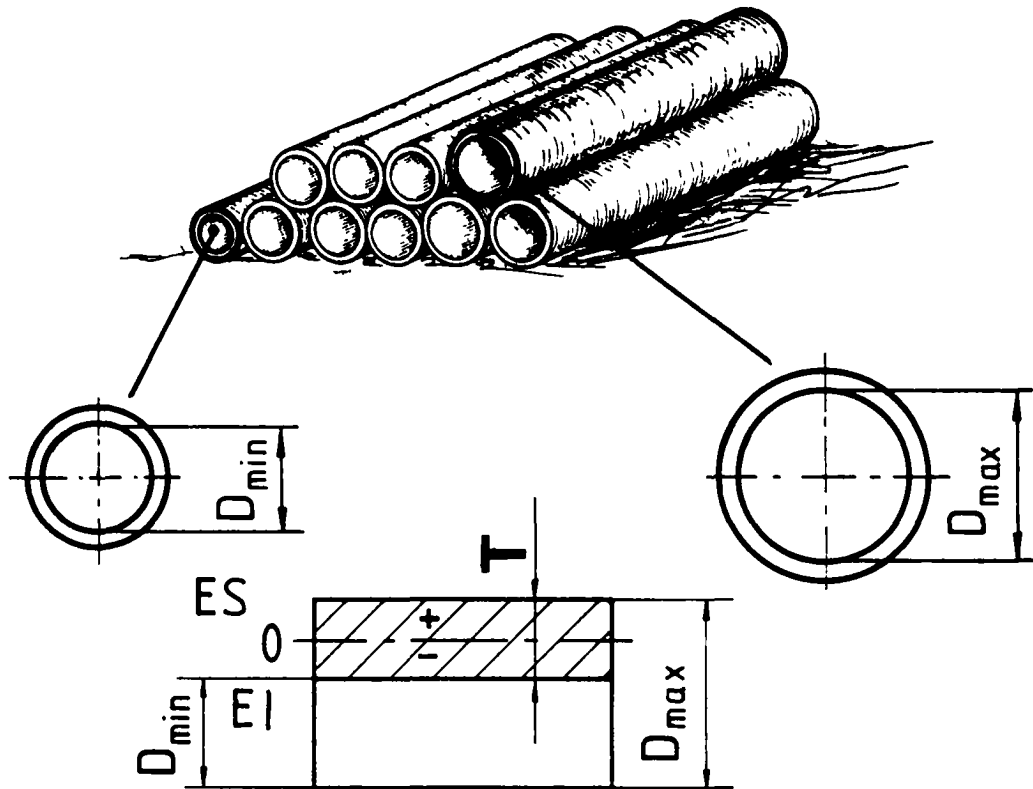
es =  mm; ei =  mm

T =  mm;  $d_{\min}$  =  mm



T =  mm

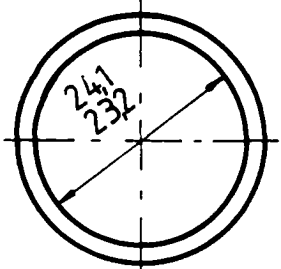




**T = E - E**

**T = D - D**

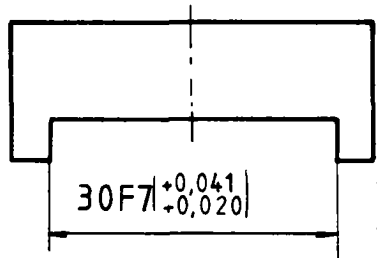
1.



$T = ?$   
 $D_{min} = ?$   
 $D_{max} = ?$   
 $T = D_{max} - D_{min}$   
 $T = 24,1\text{mm} - 23,2\text{mm}$   
 $T = 0,9\text{mm}$

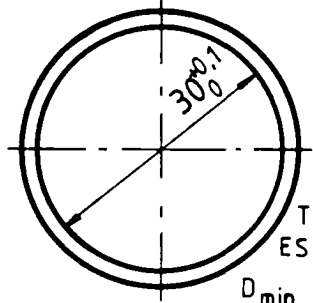
$D_{max} = 24,1\text{mm}$   
 $D_{min} = 23,2\text{mm}$   
 Test:

2.



$ES = ?$   
 $EI = ?$   
 $T = ?$   
 $L_{max} = ?$   
 $ES = 0,041\text{mm}$   
 $EI = 0,020\text{mm}$   
 $T = ES - EI$   
 $T = 0,041\text{mm} - 0,020\text{mm}$   
 $T = 0,021\text{mm}$   
 $L_{max} = 30,041\text{mm}$

a)

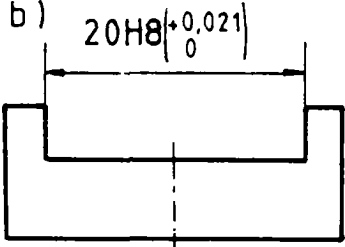


$T = ?$   
 $ES = ?$   
 $D_{min} = ?$

$T = \text{[ ] mm}, ES = \text{[ ] mm}$

$D_{min} = \text{[ ] mm}$

b)

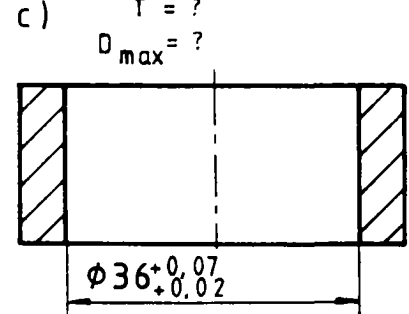


$T = ?$   
 $L_{max} = ?$

$T = \text{[ ] mm}$

$L_{max} = \text{[ ] mm}$

c)



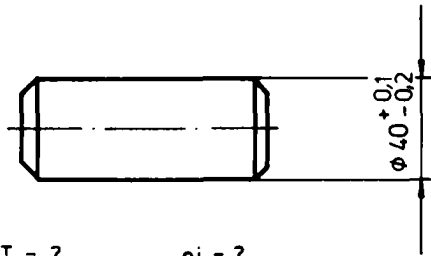
$T = ?$   
 $D_{max} = ?$

$T = \text{[ ] mm}$

$D_{max} = \text{[ ] mm}$

a)  $T = 0,1\text{mm}, ES = 0,1\text{mm}, D_{min} = 30\text{mm}$  b)  $T = 0,021\text{mm}, L_{max} = 20,021\text{mm}$  c)  $T = 0,05\text{mm}, D_{max} = 36,07\text{mm}$

1

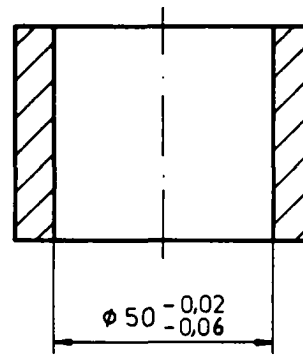


$T = ?$        $ei = ?$

$T =$   mm ;  $ei =$   mm

2

$D_{max} = ?$   
 $D_{min} = ?$

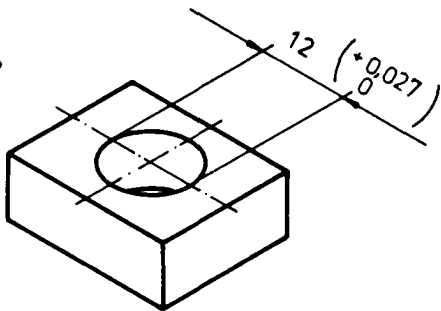


$D_{max} =$   mm ;  $D_{min} =$   mm

3

$D_{max} = ?$

$T = ?$

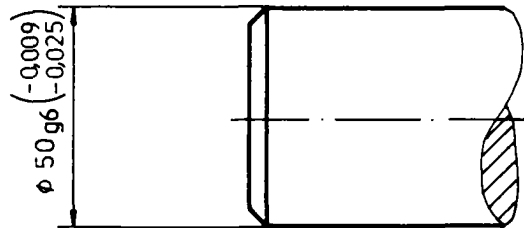


$D_{max} =$   mm ;  $T =$   mm

4

$T = ?$

$d_{max} = ?$

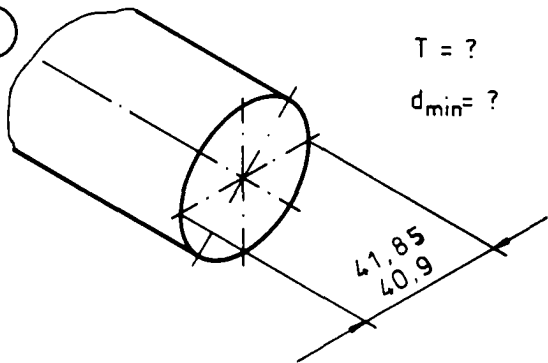


$T =$   mm ;  $d_{max} =$   mm

5

$T = ?$

$d_{min} = ?$

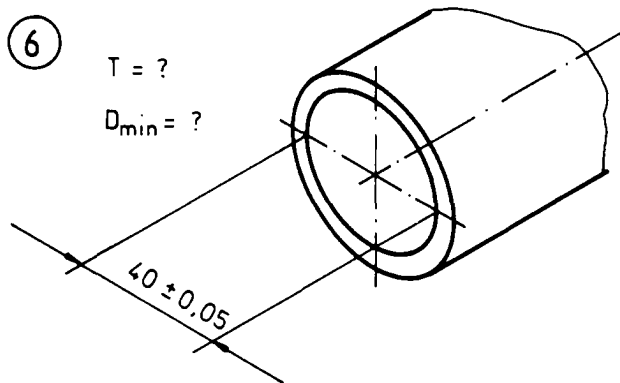


$T =$   mm ;  $d_{min} =$   mm

6

$T = ?$

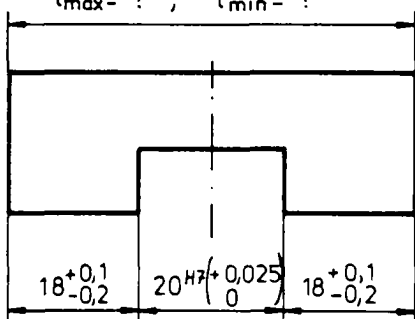
$D_{min} = ?$



$T =$   mm ;  $D_{min} =$   mm

7

$l_{max} = ?$  ;  $l_{min} = ?$



$l_{max} =$   mm ;  $l_{min} =$   mm

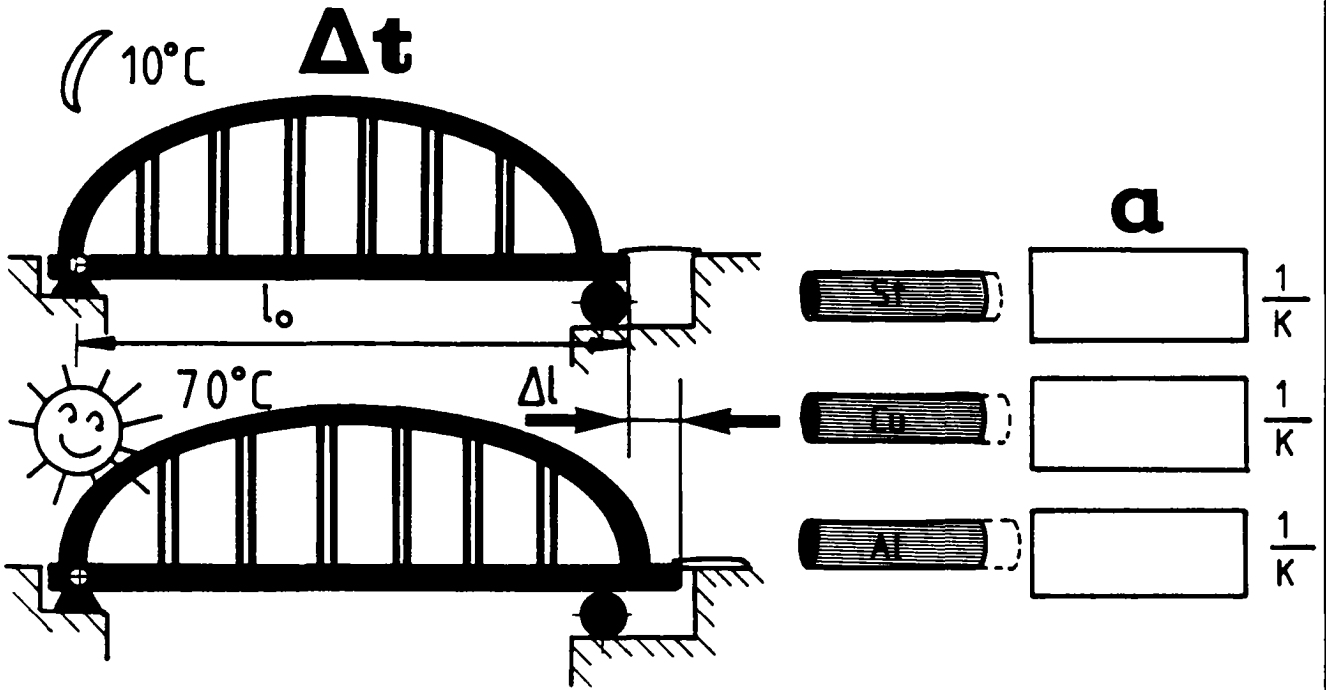
8

$100^0_{-0.02}$

$l_{max} = ?$   
 $l_{min} = ?$

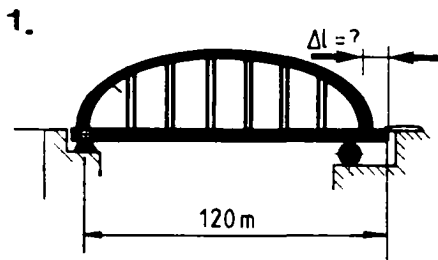


$l_{max} =$   mm ;  $l_{min} =$   mm



$$\Delta t = \boxed{\phantom{000}} \text{ K}$$

$$\Delta l = \boxed{\phantom{000}} \cdot \boxed{\phantom{000}} \cdot \boxed{\phantom{000}}$$



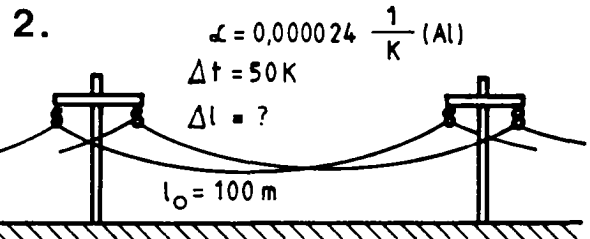
$$\alpha = 0,000012 \frac{1}{K}$$

$$\Delta t = 70\text{ K}$$

$$\Delta l = l_0 \cdot \Delta t \cdot \alpha$$

$$\Delta l = 120\text{m} \cdot 70\text{K} \cdot 0,000012 \frac{1}{K}$$

$$\Delta l = 0,1008\text{m} = 10,08\text{cm}$$



$$\alpha = 0,000024 \frac{1}{K} (\text{Al})$$

$$\Delta t = 50\text{ K}$$

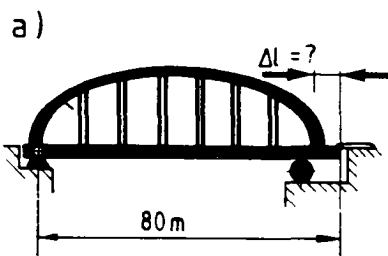
$$\Delta l = ?$$

$$\Delta l = l_0 \cdot \Delta t \cdot \alpha$$

$$\Delta l = 100\text{m} \cdot 50\text{K} \cdot 0,000024 \frac{1}{K}$$

$$\Delta l = 0,12\text{m} = 12\text{cm}$$

Test:



$$\alpha = 0,000012 \frac{1}{K}$$

$$\Delta t = 50\text{ K}$$

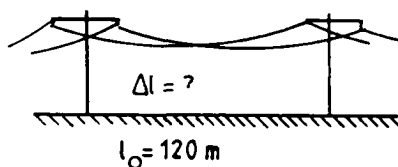
$$\Delta l = \boxed{\phantom{000}} \text{ cm}$$

b)

$$\alpha = 0,000024 \frac{1}{K}$$

$$t_1 = -10^\circ\text{C}$$

$$t_2 = +60^\circ\text{C}$$

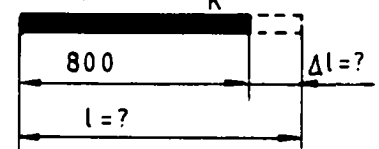


$$\Delta l = \boxed{\phantom{000}} \text{ cm}$$

c)

$$\Delta t = 80\text{ K}$$

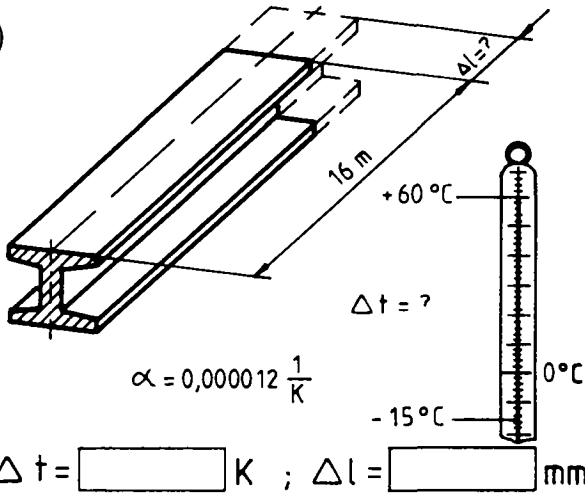
$$\alpha = 0,000017 \frac{1}{K} (\text{Cu})$$



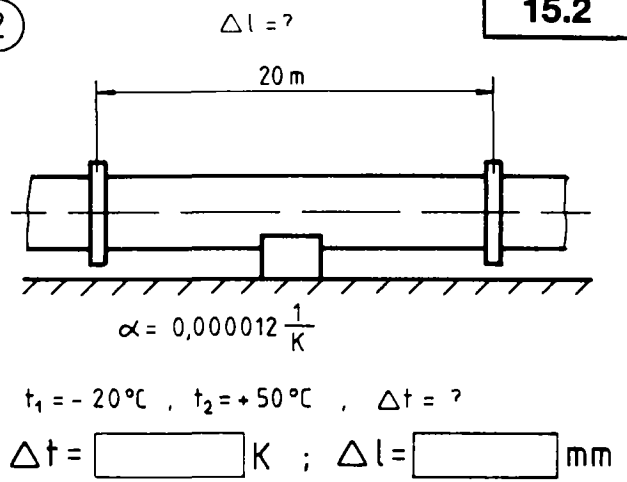
$$\Delta l = \boxed{\phantom{000}} \text{ mm}$$

$$l = \boxed{\phantom{000}} \text{ mm}$$

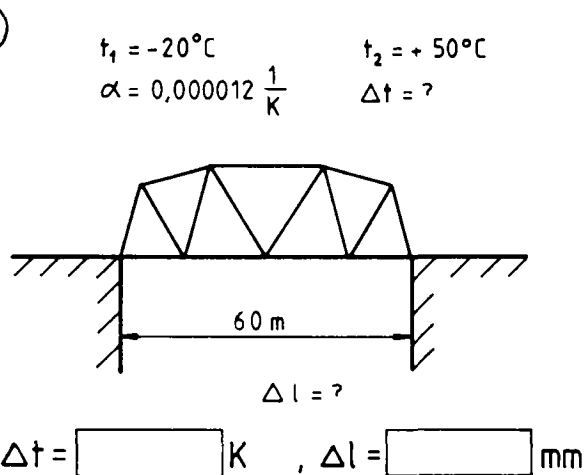
1



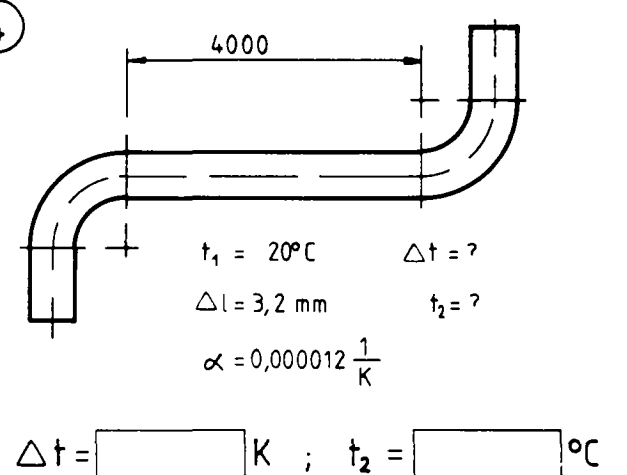
2



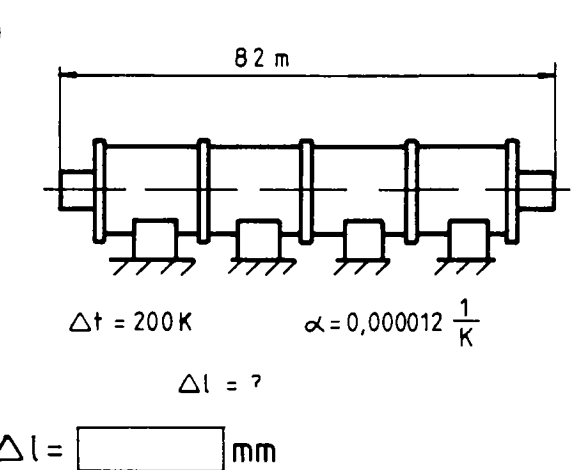
3



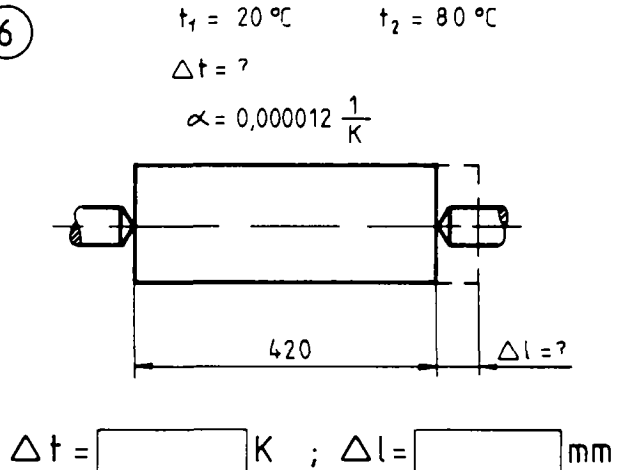
4



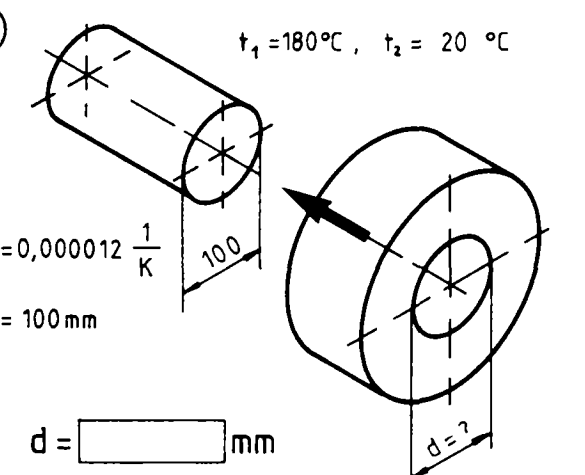
5



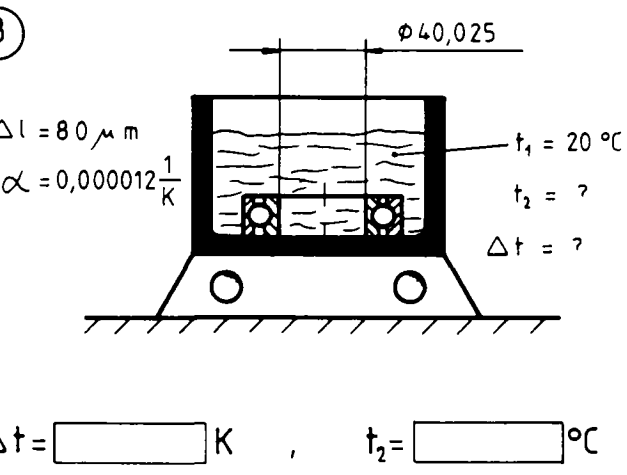
6



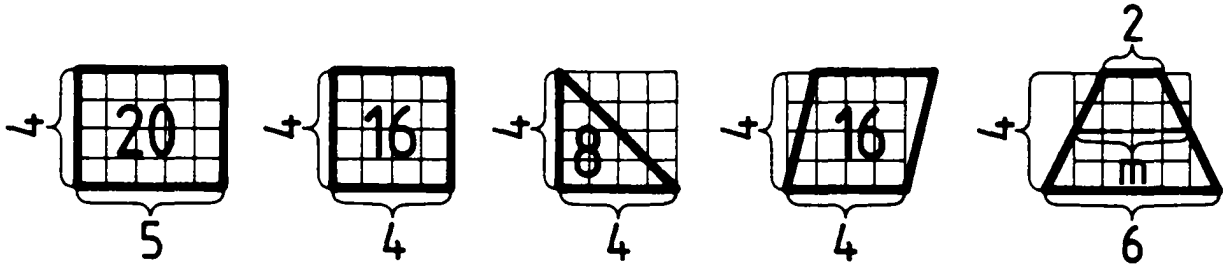
7



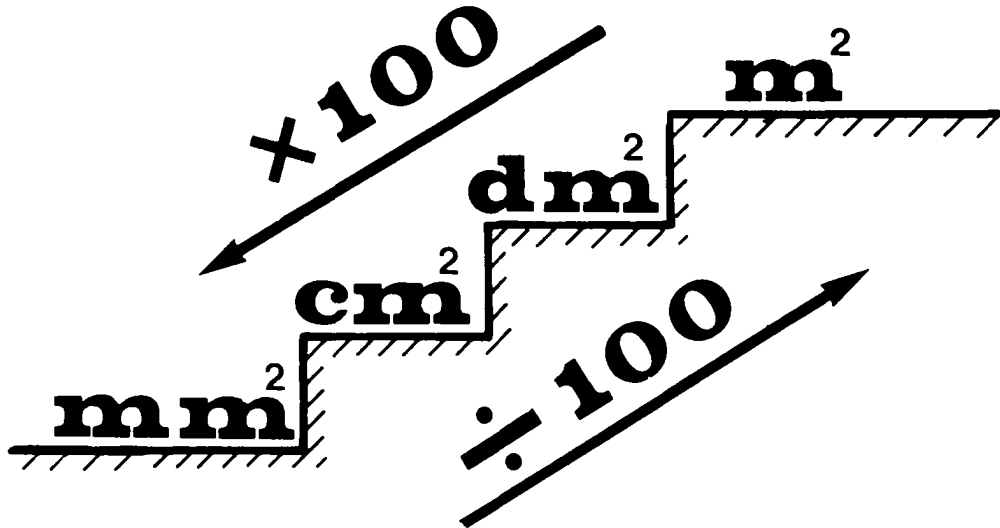
8



Five empty rectangular boxes for student identification.



Five boxes for area calculations:  $A = \cdot$ ,  $A =$ ,  $A = \frac{\cdot}{\cdot}$ ,  $A = \cdot$ ,  $A = \cdot$



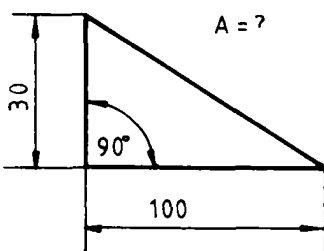
$1 \text{ m}^2 = \boxed{\phantom{0000}} \text{ dm}^2 = \boxed{\phantom{000000}} \text{ cm}^2 = \boxed{\phantom{00000000}} \text{ mm}^2$

Test

a)

	$\text{m}^2$	$\text{dm}^2$	$\text{cm}^2$
1.	2		
2.		120	
3.			4000

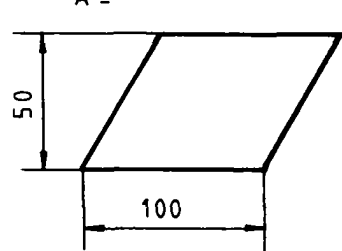
b)



$A = \boxed{\phantom{0000}} \text{ mm}^2$

$A = \boxed{\phantom{0000}} \text{ cm}^2$

c)



$A = \boxed{\phantom{0000}} \text{ mm}^2$

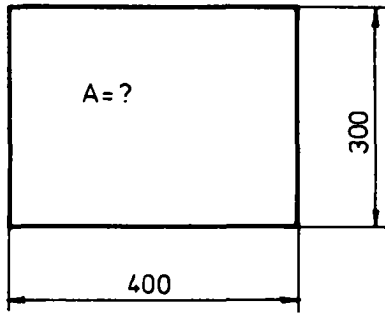
$A = \boxed{\phantom{0000}} \text{ cm}^2$

- 1.  $2 \text{ m}^2 = 200 \text{ dm}^2 = 20000 \text{ cm}^2$
- 2.  $120 \text{ dm}^2 = 1,2 \text{ m}^2 = 12000 \text{ cm}^2$
- 3.  $4000 \text{ cm}^2 = 0,4 \text{ m}^2 = 40 \text{ dm}^2$

b)  $A = 1500 \text{ mm}^2 = 15 \text{ cm}^2$

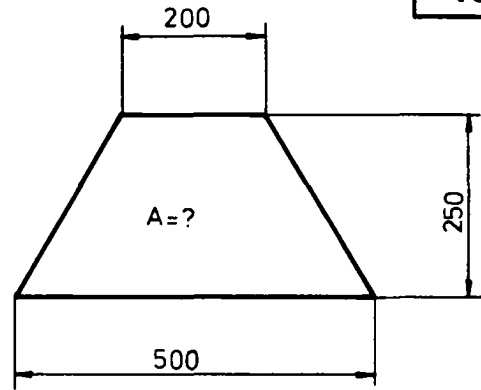
c)  $A = 5000 \text{ mm}^2 = 50 \text{ cm}^2$

①



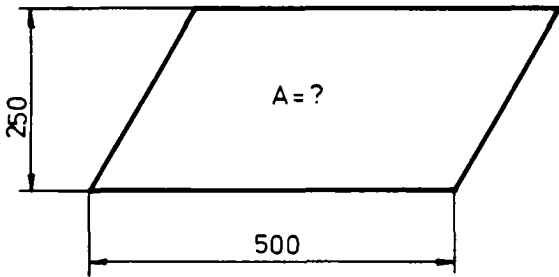
$A = \boxed{\phantom{000}} \text{ cm}^2$

②



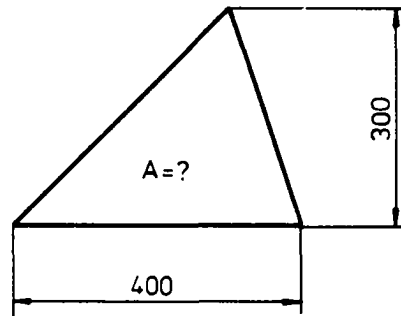
$A = \boxed{\phantom{000}} \text{ cm}^2$

③



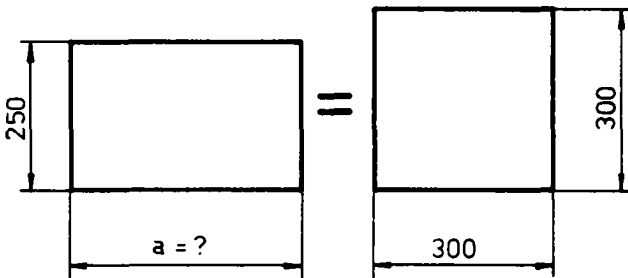
$A = \boxed{\phantom{000}} \text{ m}^2$

④



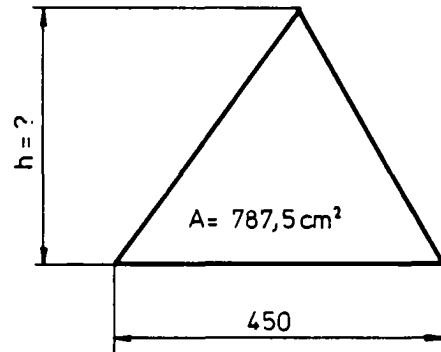
$A = \boxed{\phantom{000}} \text{ dm}^2$

⑤



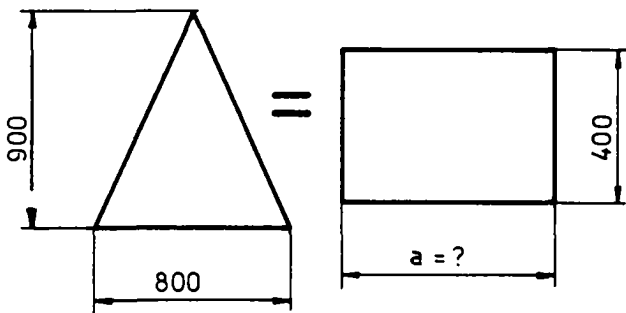
$a = \boxed{\phantom{000}} \text{ mm}$

⑥



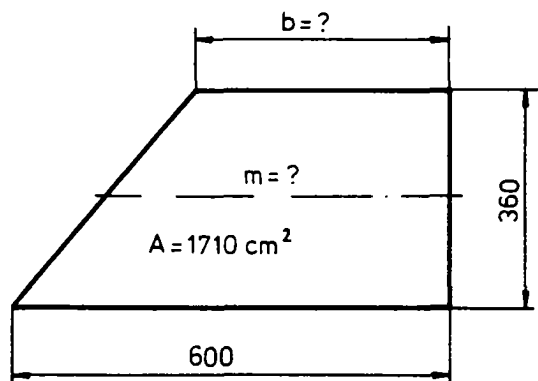
$h = \boxed{\phantom{000}} \text{ mm}$

⑦

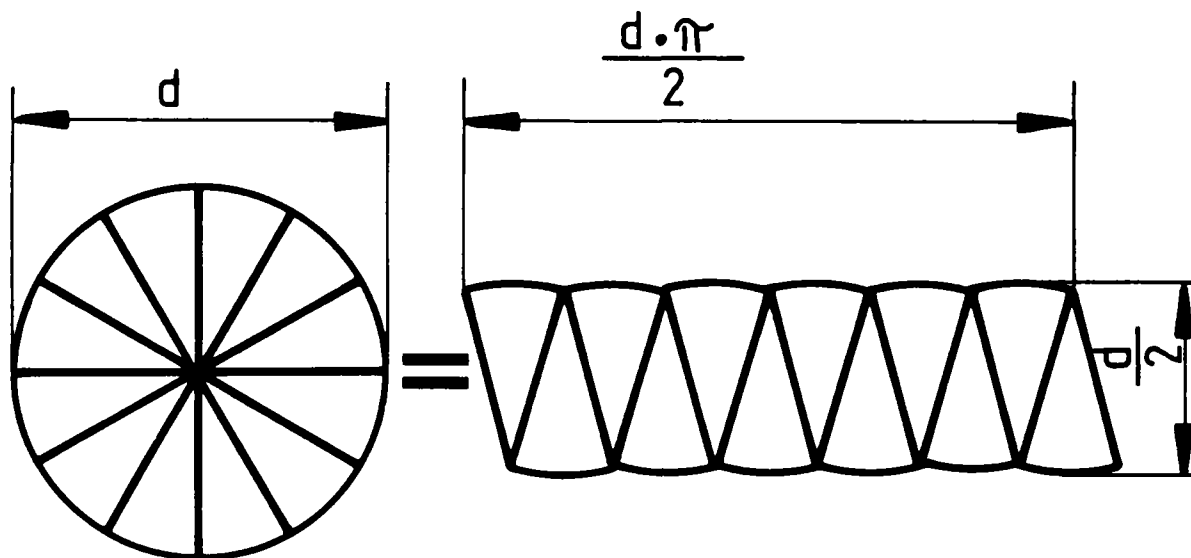


$a = \boxed{\phantom{000}} \text{ mm}$

⑧

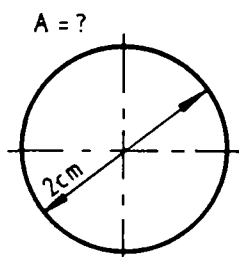


$m = \boxed{\phantom{000}} \text{ mm} \quad b = \boxed{\phantom{000}} \text{ mm}$



$$A = \underline{\hspace{2cm}}$$

1.

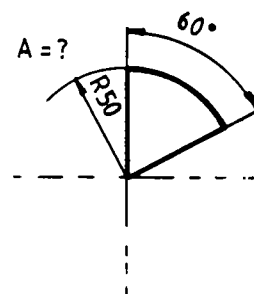


$$A = \frac{d^2 \cdot \pi}{4}$$

$$A = \frac{2^2 \text{ cm}^2 \cdot 3,14}{4}$$

$$A = 3,14 \text{ cm}^2$$

2.



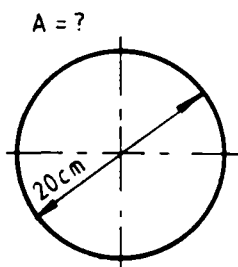
$$A = \frac{d^2 \cdot \pi}{4 \cdot 6}$$

$$A = \frac{100^2 \text{ mm}^2 \cdot 3,14}{4 \cdot 6}$$

$$A = 1308 \text{ mm}^2$$

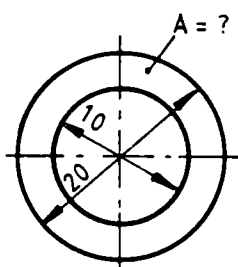
Test:

a)



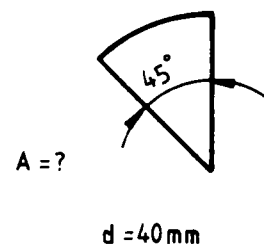
$$A = \boxed{\hspace{1cm}} \text{ cm}^2$$

b)



$$A = \boxed{\hspace{1cm}} \text{ cm}^2$$

c)



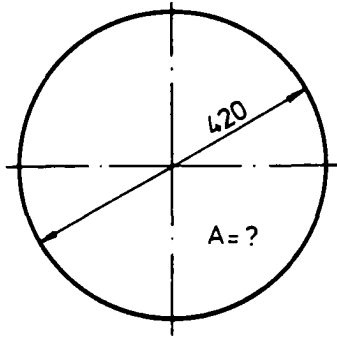
$$A = \boxed{\hspace{1cm}} \text{ cm}^2$$

 c)  $A = 1,57 \text{ cm}^2$ 

 b)  $A = 2,355 \text{ cm}^2$ 

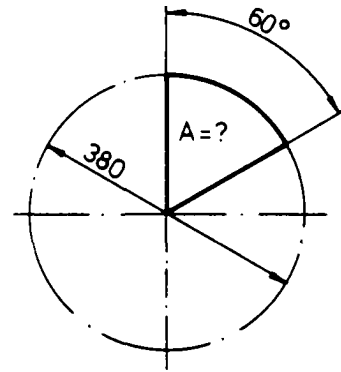
 a)  $A = 314 \text{ cm}^2$

1



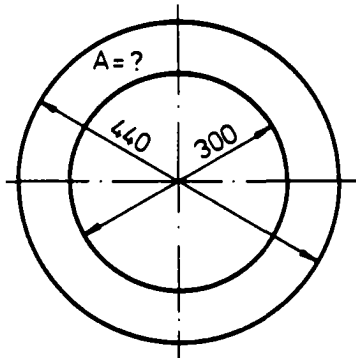
$A = \text{[ ] mm}^2$

2



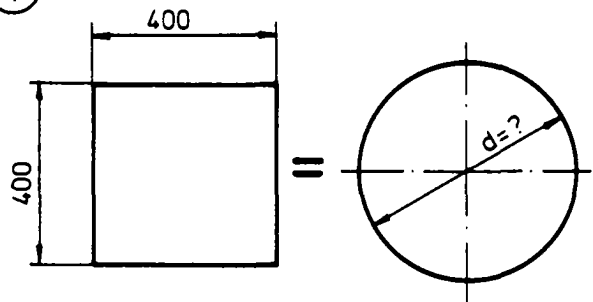
$A = \text{[ ] cm}^2$

3



$A = \text{[ ] cm}^2$

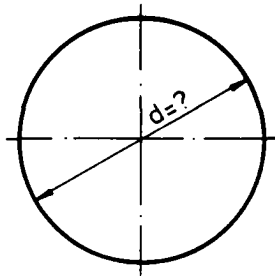
4



$d = \text{[ ] mm}$

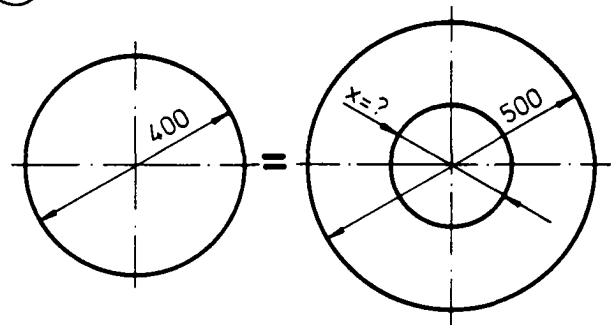
5

$A = 803,84 \text{ cm}^2$



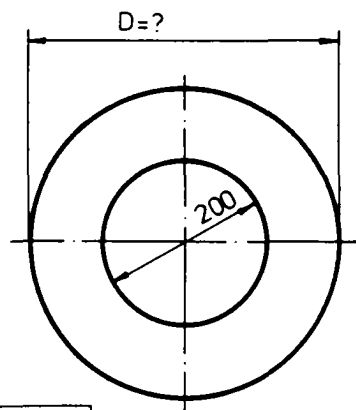
$d = \text{[ ] mm}$

6



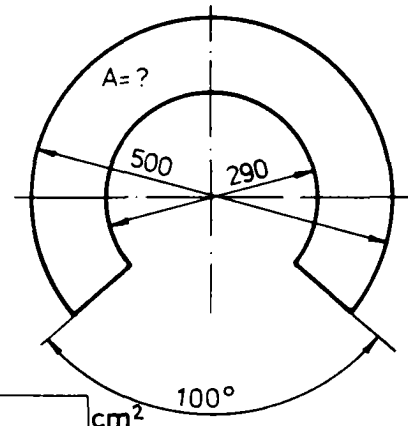
$x = \text{[ ] mm}$

7



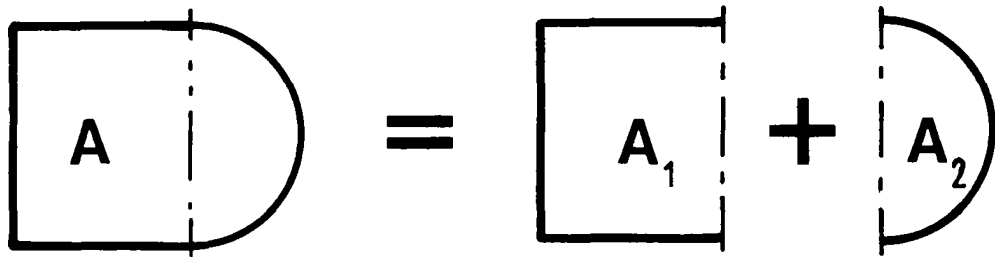
$D = \text{[ ] mm} \quad A = 1275,63 \text{ cm}^2$

8

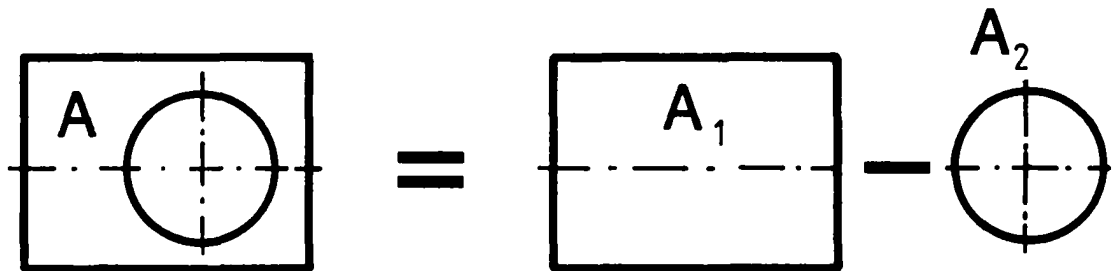


$A = \text{[ ] cm}^2$



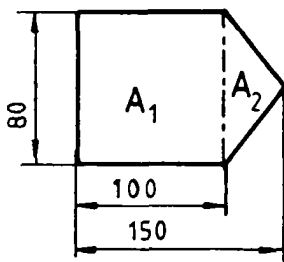


$A = +$



$A = -$

1.


 $A = ?$ 

$$A = A_1 + A_2$$

$$A_1 = 8\text{cm} \cdot 10\text{cm} \quad A_2 = 8\text{cm} \cdot 5\text{cm} \cdot \frac{1}{2}$$

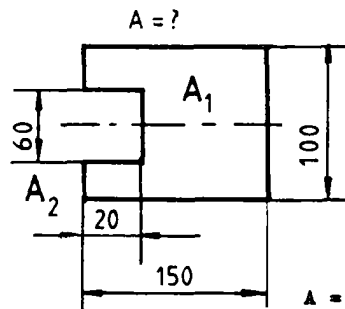
$$A_1 = 80\text{cm}^2 \quad A_2 = 20\text{cm}^2$$

$$A = 80\text{cm}^2 + 20\text{cm}^2$$

$$A = 100\text{cm}^2$$

Test:

2.


 $A = ?$ 

$$A = A_1 - A_2$$

$$A_1 = 15\text{cm} \cdot 10\text{cm}$$

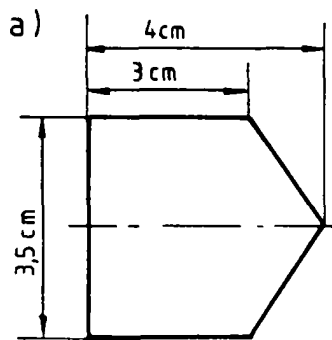
$$A_1 = 150\text{cm}^2$$

$$A_2 = 2\text{cm} \cdot 6\text{cm}$$

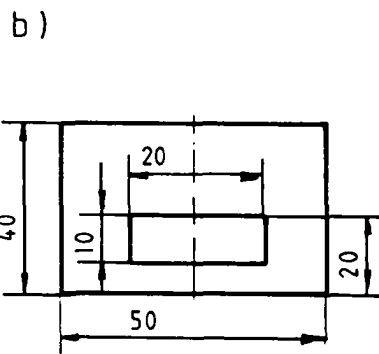
$$A_2 = 12\text{cm}^2$$

$$A = 150\text{cm}^2 - 12\text{cm}^2$$

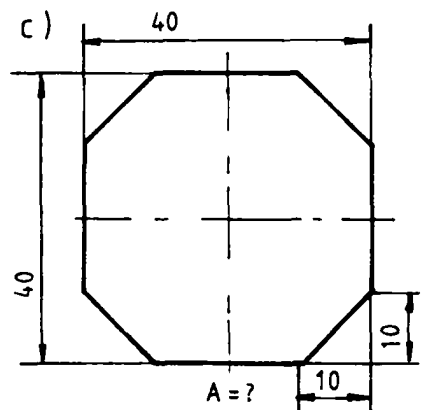
$$A = 138\text{cm}^2$$


 $A = ?$ 

$A = \boxed{\phantom{000}} \text{ cm}^2$


 $A = ?$ 

$A = \boxed{\phantom{000}} \text{ mm}^2$

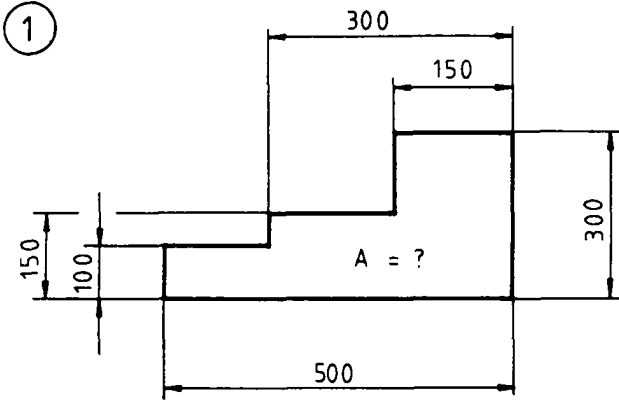

 $A = ?$ 

$A = \boxed{\phantom{000}} \text{ mm}^2$

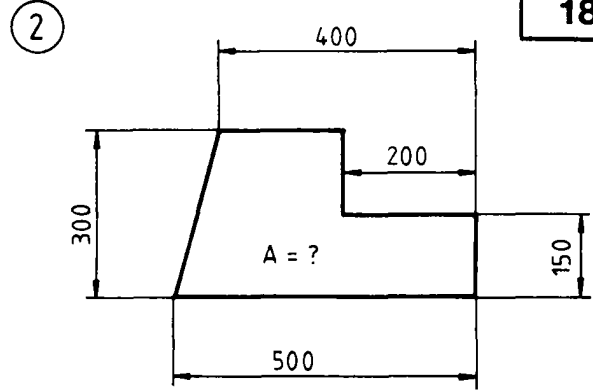
 c)  $A = 1400\text{mm}^2$ 

 b)  $A = 1800\text{mm}^2$ 

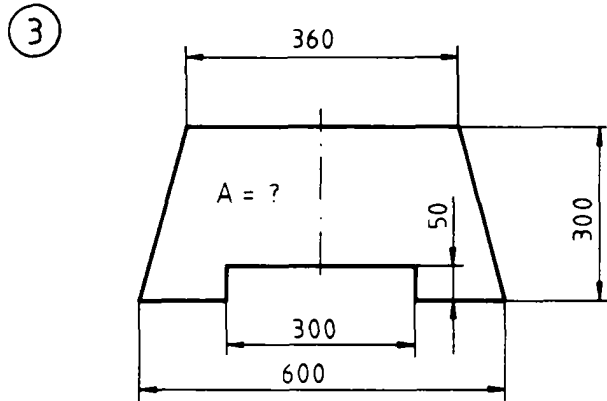
 a)  $A = 12,25\text{cm}^2$



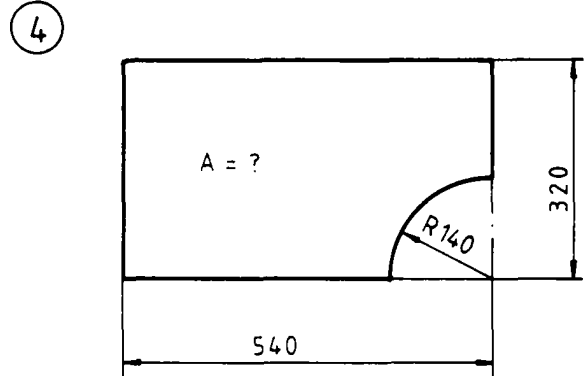
A =  cm<sup>2</sup>



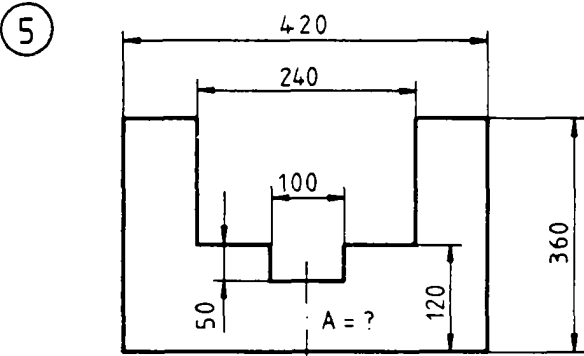
A =  cm<sup>2</sup>



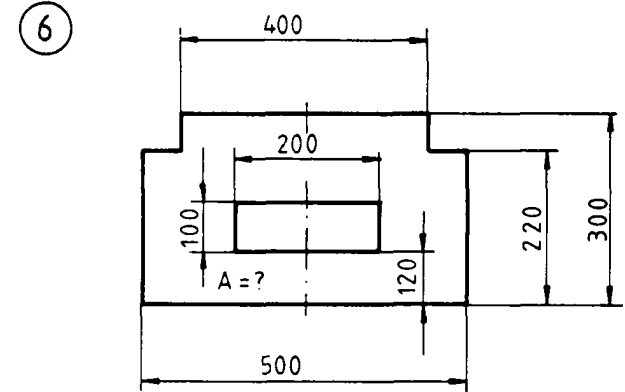
A =  cm<sup>2</sup>



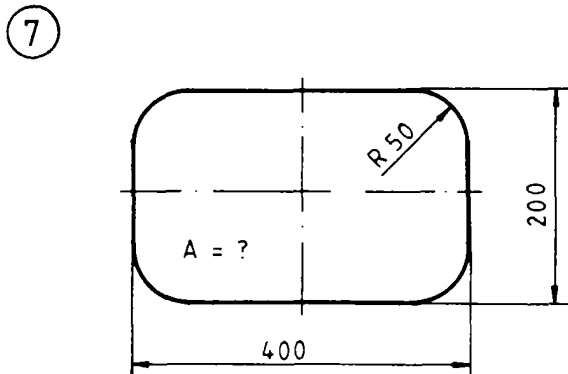
A =  dm<sup>2</sup>



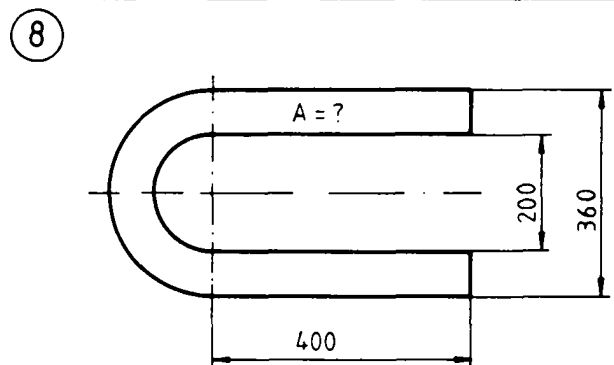
A =  cm<sup>2</sup>



A =  cm<sup>2</sup>

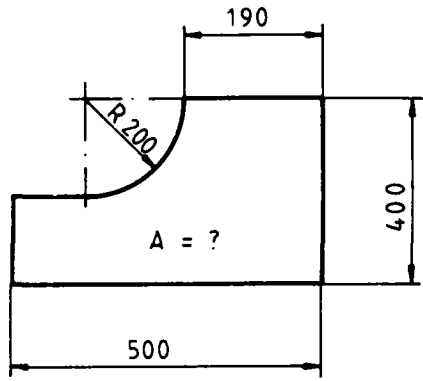


A =  cm<sup>2</sup>



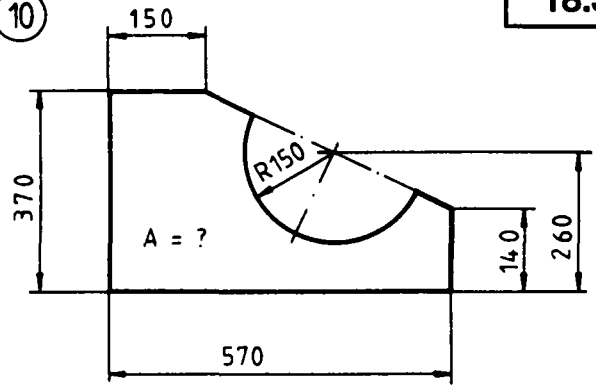
A =  cm<sup>2</sup>

9



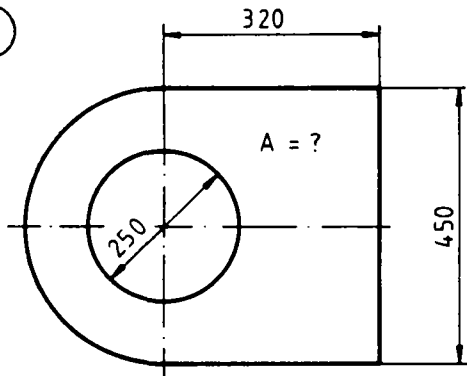
A =  dm<sup>2</sup>

10



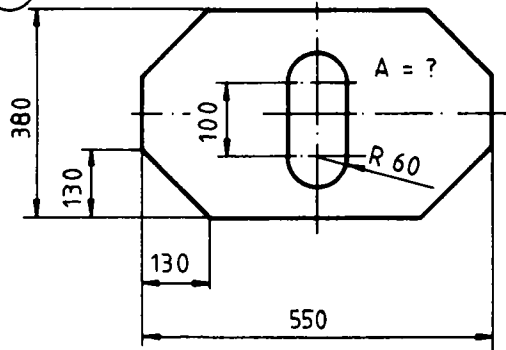
A =  m<sup>2</sup>

11



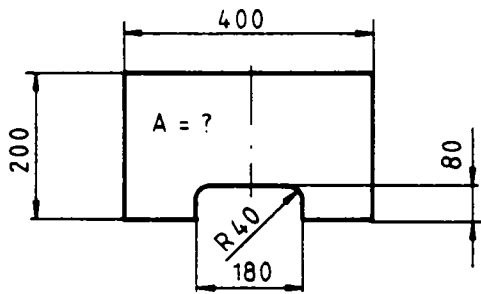
A =  dm<sup>2</sup>

12



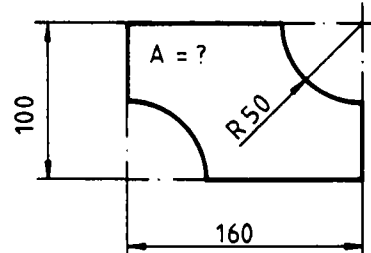
A =  dm<sup>2</sup>

13



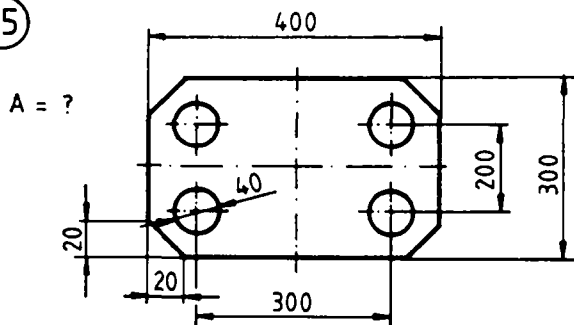
A =  dm<sup>2</sup>

14



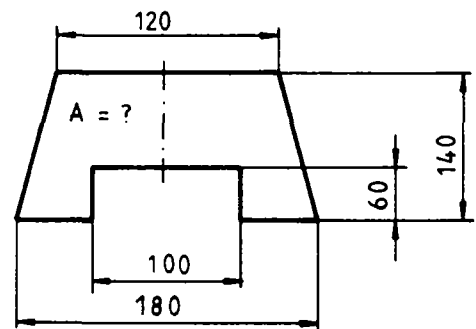
A =  dm<sup>2</sup>

15

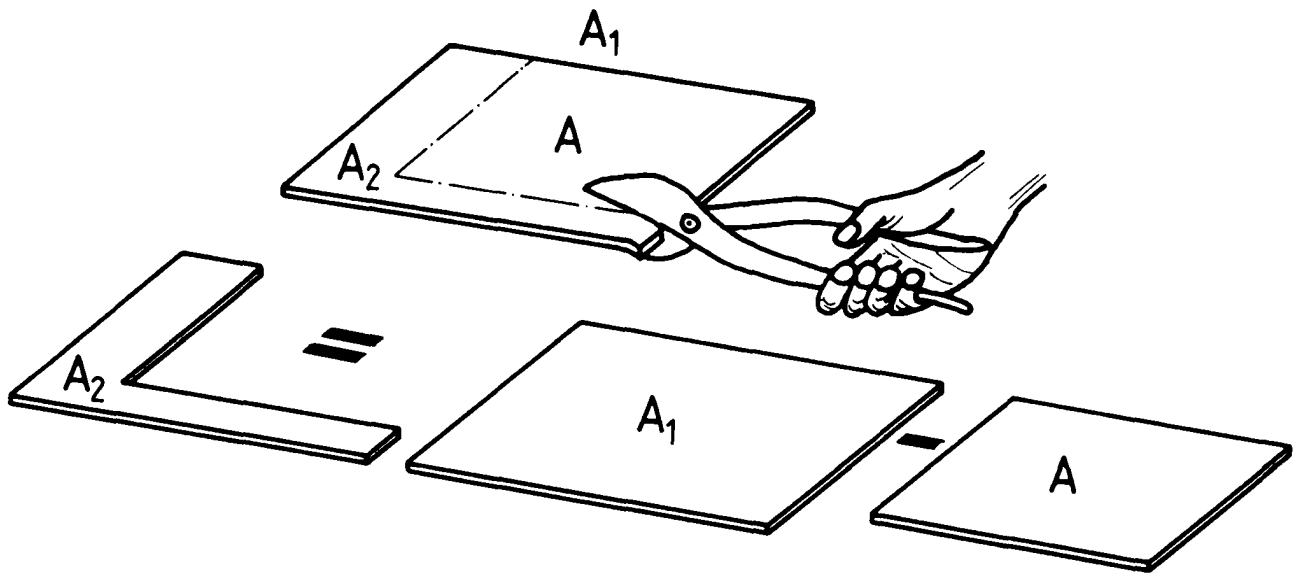


A =  dm<sup>2</sup>

16



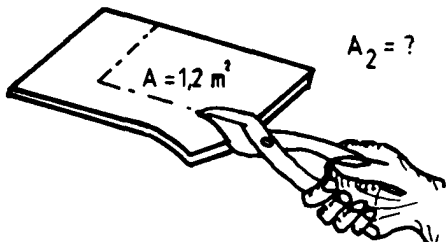
A =  dm<sup>2</sup>



$$A_2 = A_1 - A \quad A_{2\%} = \frac{A_2 \cdot 100}{A_1}$$

1.

$$A_1 = 1,5 \text{ m}^2$$



$$A_2 = ?$$

$$A = 1,2 \text{ m}^2$$

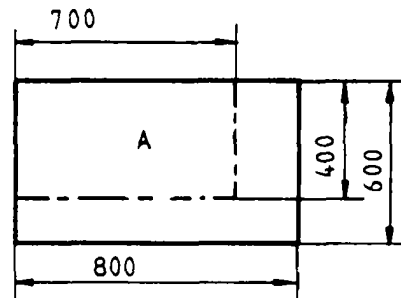
$$A_2 = A_1 - A$$

$$A_2 = 1,5 \text{ m}^2 - 1,2 \text{ m}^2$$

$$A_2 = 0,3 \text{ m}^2$$

\*\*\*\*\*

2.



$$A_2 = A_1 - A$$

$$A_1 = 8 \text{ dm} \cdot 6 \text{ dm}$$

$$A_1 = 48 \text{ dm}^2$$

$$A = 7 \text{ dm} \cdot 4 \text{ dm}$$

$$A = 28 \text{ dm}^2$$

$$A_2 = 48 \text{ dm}^2 - 28 \text{ dm}^2$$

$$A_2 = 20 \text{ dm}^2$$

$$A_{2\%} = 42\%$$

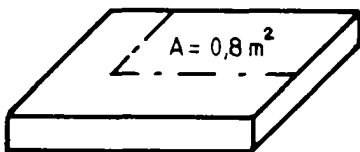
\*\*\*\*\*

$$A_2 = ? \quad A_{2\%} = ?$$

Test:

a)

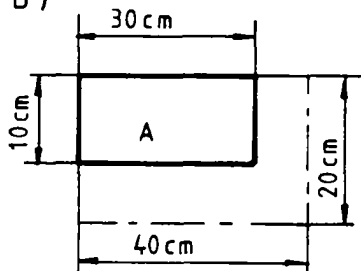
$$A_1 = 1 \text{ m}^2$$



$$A_2 = ?$$

$$A_2 = \boxed{\phantom{000}} \text{ m}^2$$

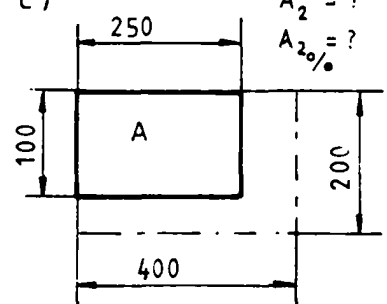
b)



$$A_2 = ?$$

$$A_2 = \boxed{\phantom{000}} \text{ cm}^2$$

c)



$$A_2 = ?$$

$$A_{2\%} = ?$$

$$A_2 = \boxed{\phantom{000}}$$

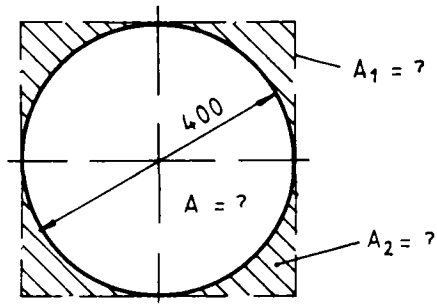
$$A_{2\%} = \boxed{\phantom{000}} \text{ mm}^2$$

$$c) A_2 = 550000 \text{ mm}^2, A_{2\%} = 42\%$$

$$b) A_2 = 500 \text{ cm}^2$$

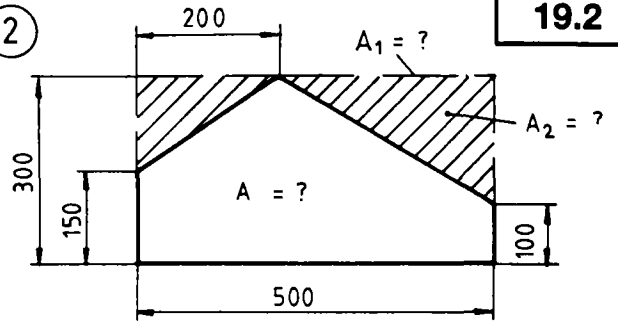
$$a) A_2 = 0,2 \text{ m}^2$$

1



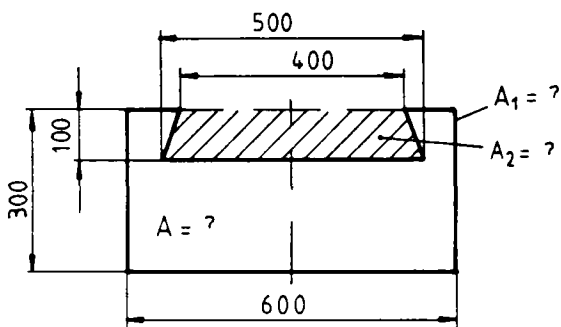
$A = \text{[ ] cm}^2$  ;  $A_1 = \text{[ ] cm}^2$   
 $A_2 = \text{[ ] cm}^2$  ;  $A_2\% = \text{[ ] \%}$

2



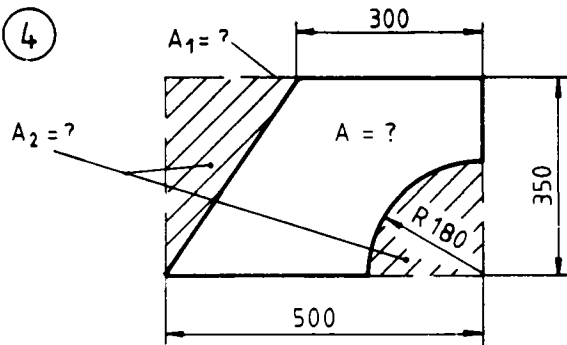
$A = \text{[ ] cm}^2$  ;  $A_1 = \text{[ ] cm}^2$   
 $A_2 = \text{[ ] cm}^2$  ;  $A_2\% = \text{[ ] \%}$

3



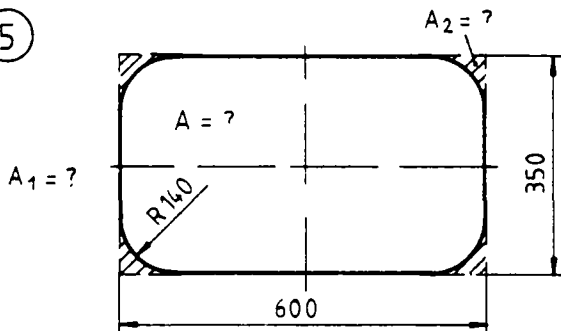
$A = \text{[ ] cm}^2$  ;  $A_1 = \text{[ ] cm}^2$   
 $A_2 = \text{[ ] cm}^2$  ;  $A_2\% = \text{[ ] \%}$

4



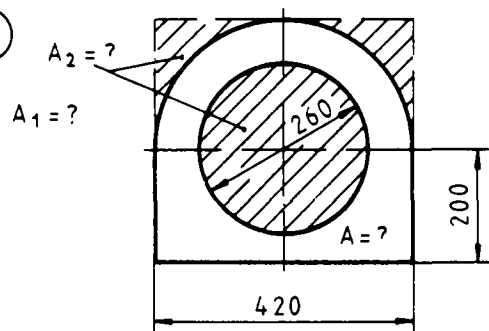
$A = \text{[ ] cm}^2$  ;  $A_1 = \text{[ ] cm}^2$   
 $A_2 = \text{[ ] cm}^2$  ;  $A_2\% = \text{[ ] \%}$

5



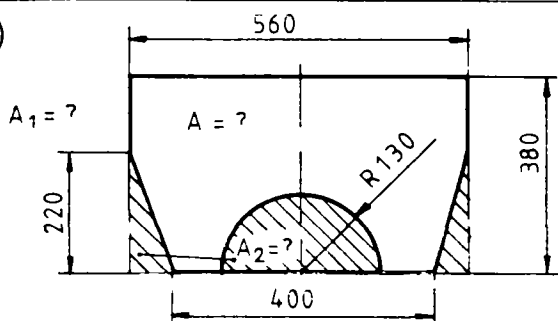
$A = \text{[ ] cm}^2$  ;  $A_1 = \text{[ ] cm}^2$   
 $A_2 = \text{[ ] cm}^2$  ;  $A_2\% = \text{[ ] \%}$

6



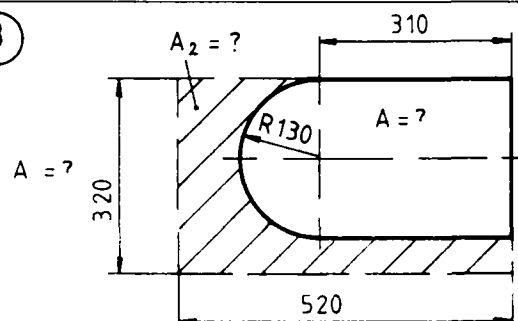
$A = \text{[ ] cm}^2$  ;  $A_1 = \text{[ ] cm}^2$   
 $A_2 = \text{[ ] cm}^2$  ;  $A_2\% = \text{[ ] \%}$

7

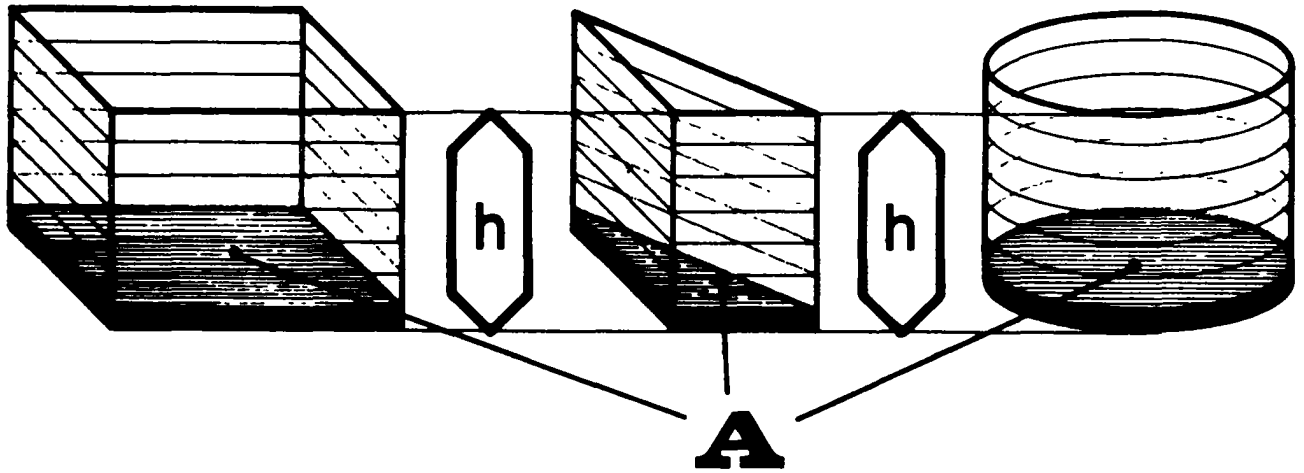


$A = \text{[ ] cm}^2$  ;  $A_1 = \text{[ ] cm}^2$   
 $A_2 = \text{[ ] cm}^2$  ;  $A_2\% = \text{[ ] \%}$

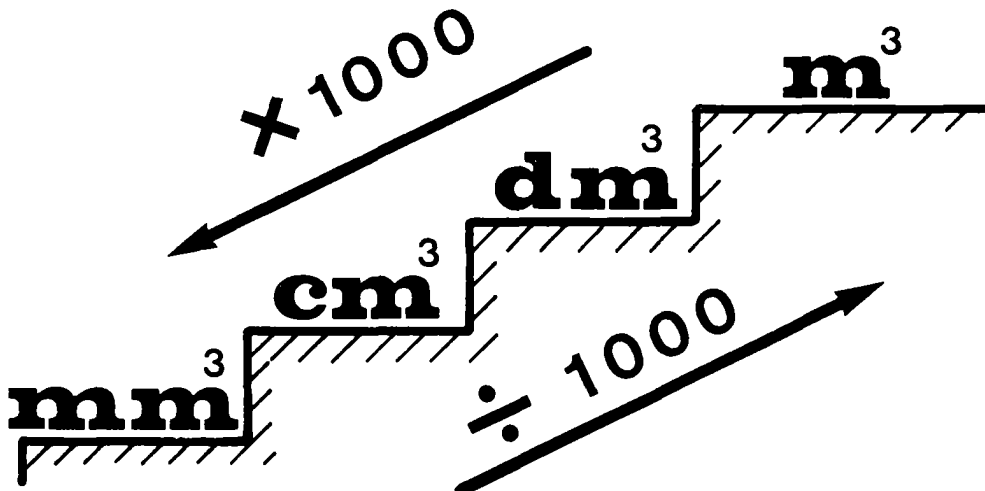
8



$A = \text{[ ] cm}^2$  ;  $A_1 = \text{[ ] cm}^2$   
 $A_2 = \text{[ ] cm}^2$  ;  $A_2\% = \text{[ ] \%}$



$V = \cdot$



$1\text{m}^3 = \text{ } \text{dm}^3 = \text{ } \text{cm}^3$

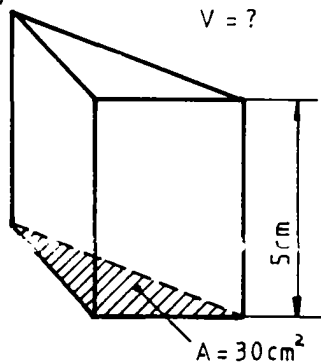
Test:

- a)  $1.0,2\text{m}^3 = 200\text{dm}^3 = 200000\text{cm}^3$
- $2.400\text{dm}^3 = 0,4\text{m}^3 = 400000\text{cm}^3$
- $3.3000\text{cm}^3 = 0,003\text{m}^3 = 3\text{dm}^3$

a)

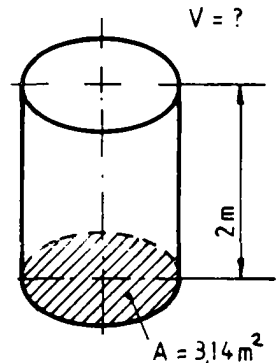
	$\text{m}^3$	$\text{dm}^3$	$\text{cm}^3$
1.	0,2		
2.		400	
3.			3000

b)



$V = \text{ } \text{cm}^3$

c)

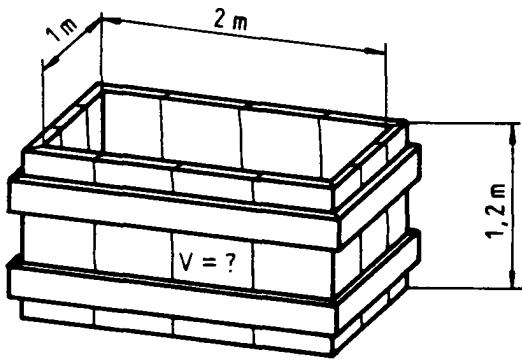


$V = \text{ } \text{m}^3$

b)  $V = 150\text{cm}^3$

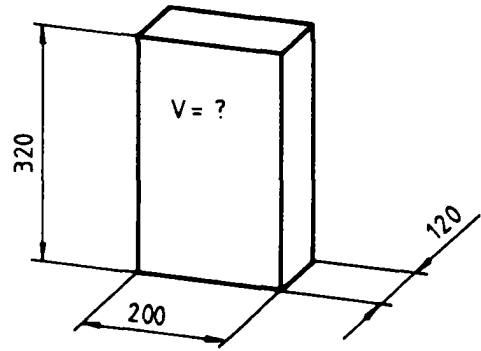
c)  $V = 6,28\text{m}^3$

1



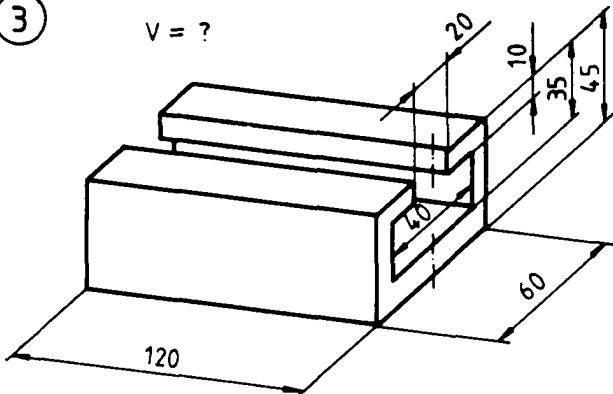
$V = \text{[ ] m}^3$

2



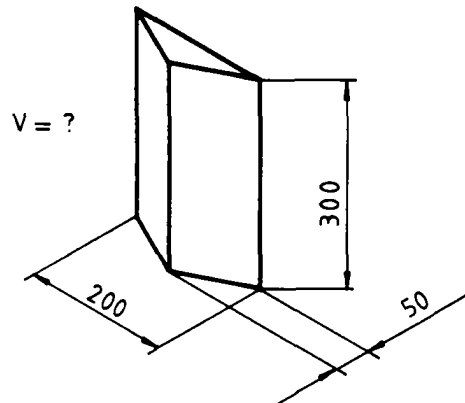
$V = \text{[ ] cm}^3$

3



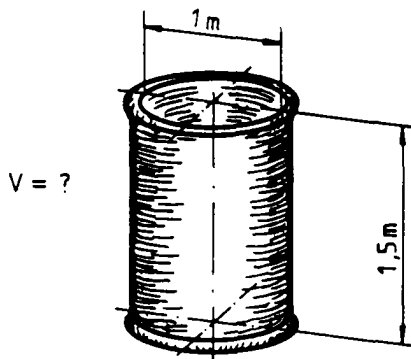
$V = \text{[ ] cm}^3$

4



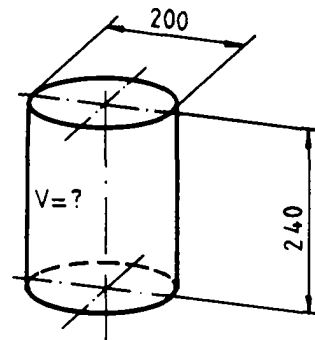
$V = \text{[ ] cm}^3$

5



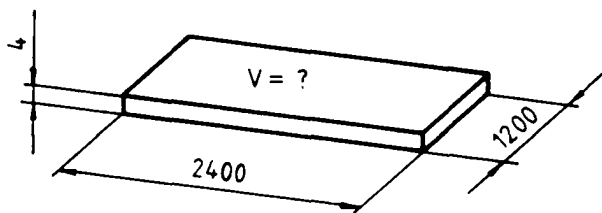
$V = \text{[ ] m}^3$

6



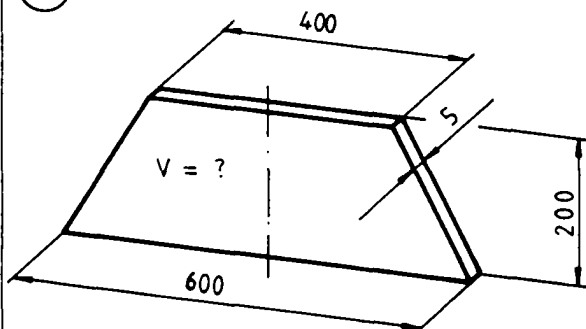
$V = \text{[ ] cm}^3$

7

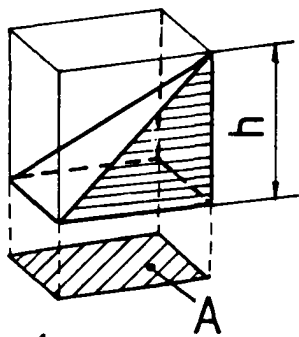
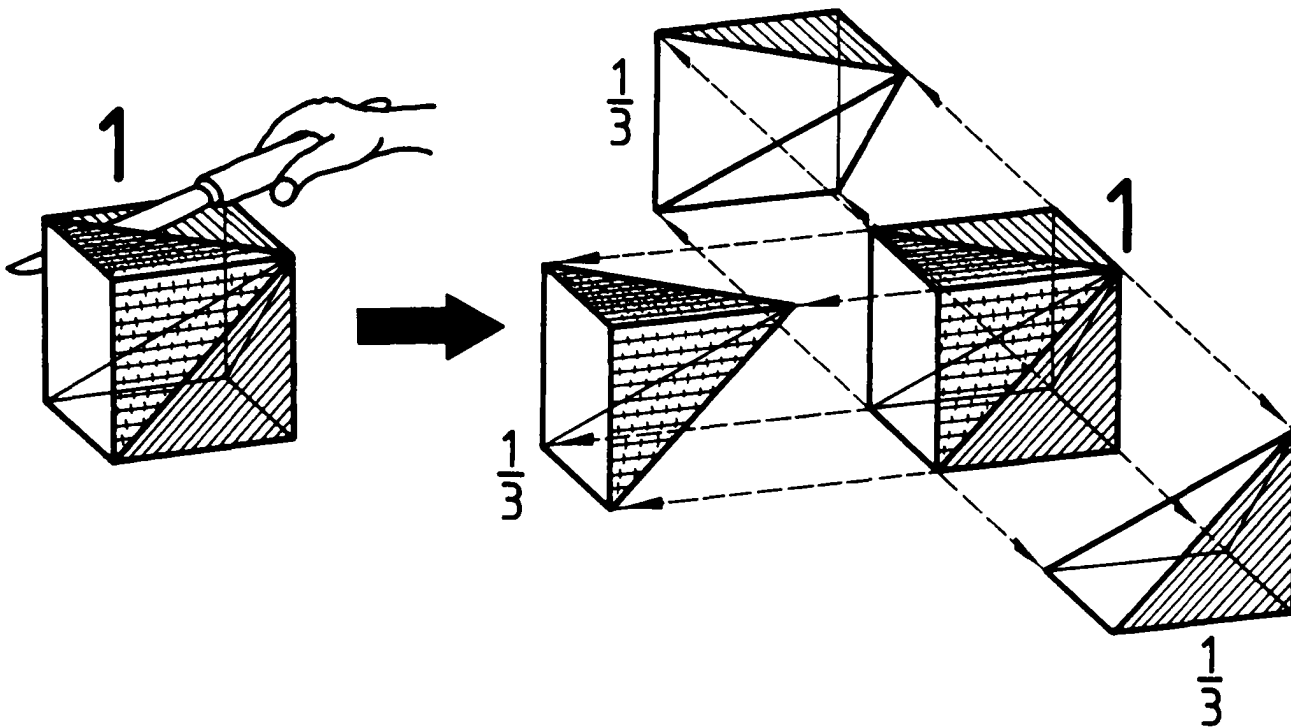


$V = \text{[ ] dm}^3$

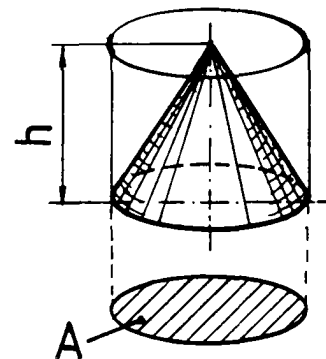
8



$V = \text{[ ] dm}^3$

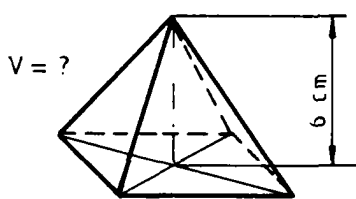


$$V = \frac{A \cdot h}{3}$$



1.

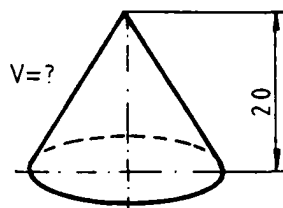
2.



$$V = \frac{A \cdot h}{3}$$

$$V = \frac{4 \text{ cm}^2 \cdot 6 \text{ cm}}{3}$$

$$V = 8 \text{ cm}^3$$



$$V = \frac{A \cdot h}{3}$$

$$V = \frac{314 \text{ mm}^2 \cdot 20 \text{ mm}}{3}$$

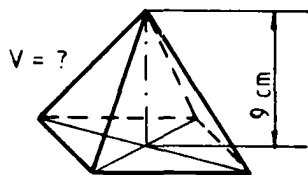
$$V = 2093 \text{ mm}^3$$

Test:

$$A = 4 \text{ cm}^2$$

$$A = 314 \text{ mm}^2$$

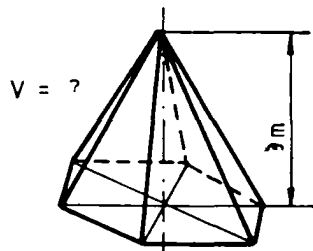
a)



$$A = 8 \text{ cm}^2$$

$$V = \boxed{\phantom{000}} \text{ cm}^3$$

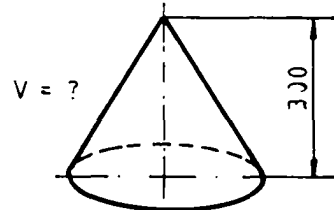
b)



$$A = 2 \text{ m}^2$$

$$V = \boxed{\phantom{000}} \text{ m}^3$$

c)



$$A = 100 \text{ mm}^2$$

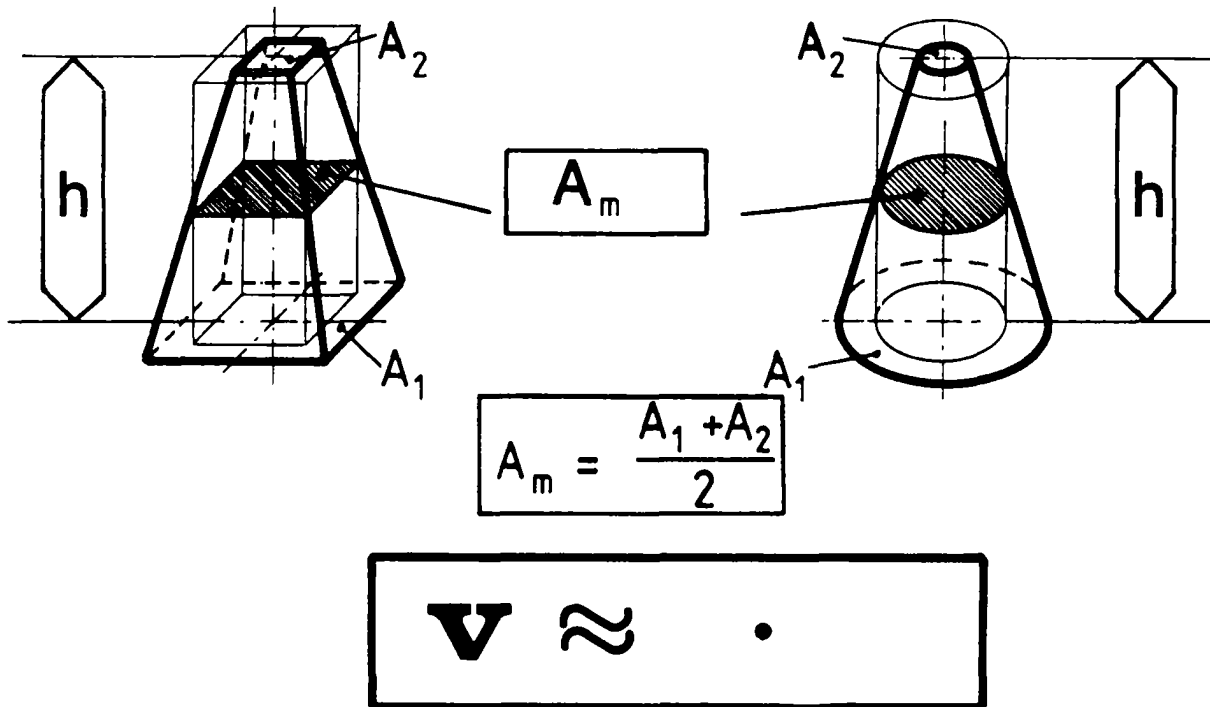
$$V = \boxed{\phantom{000}} \text{ cm}^3$$

c)  $V = 10 \text{ cm}^3$

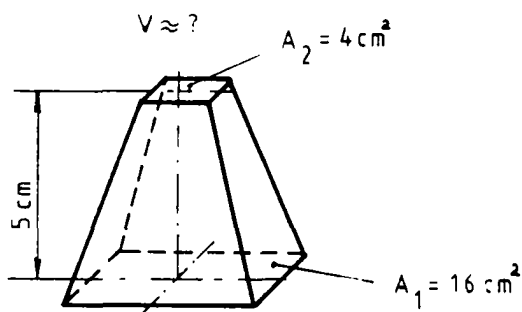
b)  $V = 2 \text{ m}^3$

a)  $V = 24 \text{ cm}^3$





1.



$$V \approx A_m \cdot h$$

$$A_m = \frac{A_1 + A_2}{2}$$

$$A_m = \frac{16 \text{ cm}^2 + 4 \text{ cm}^2}{2}$$

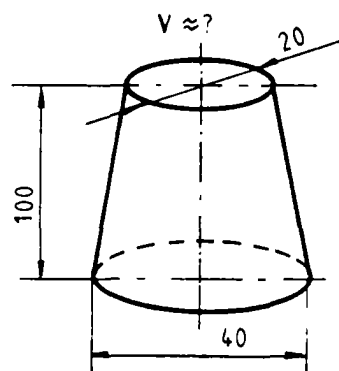
$$A_m = 10 \text{ cm}^2$$

$$V \approx 10 \text{ cm}^2 \cdot 5 \text{ cm}$$

$$V \approx 50 \text{ cm}^3$$

Test:

2.



$$V \approx A_m \cdot h$$

$$A_m = \frac{A_1 + A_2}{2}$$

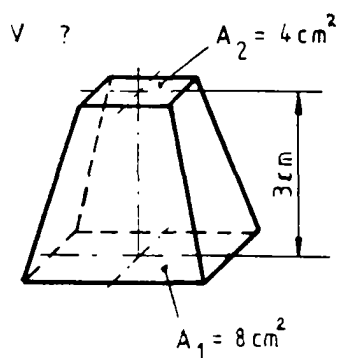
$$A_m = \frac{(4^2 + 2^2) \text{ cm}^2 \cdot 0,785}{2}$$

$$A_m = 7,85 \text{ cm}^2$$

$$V \approx 7,85 \text{ cm}^2 \cdot 10 \text{ cm}$$

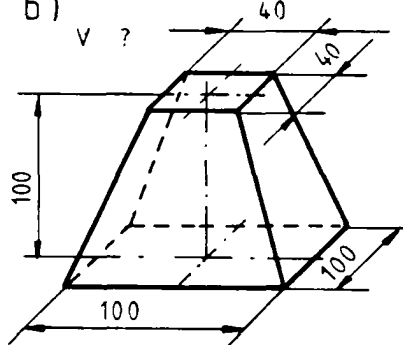
$$V \approx 78,5 \text{ cm}^3$$

a)



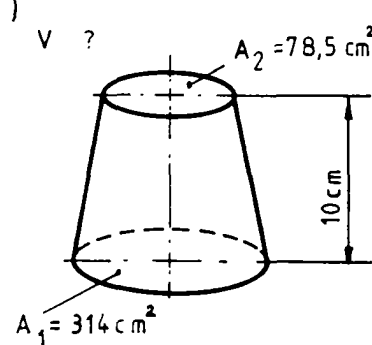
$$V \approx \boxed{\phantom{000}} \text{ cm}^3$$

b)



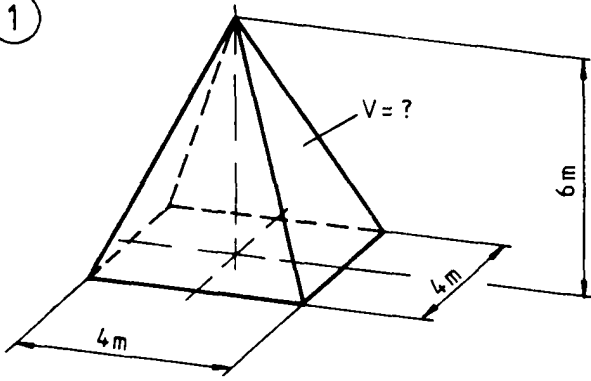
$$V \approx \boxed{\phantom{000}} \text{ cm}^3$$

c)



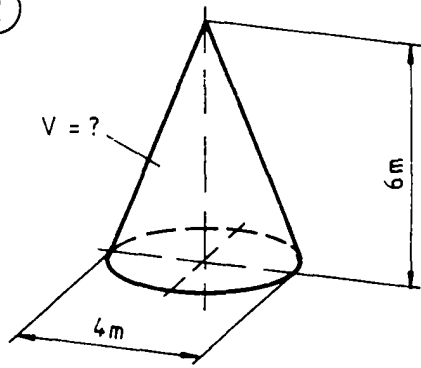
$$V \approx \boxed{\phantom{000}} \text{ cm}^3$$

1



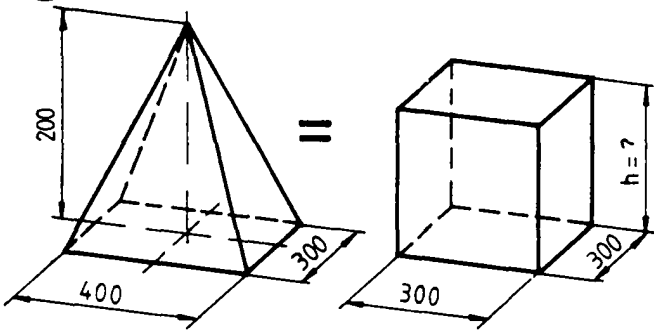
$V = \boxed{\phantom{000}} \text{ m}^3$

2



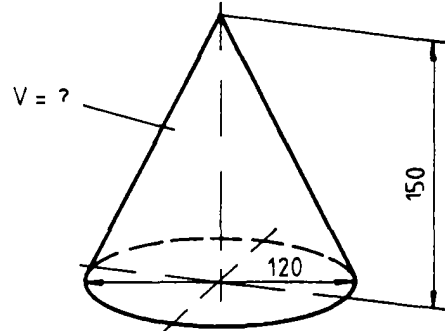
$V = \boxed{\phantom{000}} \text{ m}^3$

3



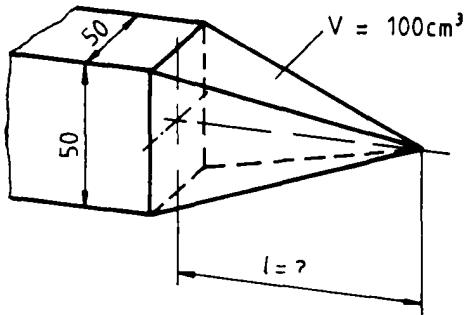
$h = \boxed{\phantom{000}} \text{ mm}$

4



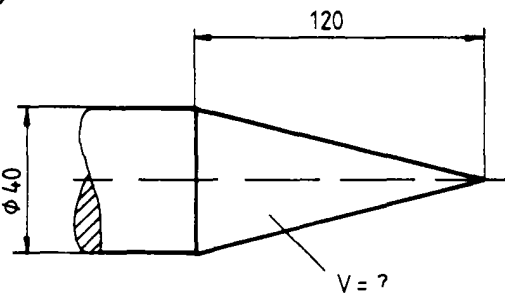
$V = \boxed{\phantom{000}} \text{ dm}^3$

5



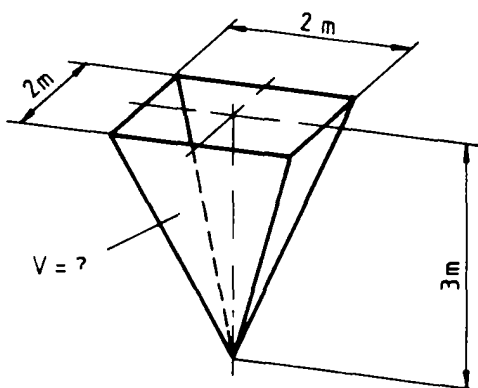
$l = \boxed{\phantom{000}} \text{ mm}$

6



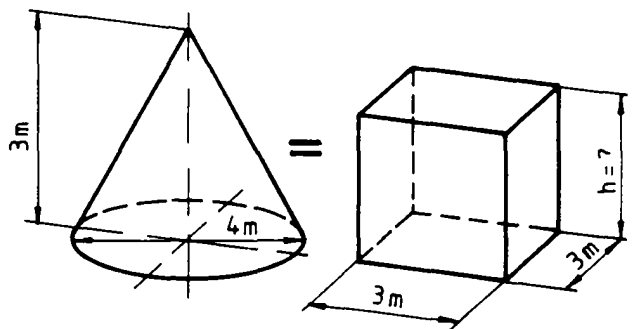
$V = \boxed{\phantom{000}} \text{ dm}^3$

7



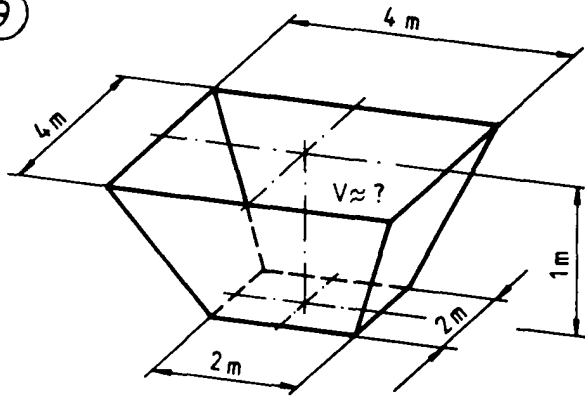
$V = \boxed{\phantom{000}} \text{ m}^3$

8



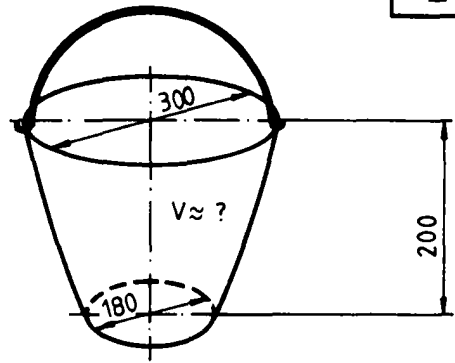
$h = \boxed{\phantom{000}} \text{ m}$

9



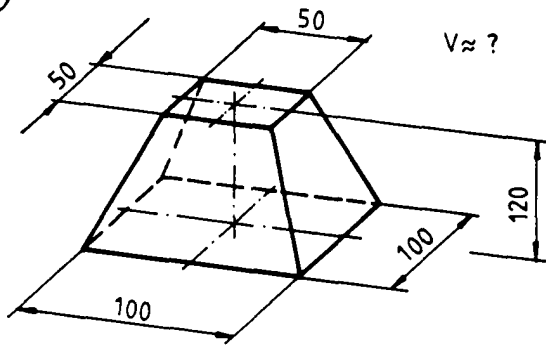
$V \approx \text{[ ] m}^3$

10



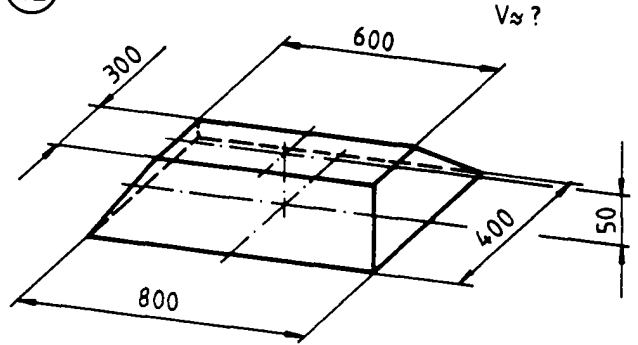
$V \approx \text{[ ] dm}^3$

11



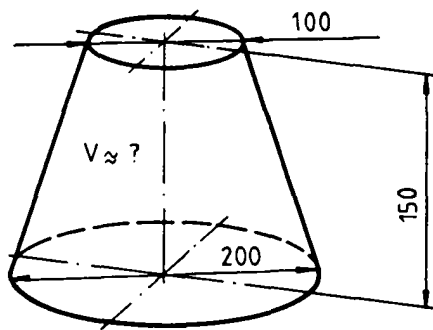
$V \approx \text{[ ] cm}^3$

12



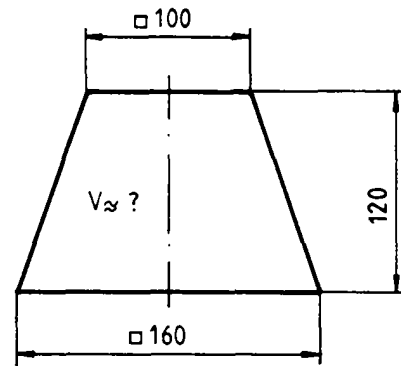
$V \approx \text{[ ] dm}^3$

13



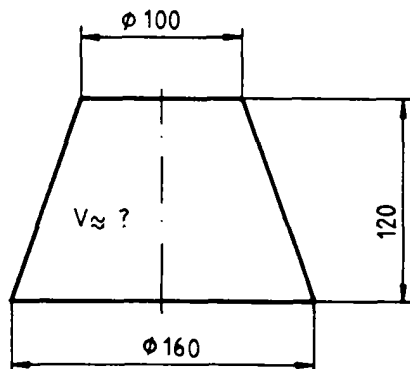
$V \approx \text{[ ] dm}^3$

14



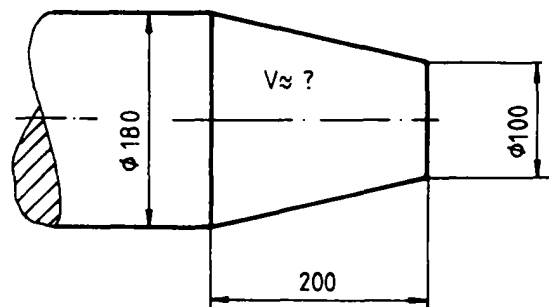
$V \approx \text{[ ] dm}^3$

15

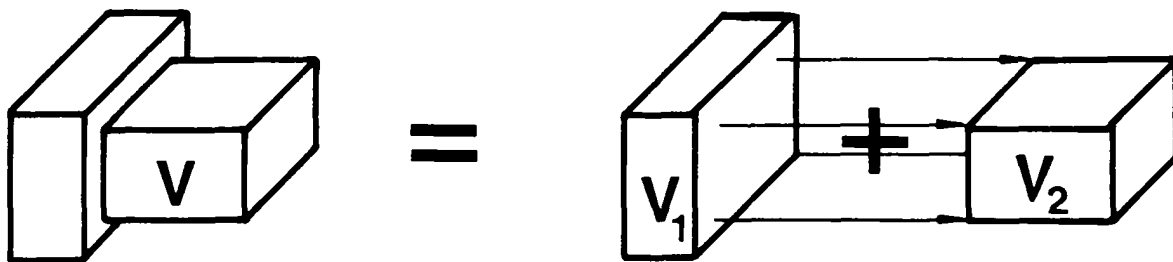


$V \approx \text{[ ] dm}^3$

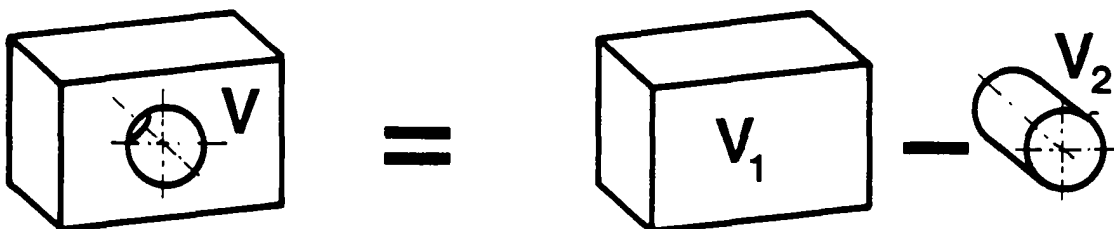
16



$V \approx \text{[ ] dm}^3$

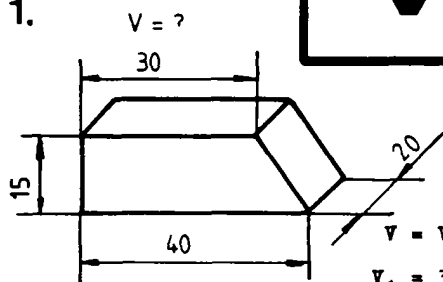


$$V = +$$



$$V = -$$

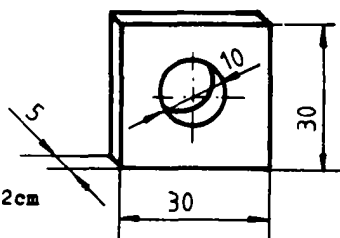
1.



$$\begin{aligned}
 V &= V_1 + V_2 \\
 V_1 &= 3\text{cm} \cdot 1,5\text{cm} \cdot 2\text{cm} \\
 V_1 &= 9\text{cm}^3 \\
 V_2 &= 1,5\text{cm} \cdot 1\text{cm} \cdot 2\text{cm} \cdot \frac{1}{2} \\
 V_2 &= 1,5\text{cm}^3 \\
 V &= 9\text{cm}^3 + 1,5\text{cm}^3 \\
 \underline{V} &= \underline{10,5\text{cm}^3}
 \end{aligned}$$

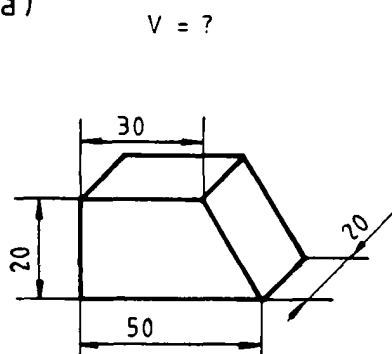
Test:

2.



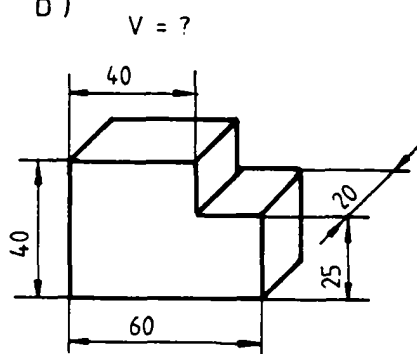
$$\begin{aligned}
 V &= V_1 - V_2 \\
 V_1 &= 0,5\text{cm} \cdot 3\text{cm} \cdot 3\text{cm} \\
 V_1 &= 4,5\text{cm}^3 \\
 V_2 &= \frac{1^2\text{cm}^2 \cdot 3,14 \cdot 0,5}{4} \\
 V_2 &= 0,3925\text{cm}^3 \\
 V &= 4,5\text{cm}^3 - 0,3925\text{cm}^3 \\
 \underline{V} &= \underline{4,1075\text{cm}^3}
 \end{aligned}$$

a)



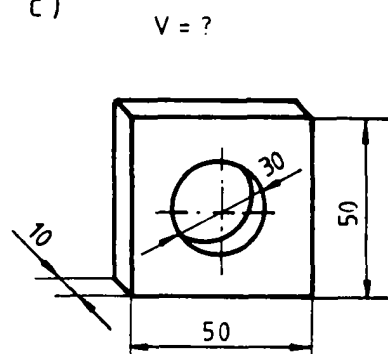
$$V = \boxed{\phantom{000}} \text{ cm}^3$$

b)



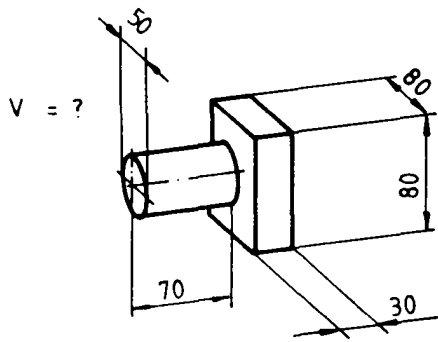
$$V = \boxed{\phantom{000}} \text{ cm}^3$$

c)



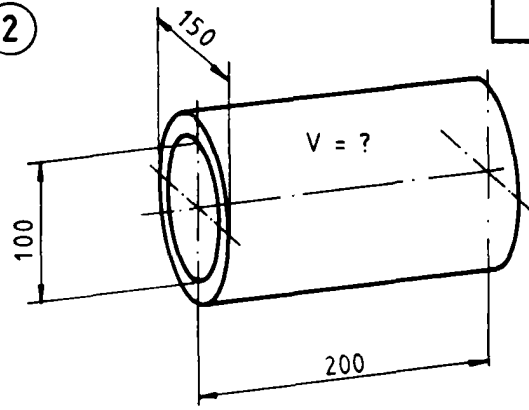
$$V = \boxed{\phantom{000}} \text{ cm}^3$$

1



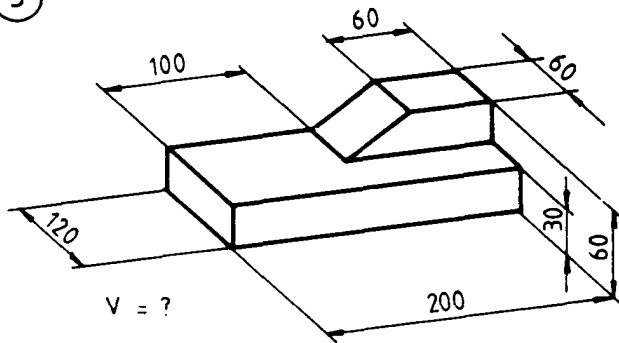
$V = \text{[ ] cm}^3$

2



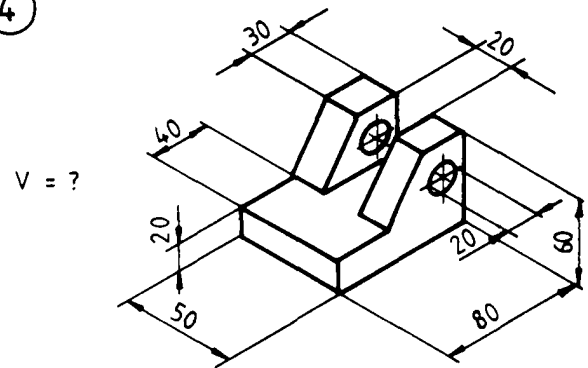
$V = \text{[ ] cm}^3$

3



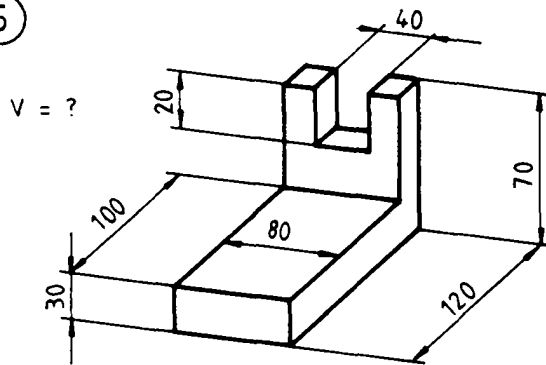
$V = \text{[ ] cm}^3$

4



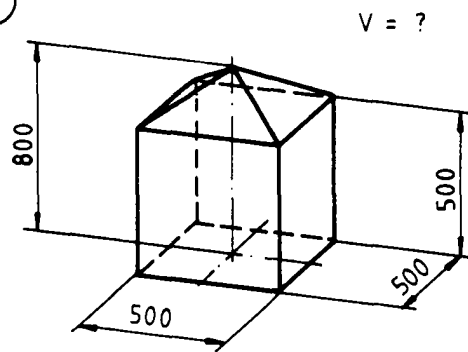
$V = \text{[ ] cm}^3$

5



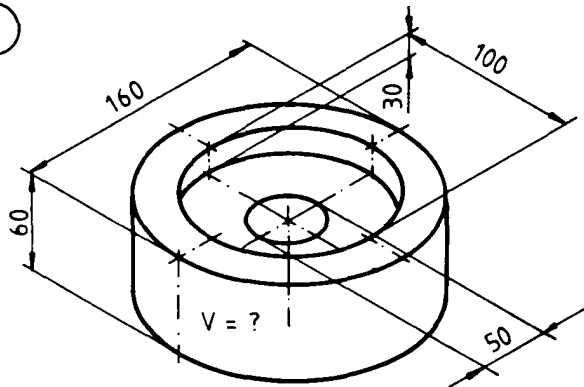
$V = \text{[ ] cm}^3$

6



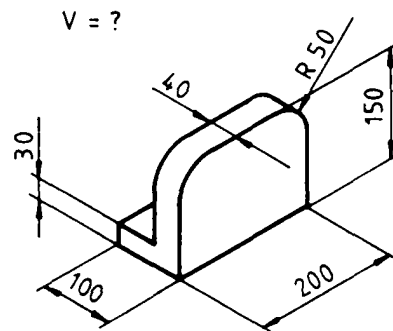
$V = \text{[ ] dm}^3$

7



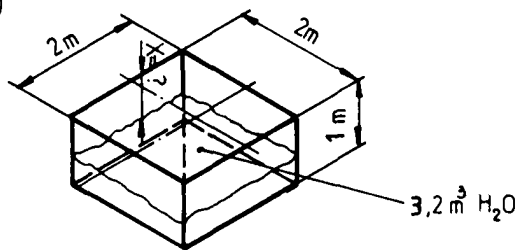
$V = \text{[ ] dm}^3$

8



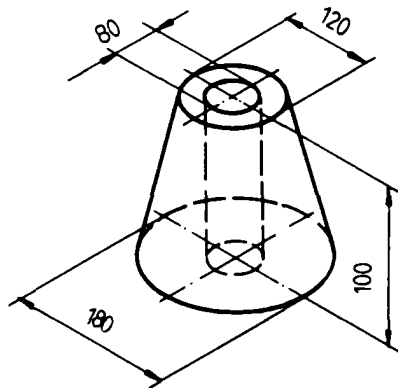
$V = \text{[ ] cm}^3$

9



$X = \text{[ ]} \text{ m}$

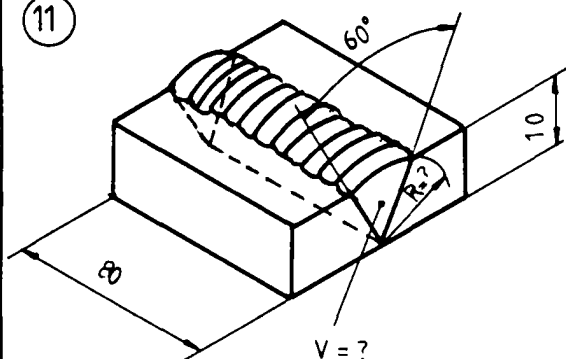
10



$V = ?$

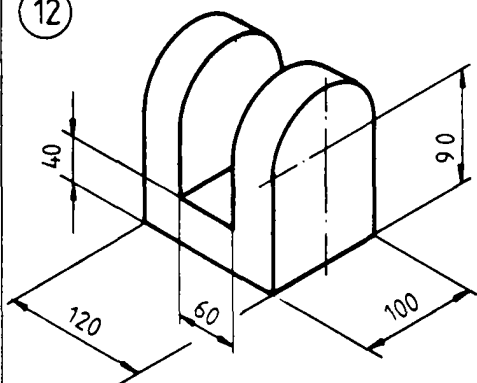
$V = \text{[ ]} \text{ dm}^3$

11



$V = \text{[ ]} \text{ cm}^3 \quad R = \text{[ ]} \text{ cm}$

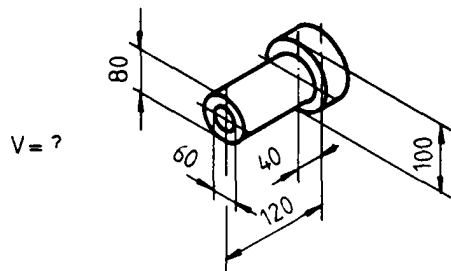
12



$V = ?$

$V = \text{[ ]} \text{ dm}^3$

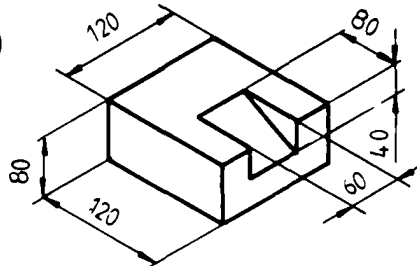
13



$V = ?$

$V = \text{[ ]} \text{ cm}^3$

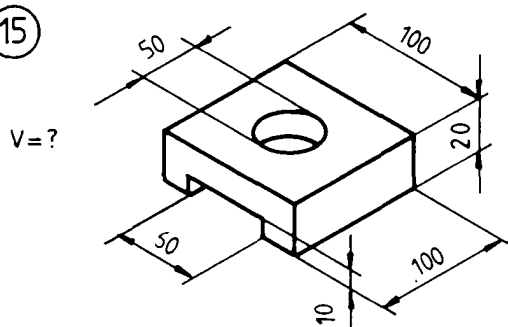
14



$V = ?$

$V = \text{[ ]} \text{ cm}^3$

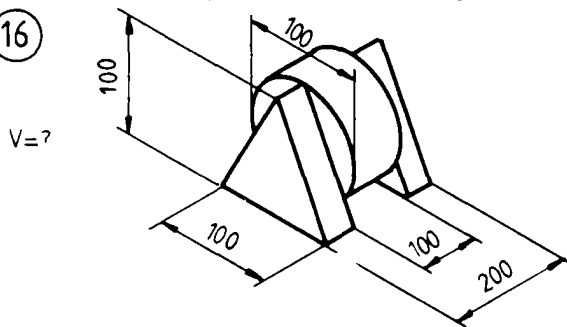
15



$V = ?$

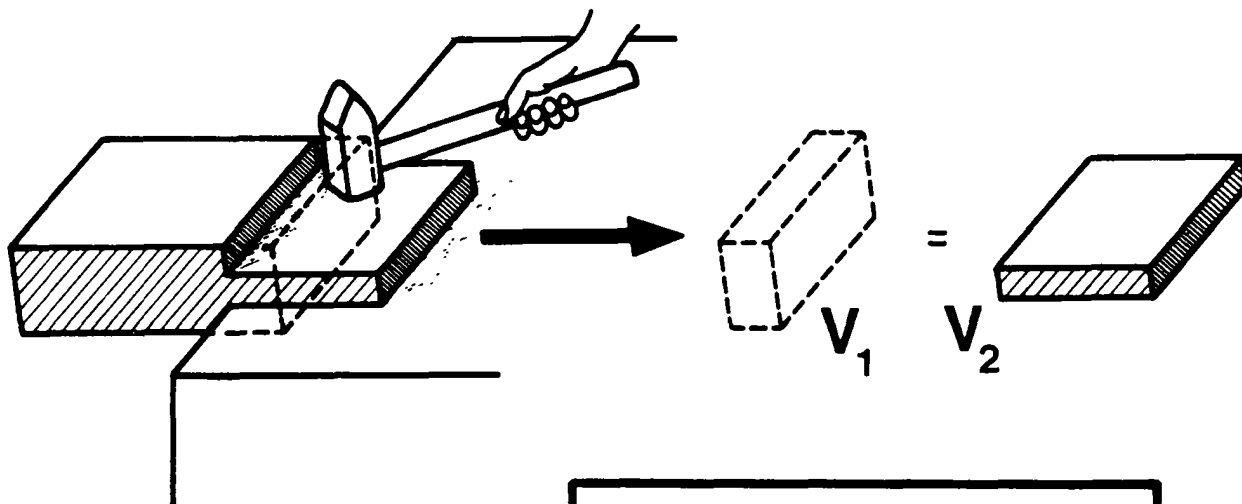
$V = \text{[ ]} \text{ cm}^3$

16



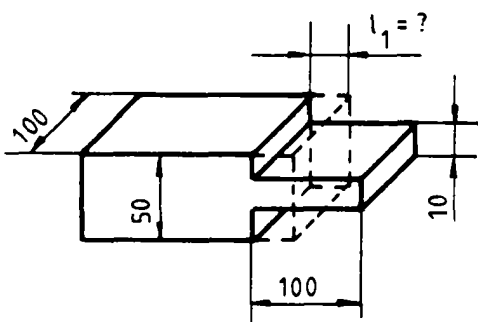
$V = ?$

$V = \text{[ ]} \text{ cm}^3$



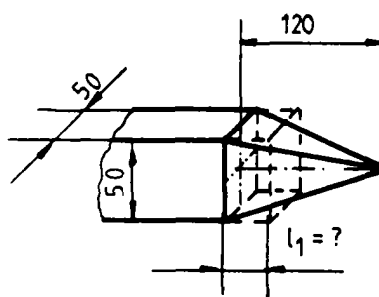
$$V_1 = V_2$$

1.



$$\begin{aligned}
 V_1 &= V_2 \\
 100\text{mm} \cdot 50\text{mm} \cdot l_1 &= 10\text{mm} \cdot 100\text{mm} \cdot 100\text{mm} \\
 l_1 &= \frac{10 \cdot 100\text{mm}}{50} \\
 l_1 &= 20\text{mm}
 \end{aligned}$$

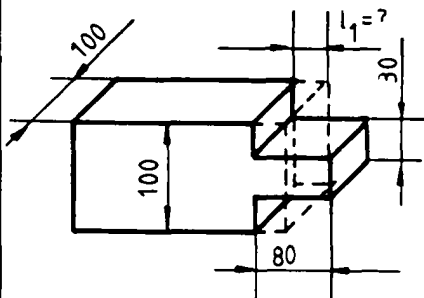
2.



$$\begin{aligned}
 V_1 &= V_2 \\
 50\text{mm} \cdot 50\text{mm} \cdot l_1 &= 50\text{mm} \cdot 50\text{mm} \cdot 120\text{mm} \cdot \frac{1}{3} \\
 l_1 &= 40\text{mm}
 \end{aligned}$$

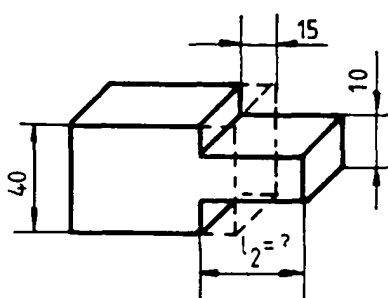
Test:

a)



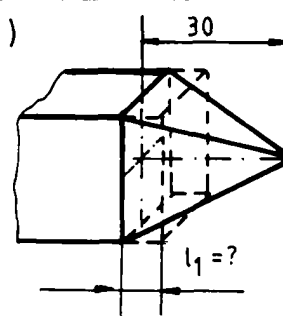
$$l_1 = \boxed{\phantom{000}} \text{ mm}$$

b)



$$l_2 = \boxed{\phantom{000}} \text{ mm}$$

c)



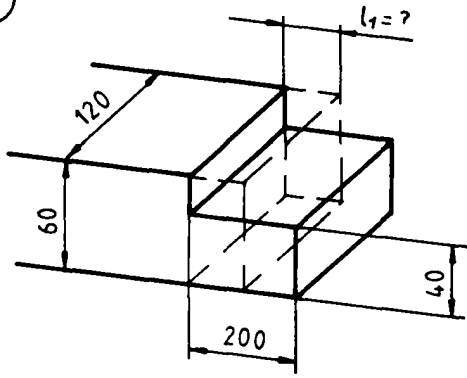
$$l_1 = \boxed{\phantom{000}} \text{ mm}$$

 a)  $l_1 = 10\text{mm}$ 

 b)  $l_2 = 60\text{mm}$ 

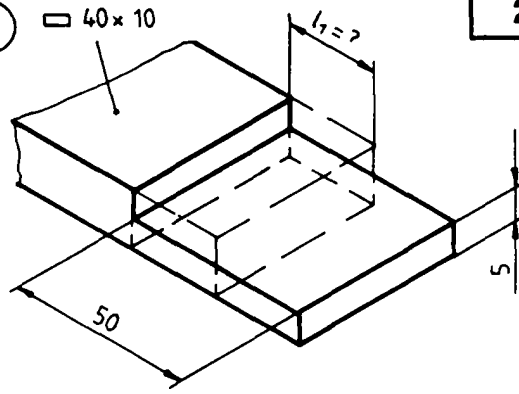
 c)  $l_1 = 24\text{mm}$

1



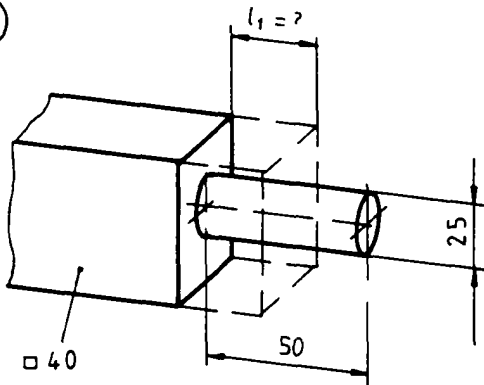
$l_1 = \text{[ ] mm}$

2



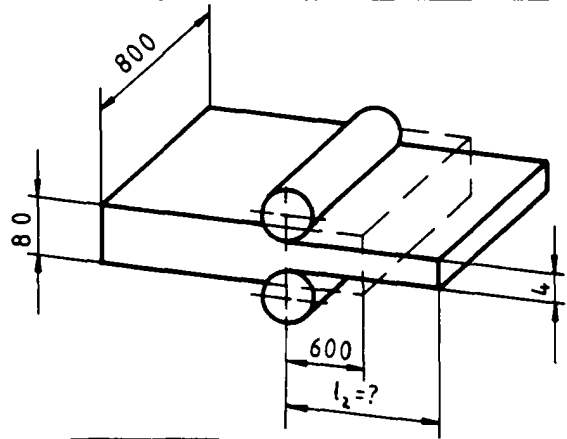
$l_1 = \text{[ ] mm}$

3



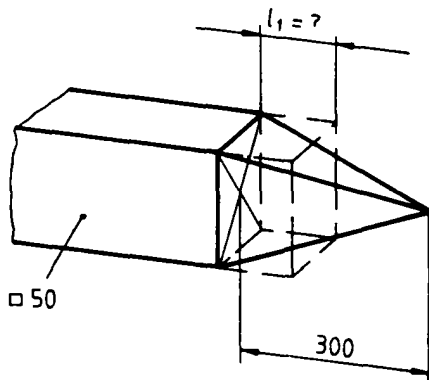
$l_1 = \text{[ ] mm}$

4



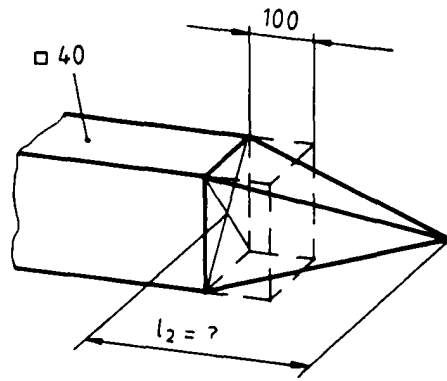
$l_2 = \text{[ ] m}$

5



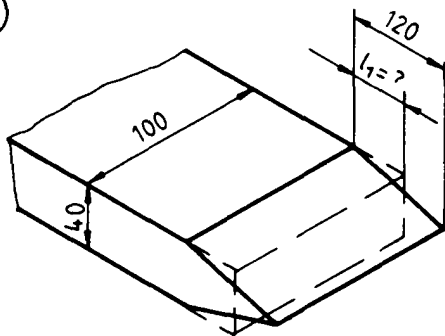
$l_1 = \text{[ ] mm}$

6



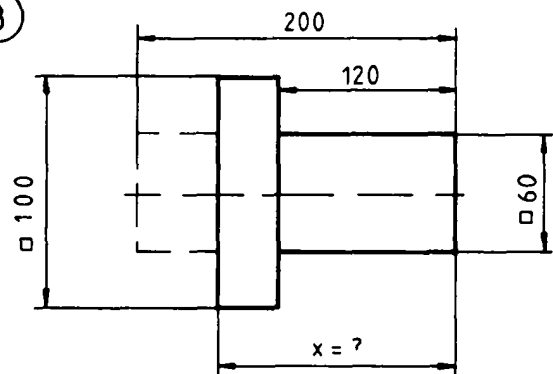
$l_2 = \text{[ ] mm}$

7



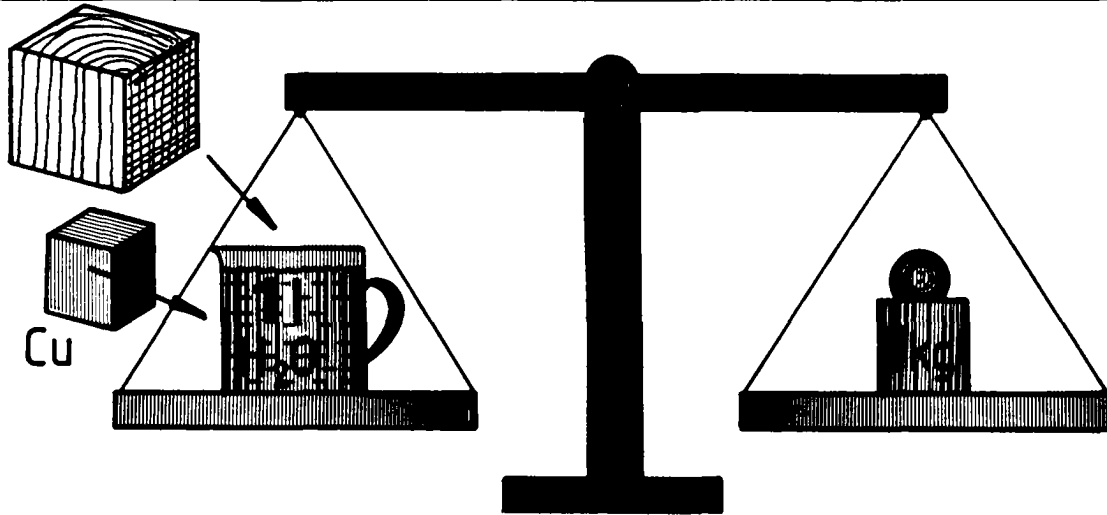
$l_1 = \text{[ ] mm}$

8



$x = \text{[ ] mm}$





$$=$$

$$\rho =$$

$$m = \rho \cdot V$$

$$1 \text{ t} = \quad \text{kg} = \quad \text{g}$$

1.  $m = ?$

$V = 10 \text{ dm}^3$

$\rho = 7,8 \frac{\text{kg}}{\text{dm}^3}$

$m = \rho \cdot V$

$m = 7,8 \frac{\text{kg}}{\text{dm}^3} \cdot 10 \text{ dm}^3$

2.  $m = ?$

$\rho = 2,7 \frac{\text{kg}}{\text{dm}^3}$

$m = \rho \cdot V$

$V = 0,2 \text{ dm} \cdot 2 \text{ dm} \cdot 1,2 \text{ dm}$

$V = 0,48 \text{ dm}^3$

$m = 2,7 \frac{\text{kg}}{\text{dm}^3} \cdot 0,48 \text{ dm}^3$

Test:  $m = 78 \text{ kg}$

$m = 1,296 \text{ kg}$

a)  $m = ?$

$\rho = 2,7 \frac{\text{kg}}{\text{dm}^3}$

(Al)

$V = 10 \text{ dm}^3$

b)  $m = ?$

$\rho = 8,9 \frac{\text{kg}}{\text{dm}^3}$

(Cu)

$V = 3 \text{ dm}^3$

c)  $m = ?$

$\rho = 7,8 \frac{\text{kg}}{\text{dm}^3}$

(St)

$V = 100 \text{ dm}^3$

$$m = \quad \text{kg}$$

$$m = \quad \text{kg}$$

$$m = \quad \text{kg}$$

$$m = \quad \text{t}$$

1

$m = ?$

$\rho = 2,2 \frac{\text{kg}}{\text{dm}^3}$

$m = \text{[ ] kg ; } m = \text{[ ] t$

2

$m = ?$

$\rho = 0,95 \frac{\text{kg}}{\text{dm}^3}$

$m = \text{[ ] kg ; } m = \text{[ ] t$

3

$m = ?$

$\rho = 7,85 \frac{\text{kg}}{\text{dm}^3}$

$m = \text{[ ] kg$

4

$\rho = 2,5 \frac{\text{kg}}{\text{dm}^3}$

2,5 t

$x = ?$

1,2 m

$x = \text{[ ] m$

5

$\rho = 8,96 \frac{\text{kg}}{\text{dm}^3}$

$m = ?$

$m = \text{[ ] kg$

6

$m = ?$

$\phi 400$

H<sub>2</sub>O

$\phi 300$

200

$m = \text{[ ] kg$

7

20 m

$m = ?$

$\rho = 7,8 \frac{\text{kg}}{\text{dm}^3}$

$\phi 2$

$m = \text{[ ] kg$

8

$m = ?$

700

500

300

5

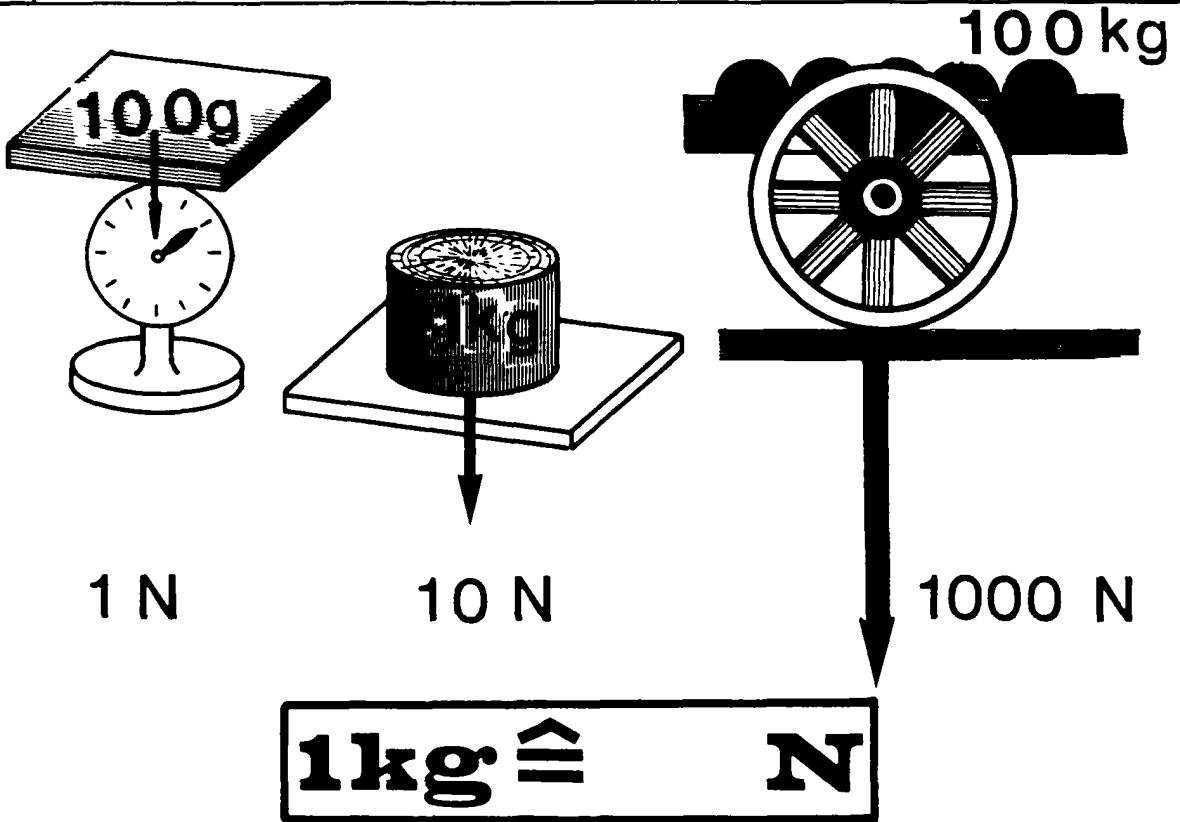
800

300

400

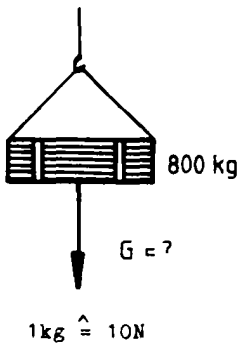
$m = \text{[ ] kg$

$\rho = 7,8 \frac{\text{kg}}{\text{dm}^3}$

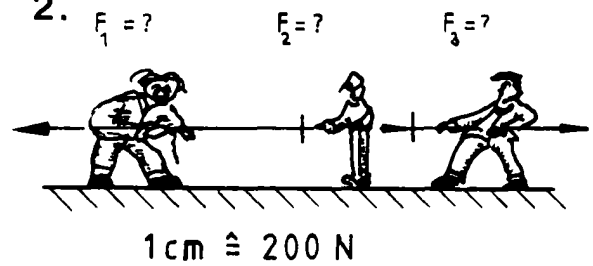


$$1 \text{ kN} = \boxed{\phantom{000}} \text{ daN} = \boxed{\phantom{000}} \text{ N}$$

1.


 Test.  $G = \underline{\underline{8000 \text{ N}}}$ 

2.

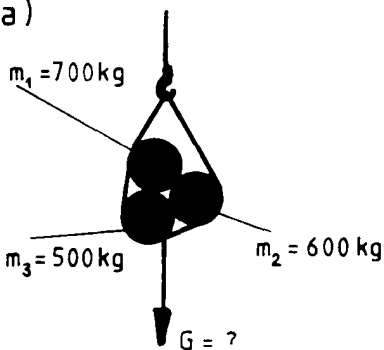


$$\begin{aligned} F_1 &\hat{=} 4 \text{ cm} \\ F_1 &= 4 \cdot 200 \text{ N} \\ F_1 &= 800 \text{ N} \\ \underline{\underline{\phantom{000}}} \end{aligned}$$

$$\begin{aligned} F_2 &\hat{=} 1,5 \text{ cm} \\ F_2 &= 1,5 \cdot 200 \text{ N} \\ F_2 &= 300 \text{ N} \\ \underline{\underline{\phantom{000}}} \end{aligned}$$

$$\begin{aligned} F_3 &= 2,5 \text{ cm} \\ F_3 &= 2,5 \cdot 200 \text{ N} \\ F_3 &= 500 \text{ N} \\ \underline{\underline{\phantom{000}}} \end{aligned}$$

a)

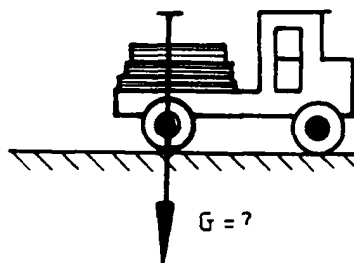


$$G = \boxed{\phantom{000}} \text{ kN}$$

 $1 \text{ kN} = 1000 \text{ N}$ 
 $1 \text{ kg} = 10 \text{ N}$ 

b)

$$1 \text{ cm} \hat{=} 5 \text{ kN}$$



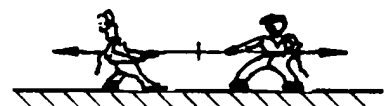
$$G = \boxed{\phantom{000}} \text{ N}$$

 $1 \text{ kN} = 1000 \text{ N}$ 

c)

$$1 \text{ cm} \hat{=} 150 \text{ N}$$

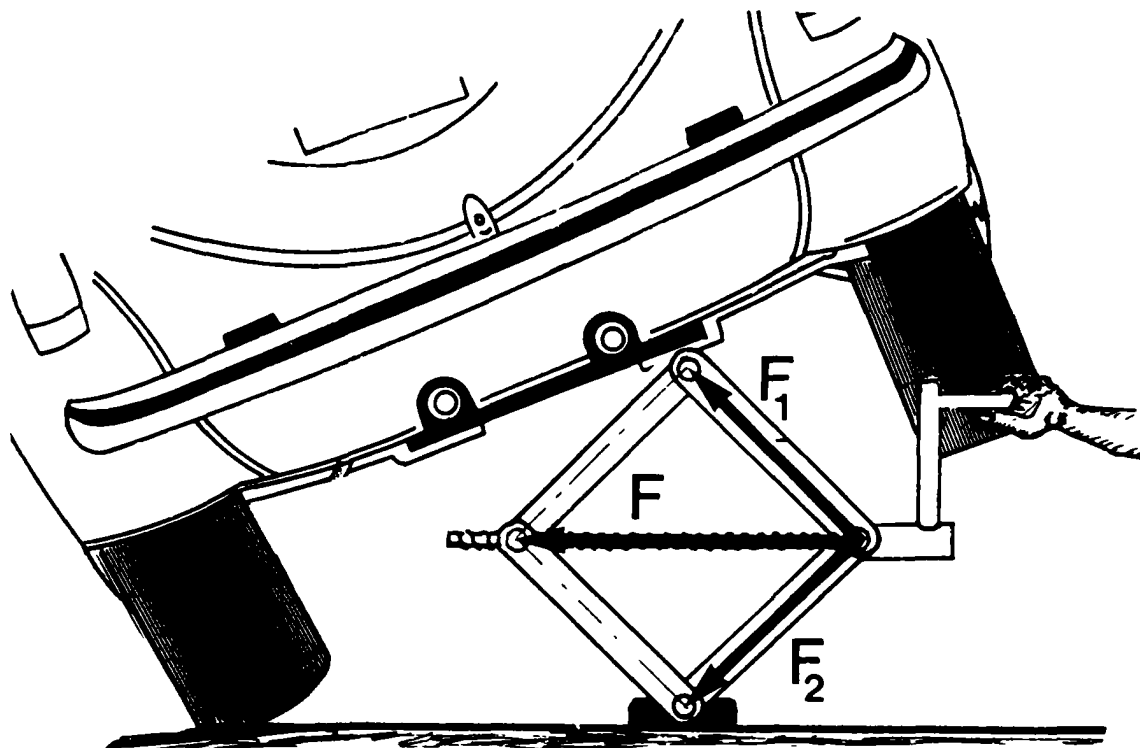
$$F_1 = ? \quad F_2 = ?$$



$$F_1 = \boxed{\phantom{000}} \text{ N}$$

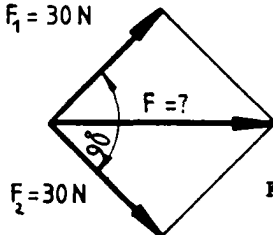
$$F_2 = \boxed{\phantom{000}} \text{ N}$$

 $1 \text{ kN} = 1000 \text{ N}$



$$F^2 = \quad +$$

1.

 $F_1 = 30\text{ N}$ 


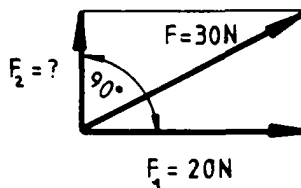
$$F^2 = F_1^2 + F_2^2$$

$$F = \sqrt{F_1^2 + F_2^2}$$

$$F = \sqrt{30^2 + 30^2}$$

$$F = 42,4\text{ N}$$

2.



$$F^2 = F_1^2 + F_2^2$$

$$F_2^2 = F^2 - F_1^2$$

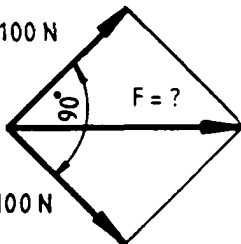
$$F_2 = \sqrt{F^2 - F_1^2}$$

$$F_2 = \sqrt{30^2 - 20^2}$$

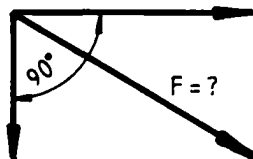
$$F_2 = 22,4\text{ N}$$

Test:

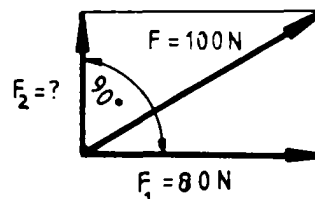
a)

 $F_1 = 100\text{ N}$ 

 $F_2 = 100\text{ N}$ 
 $F = \quad \text{N}$ 
 $\cos 90^\circ = 0$ 

b)

 $F_1 = 40\text{ N}$ 

 $F_2 = 30\text{ N}$ 
 $F = \quad \text{N}$ 
 $\cos 90^\circ = 0$ 

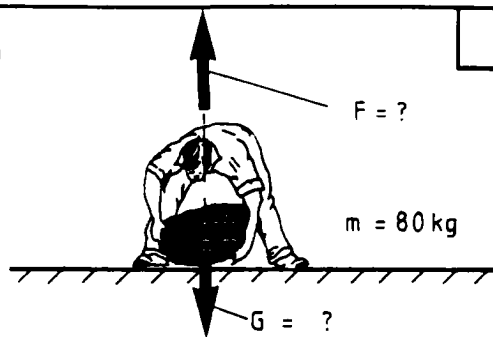
c)


 $F_2 = \quad \text{N}$ 
 $\sin 141^\circ = 1$

1

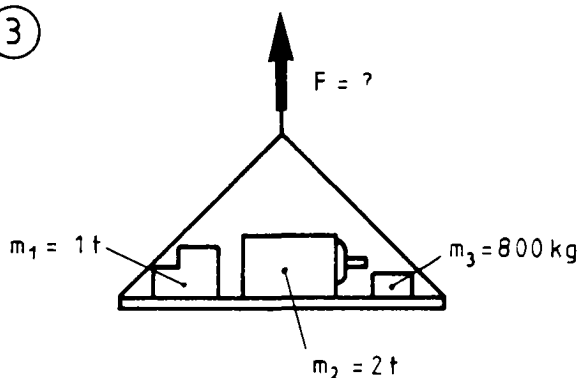
	N	daN	kN
a)	2000		
b)		840	
c)			5,2
d)		225	
e)	4500		

2



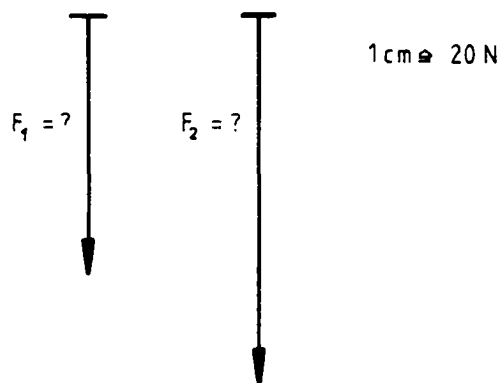
$G = \text{[ ] N ; } F = \text{[ ] N}$

3



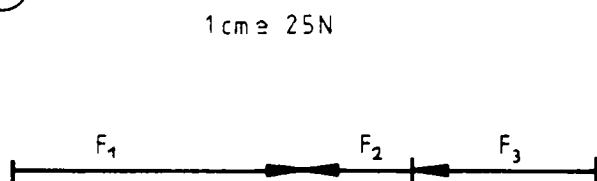
$F = \text{[ ] N}$

4



$F_1 = \text{[ ] N ; } F_2 = \text{[ ] N}$

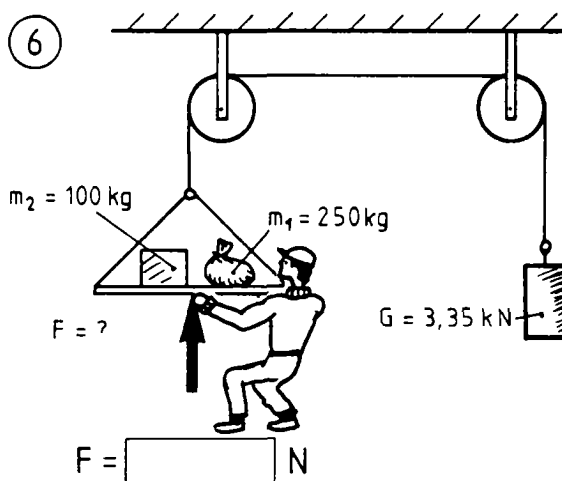
5



$F_1 = \text{[ ] N}$

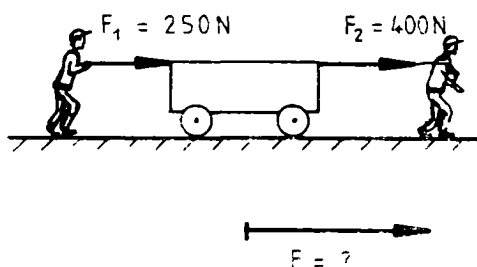
$F_2 = \text{[ ] N , } F_3 = \text{[ ] N}$

6



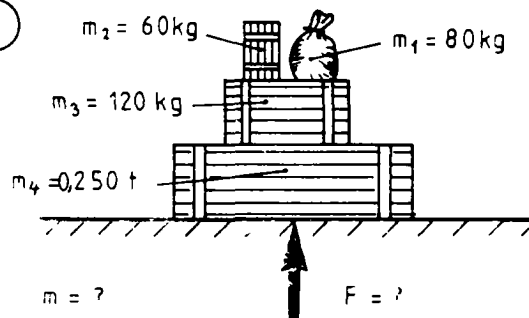
$F = \text{[ ] N}$

7

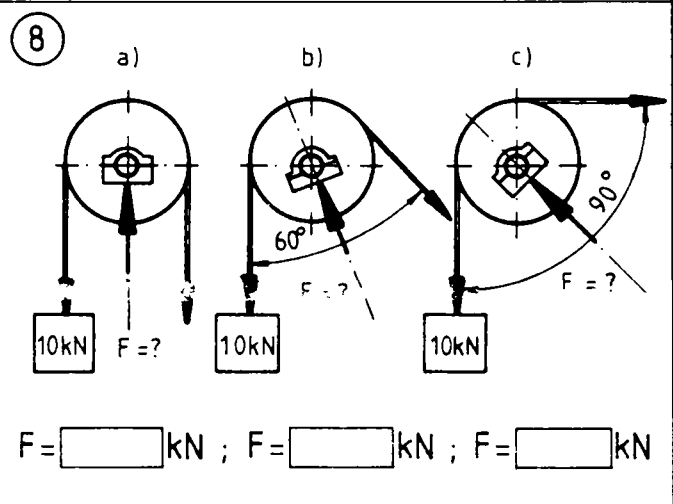
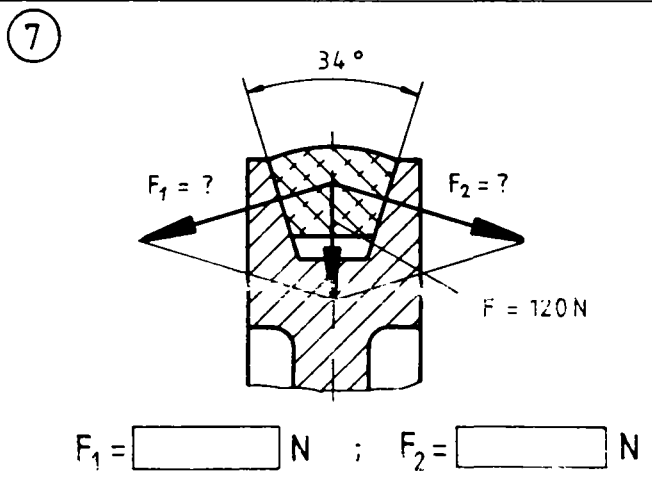
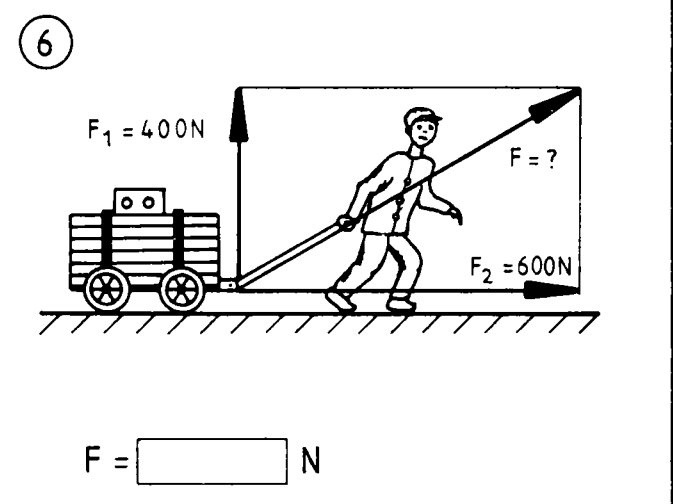
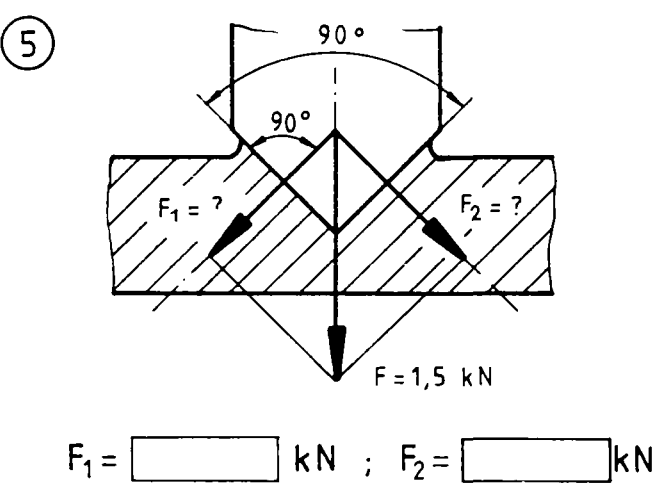
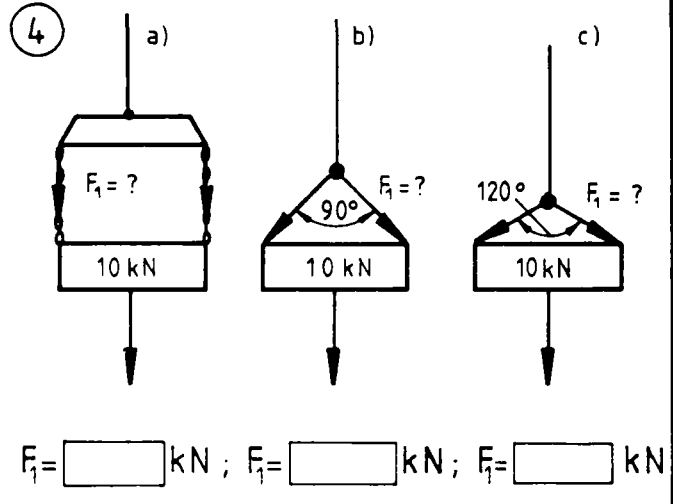
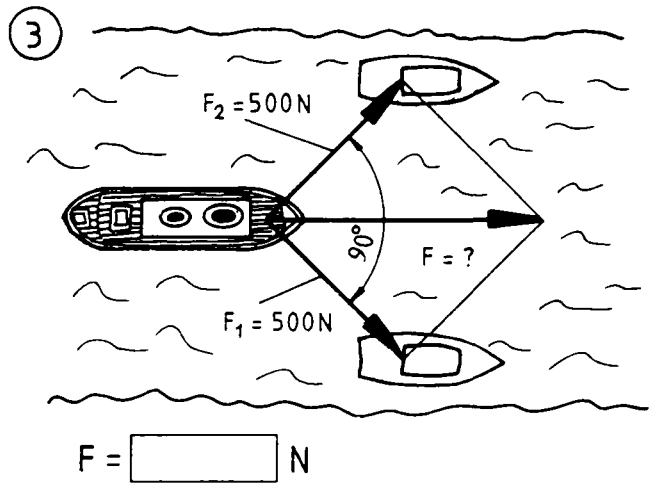
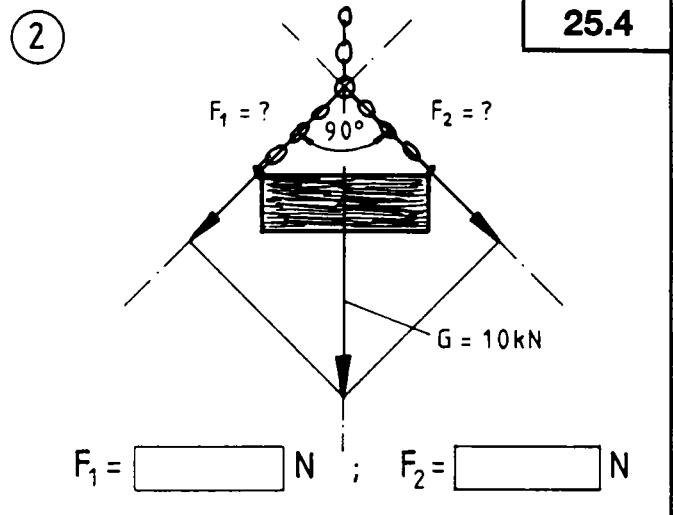
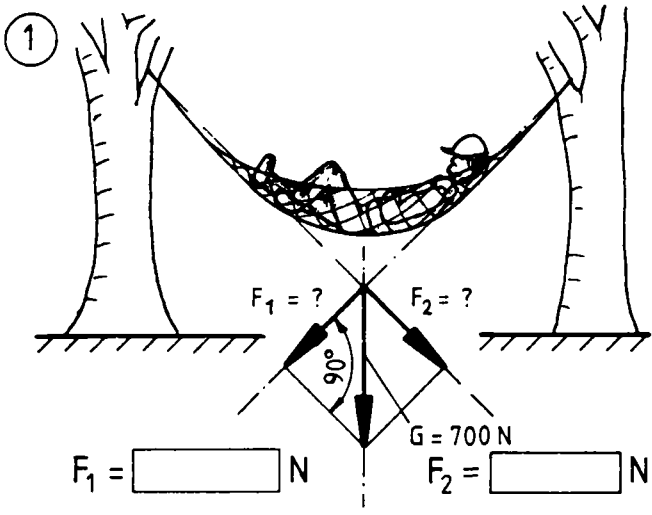


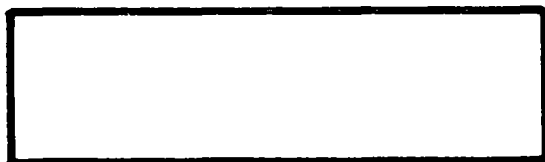
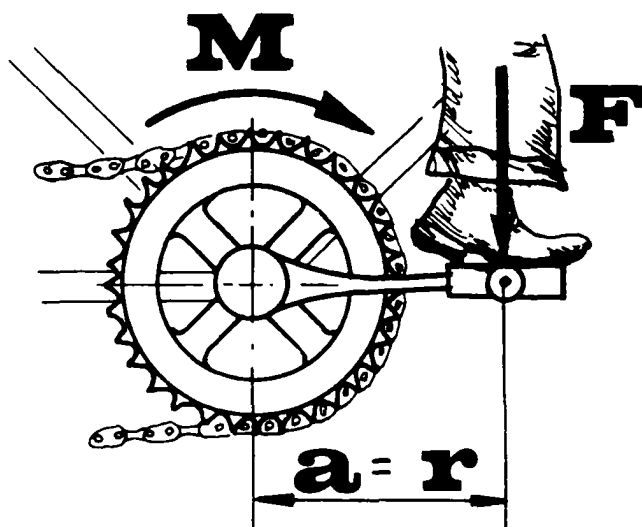
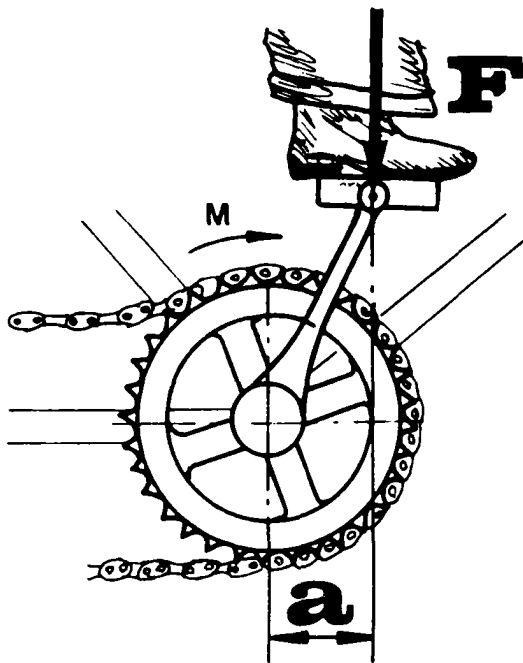
$F = \text{[ ] N}$

8

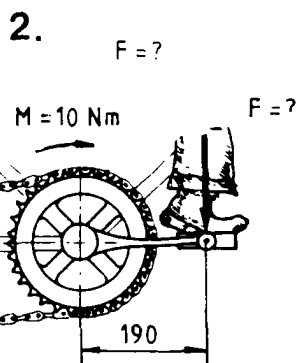
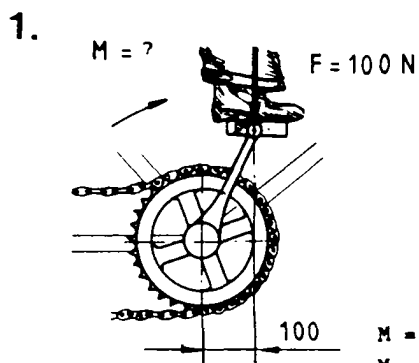


$m = \text{[ ] kg , } F = \text{[ ] kN}$





$$M = \cdot$$



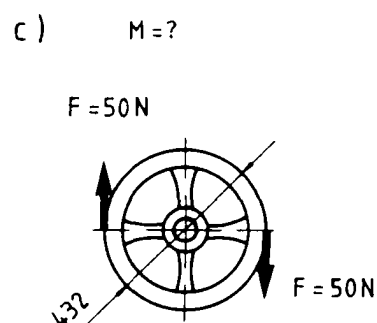
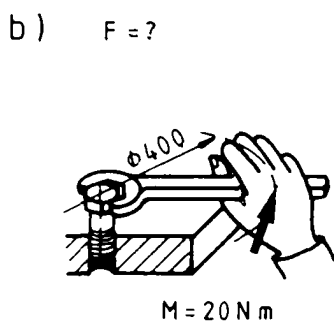
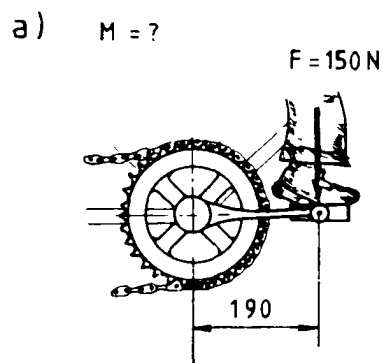
$$M = F \cdot r$$

$$F = \frac{M}{r}$$

$$F = \frac{10 \text{ Nm}}{0,19 \text{ m}}$$

$$F = 52,6 \text{ N}$$

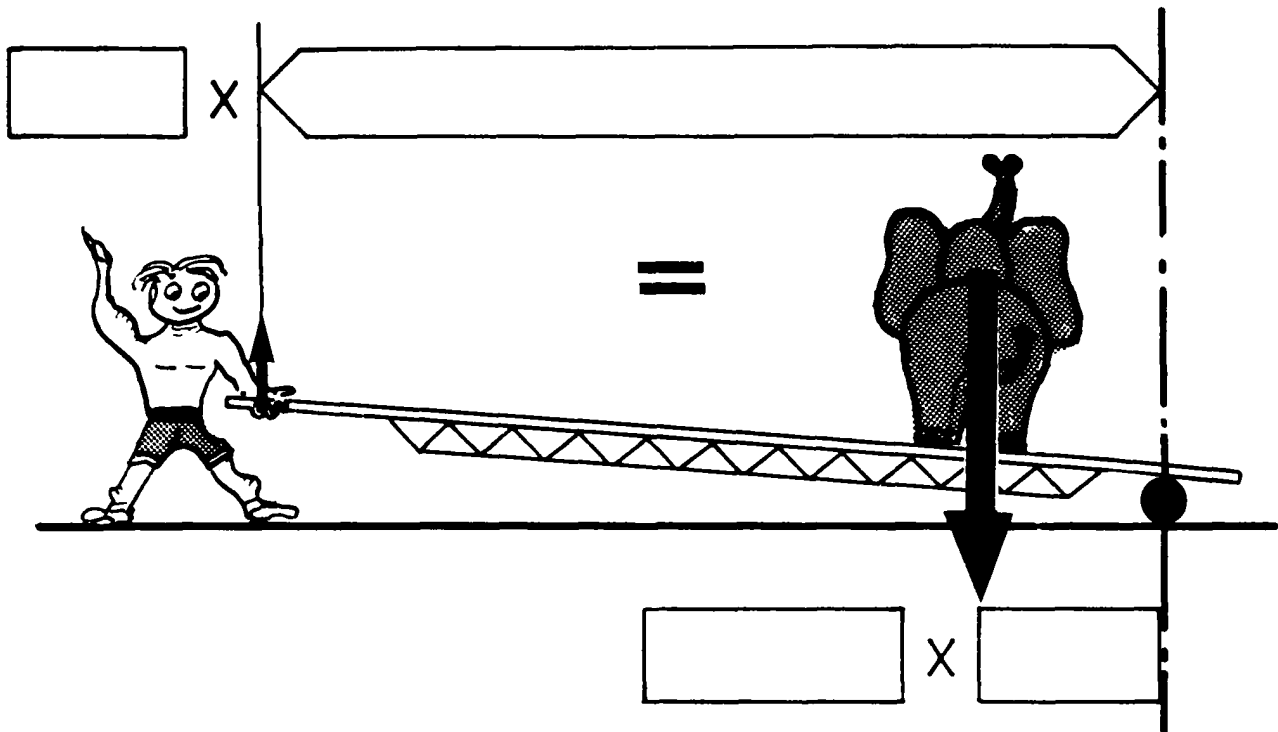
Test:



$M = \text{ } \text{ Nm}$

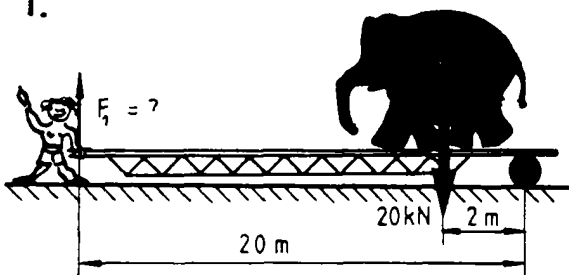
$F = \text{ } \text{ N}$

$M = \text{ } \text{ Nm}$



$$F_1 \cdot l_1 = F_2 \cdot l_2$$

1.

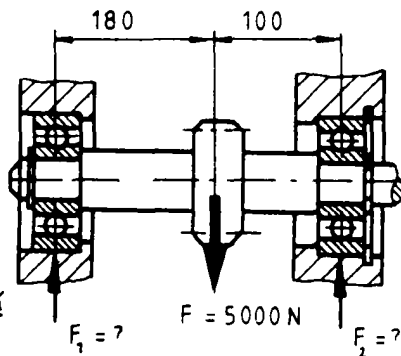


$$F_1 \cdot l_1 = F_2 \cdot l_2$$

$$F_1 = \frac{F_2 \cdot l_2}{l_1}$$

Test

2.



$$F_1 = \frac{20000 \text{ N} \cdot 2 \text{ m}}{20 \text{ m}}$$

$$F_1 = 2000 \text{ N}$$

$$F_1 \cdot l_1 = F \cdot l$$

$$F_1 = \frac{F \cdot l}{l_1}$$

$$F_1 = \frac{5000 \text{ N} \cdot 100 \text{ mm}}{280 \text{ mm}}$$

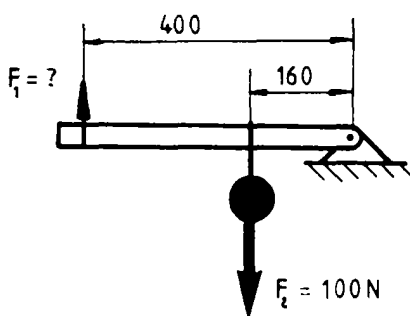
$$F_1 = 1786 \text{ N}$$

$$F_2 = F - F_1$$

$$F_2 = 5000 \text{ N} - 1786 \text{ N}$$

$$F_2 = 3214 \text{ N}$$

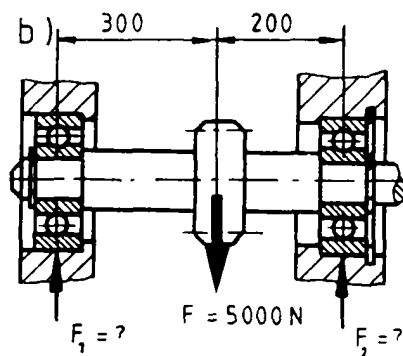
a)



$$= \text{ [ ] } \text{ N}$$

c)  $F_1 = 40 \text{ N}$ ,  $F_2 = 250 \text{ N}$ ,  $F_3 = 150 \text{ N}$

b)

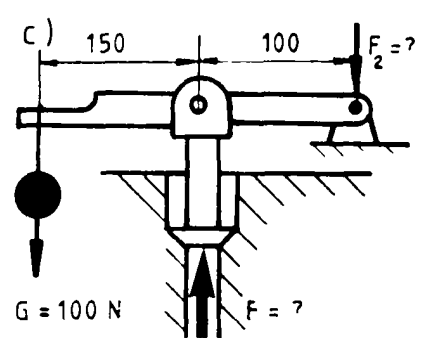


$$F_1 = \text{ [ ] } \text{ N}$$

$$F_2 = \text{ [ ] } \text{ N}$$

b)  $F_1 = 3000 \text{ N}$ ,  $F_2 = 2000 \text{ N}$

c)



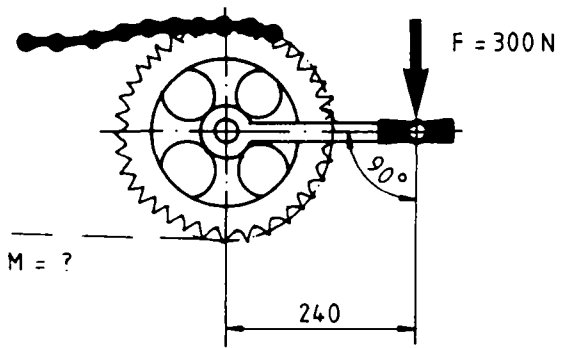
$$F = \text{ [ ] } \text{ N}$$

$$F_2 = \text{ [ ] } \text{ N}$$

a)  $F_1 = 40 \text{ N}$ ,  $F_2 = 250 \text{ N}$ ,  $F_3 = 150 \text{ N}$

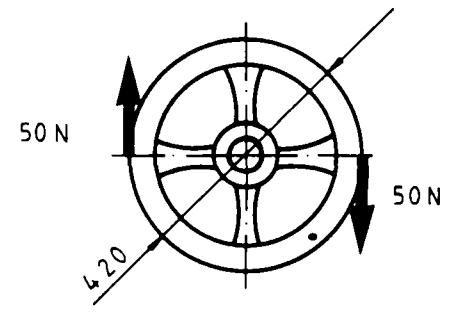


1



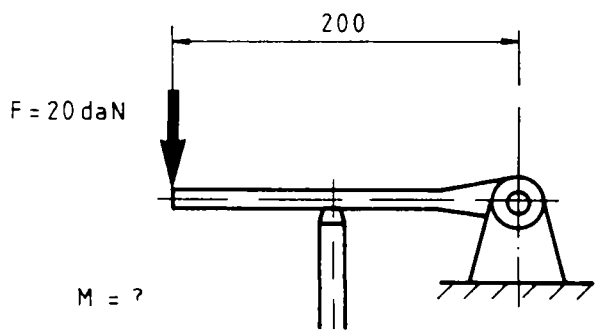
$M = \text{[ ] Nm}$

2



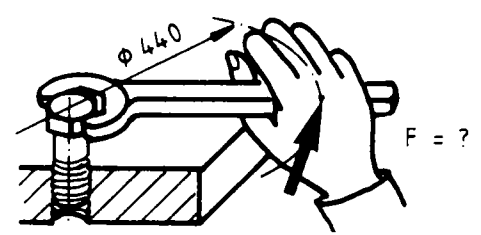
$M = \text{[ ] Nm}$

3



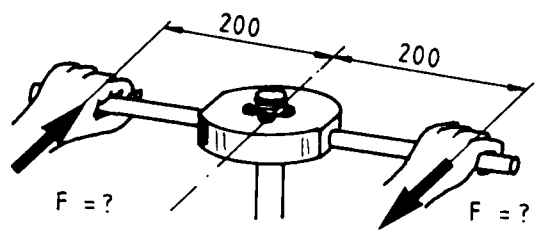
$M = \text{[ ] Nm}$

4



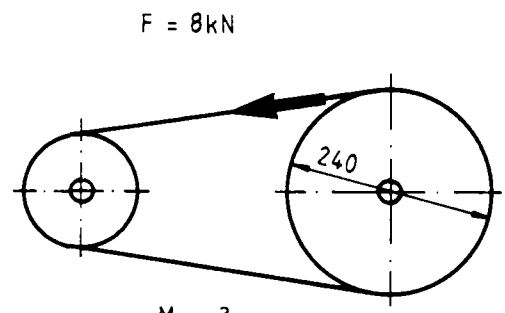
$F = \text{[ ] N}$

5



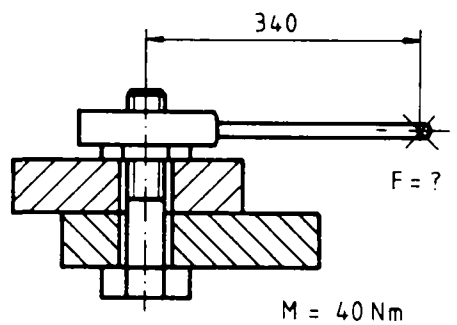
$F = \text{[ ] N}$

6



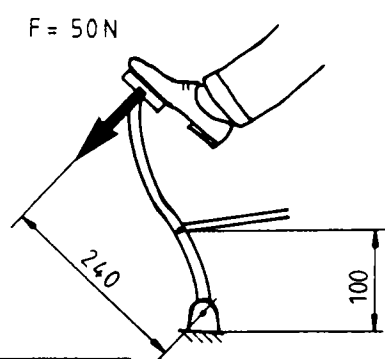
$M = \text{[ ] Nm}$

7



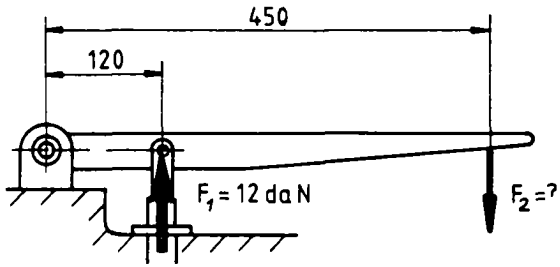
$F = \text{[ ] N}$

8



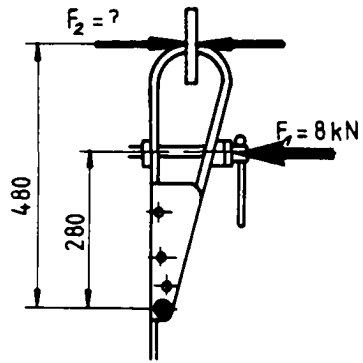
$M = \text{[ ] Nm}$

1



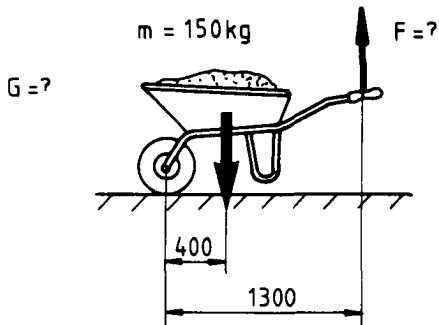
$F_2 = \text{[ ] daN}$

2



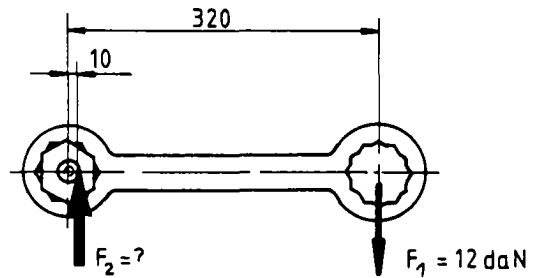
$F_2 = \text{[ ] kN}$

3



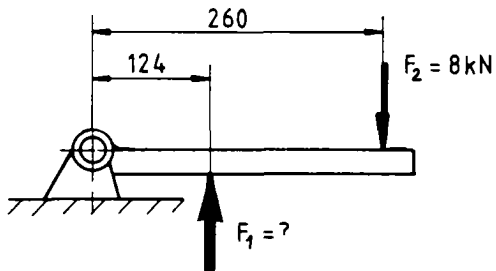
$G = \text{[ ] N; } F = \text{[ ] N}$

4



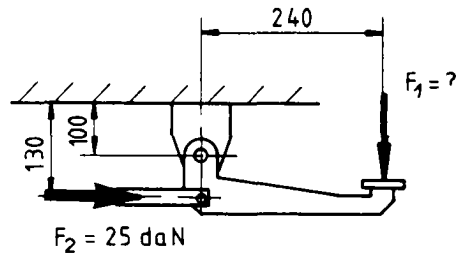
$F_2 = \text{[ ] daN}$

5



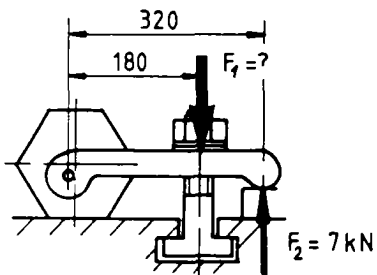
$F_1 = \text{[ ] kN}$

6



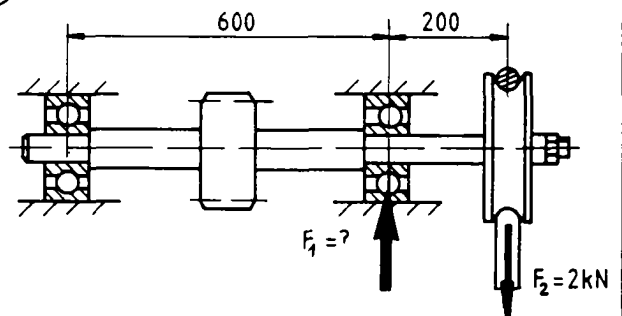
$F_1 = \text{[ ] daN}$

7



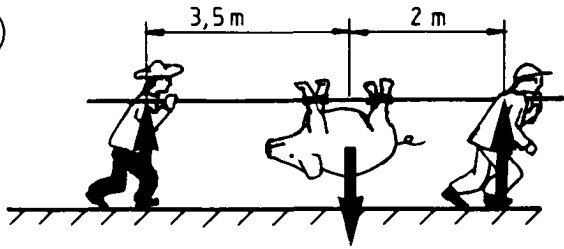
$F_1 = \text{[ ] kN}$

8



$F_1 = \text{[ ] kN}$

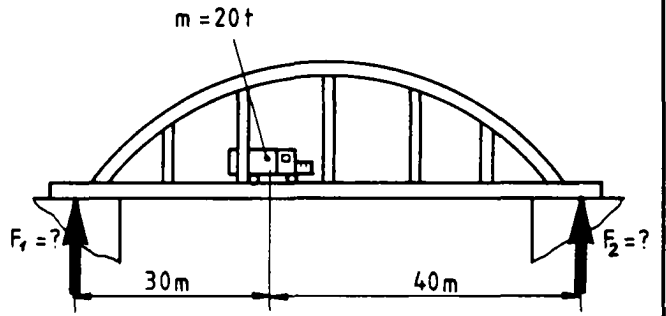
1



$F_1 = ?$        $G = 120 \text{ daN}$        $F_2 = ?$

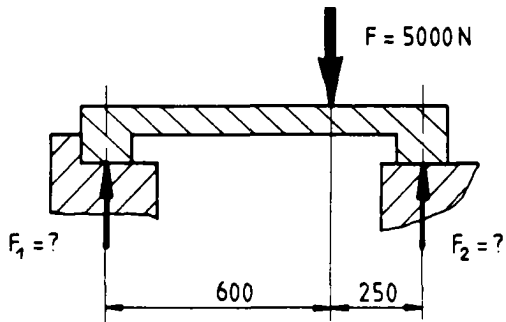
$F_1 = \boxed{\phantom{000}} \text{ daN}; F_2 = \boxed{\phantom{000}} \text{ daN}$

2



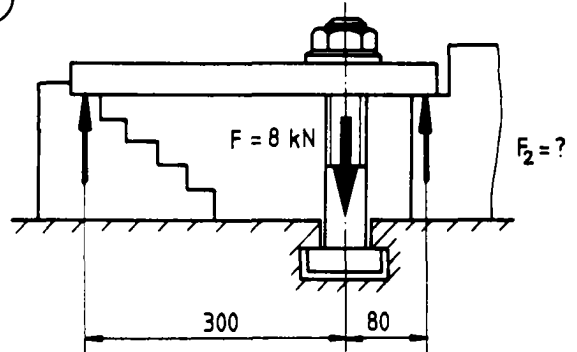
$F_1 = \boxed{\phantom{000}} \text{ kN}; F_2 = \boxed{\phantom{000}} \text{ kN}$

3



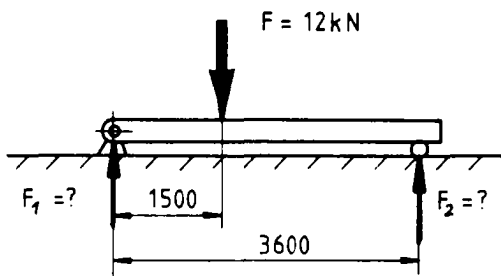
$F_1 = \boxed{\phantom{000}} \text{ N}; F_2 = \boxed{\phantom{000}} \text{ N}$

4



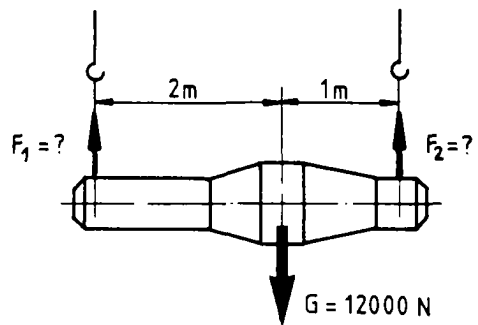
$F_2 = \boxed{\phantom{000}} \text{ N}$

5



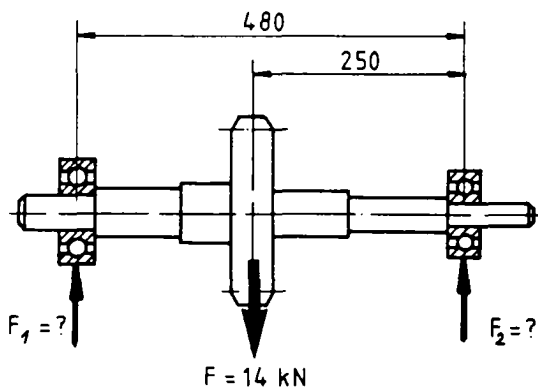
$F_1 = \boxed{\phantom{000}} \text{ N}; F_2 = \boxed{\phantom{000}} \text{ N}$

6



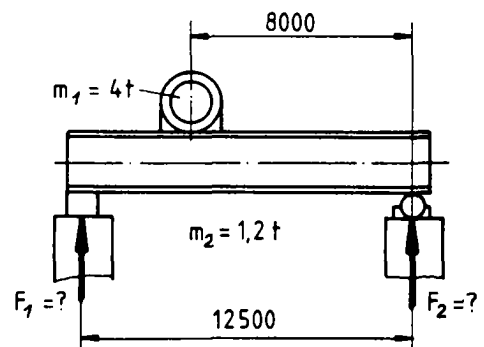
$F_1 = \boxed{\phantom{000}} \text{ N}; F_2 = \boxed{\phantom{000}} \text{ N}$

7

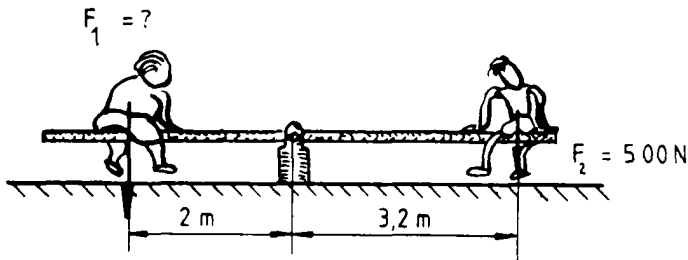
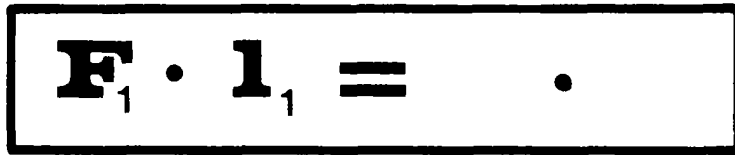
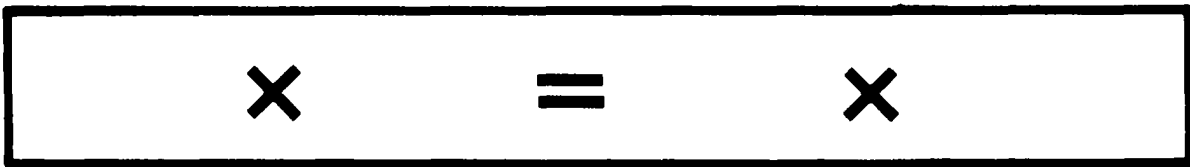
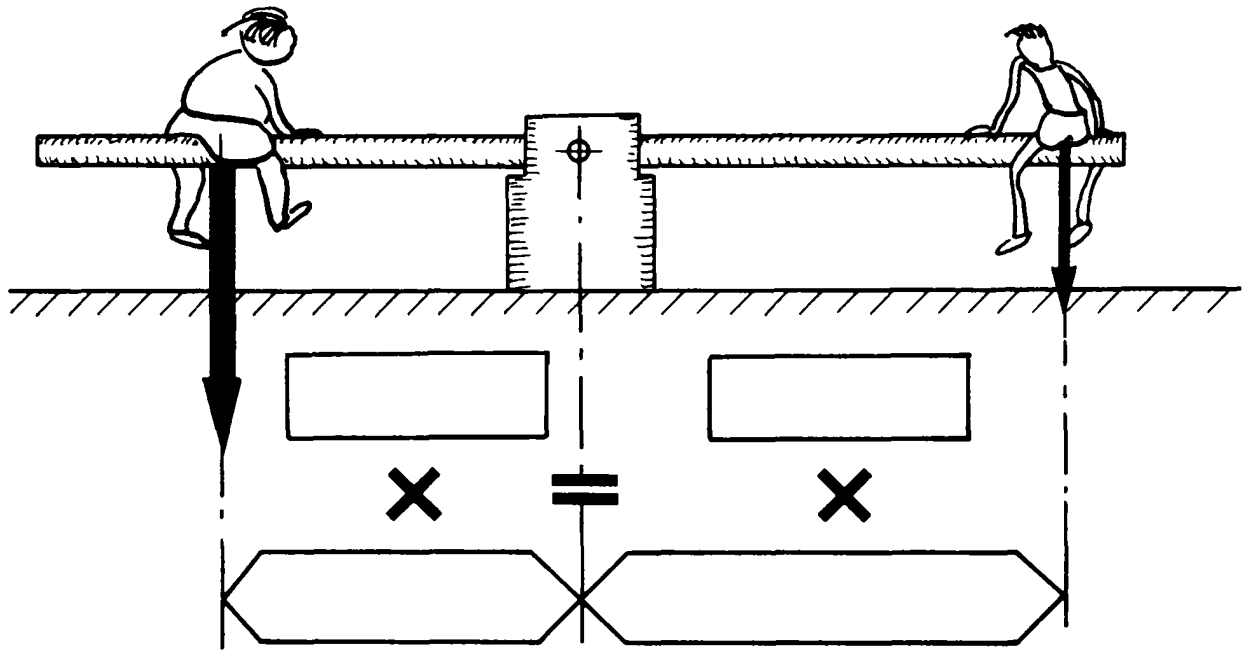


$F_1 = \boxed{\phantom{000}} \text{ N}; F_2 = \boxed{\phantom{000}} \text{ N}$

8



$F_1 = \boxed{\phantom{000}} \text{ kN}; F_2 = \boxed{\phantom{000}} \text{ kN}$



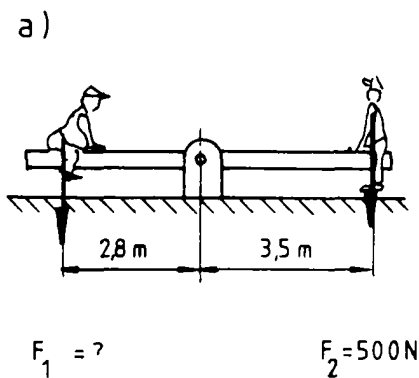
$$F_1 \cdot 2\text{m} = F_2 \cdot 3,2\text{m}$$

$$F_1 = \frac{F_2 \cdot 3,2\text{m}}{2\text{m}}$$

$$F_1 = \frac{500\text{N} \cdot 3,2}{2}$$

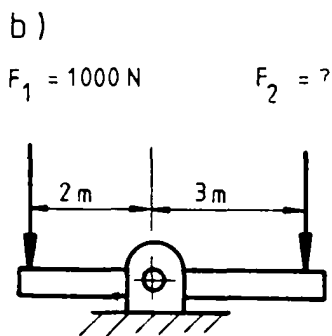
$$F_1 = 800\text{N}$$

Test :



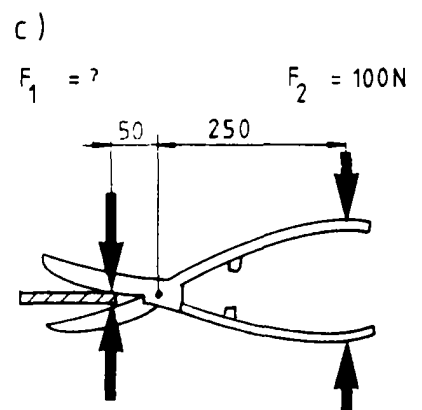
$F_1 =$   N

NOOS =  $l_a$  (c)



$F_2 =$   N

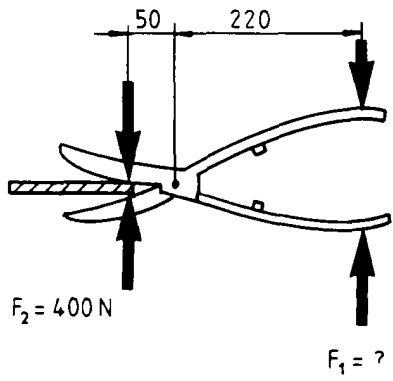
N L99 =  $z_a$  (q)



$F_1 =$   N

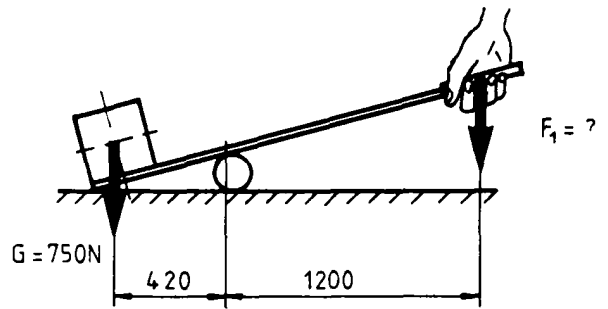
NO09 =  $l_a$  (p)

1



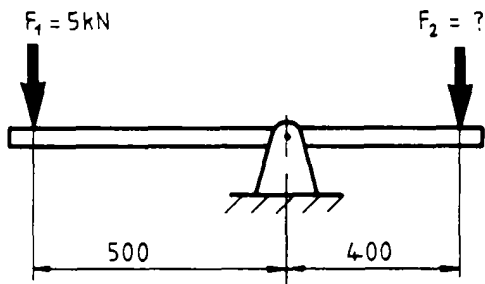
$F_1 = \text{[ ]} \text{ N}$

2



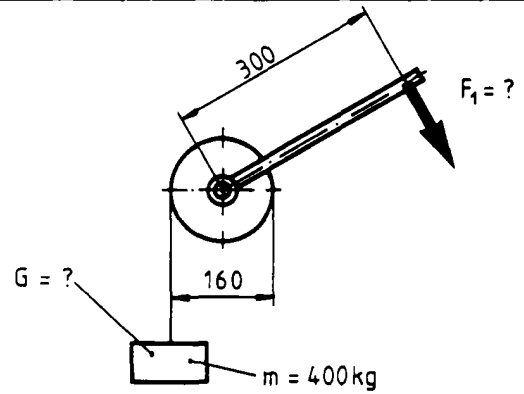
$F_1 = \text{[ ]} \text{ N}$

3



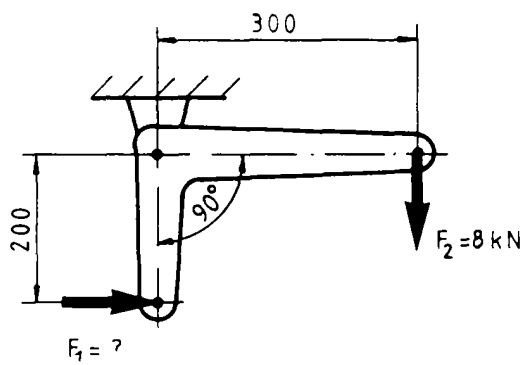
$F_2 = \text{[ ]} \text{ kN}$

4



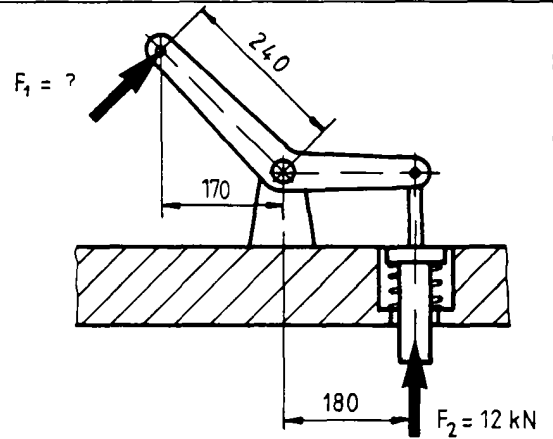
$G = \text{[ ]} \text{ N} ; F_1 = \text{[ ]} \text{ N}$

5



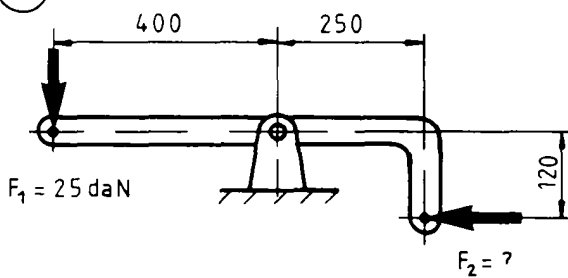
$F_1 = \text{[ ]} \text{ kN}$

6



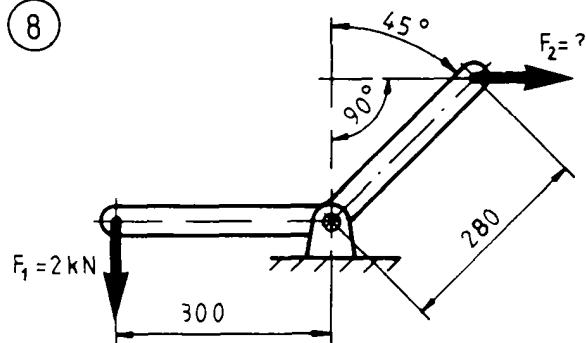
$F_1 = \text{[ ]} \text{ kN}$

7

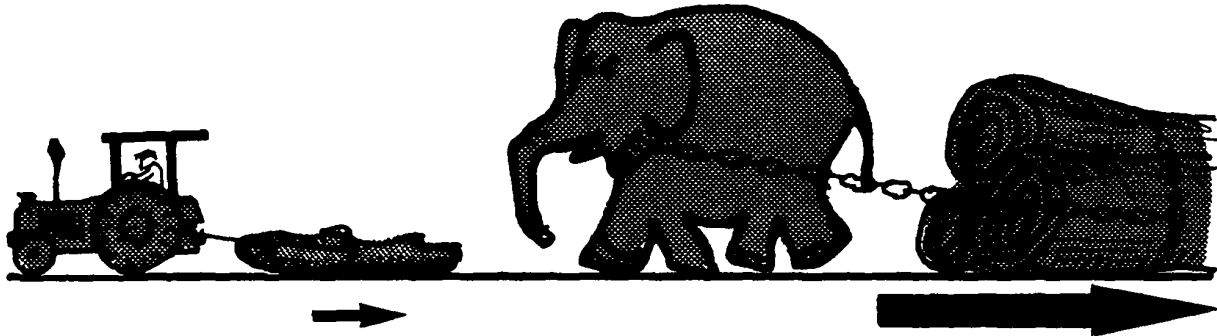


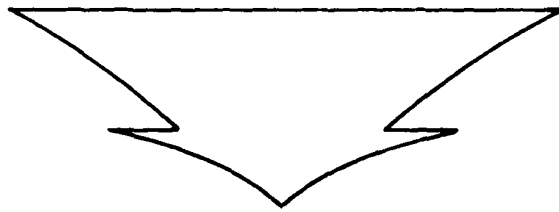
$F_2 = \text{[ ]} \text{ daN}$

8



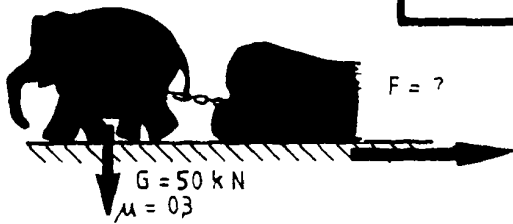
$F_2 = \text{[ ]} \text{ kN}$



$F \sim G$

**F = .**



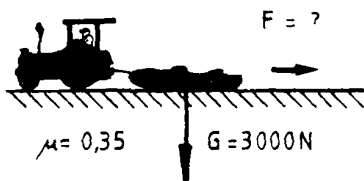
$$F = \mu \cdot G$$

$$F = 0,3 \cdot 2000N$$

$$F = 600N$$

Test

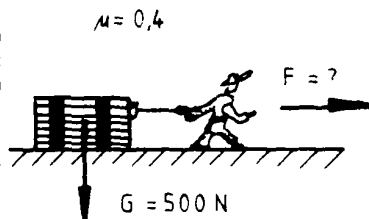
a)



F =  N

$\mu = 0,05$

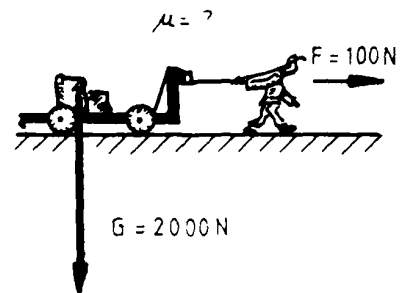
b)



F =  N

$\mu = 200N$

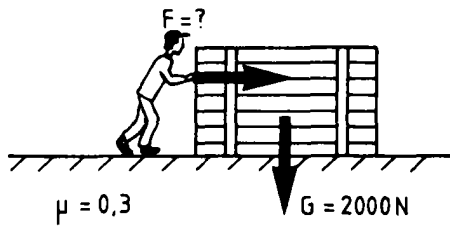
c)



$\mu =$

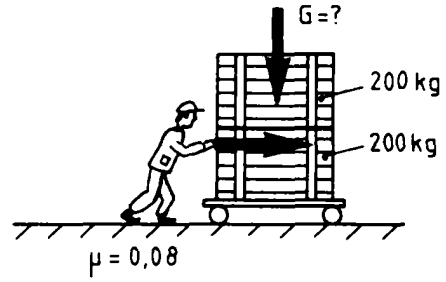
$F = 1050N$

1



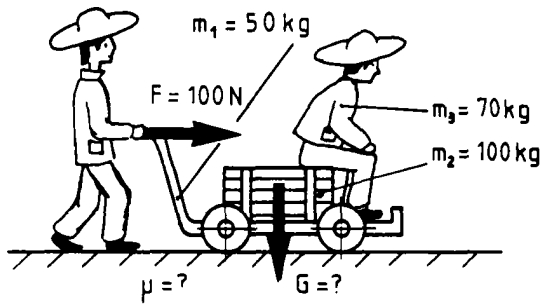
$F = \text{[ ] N}$

2



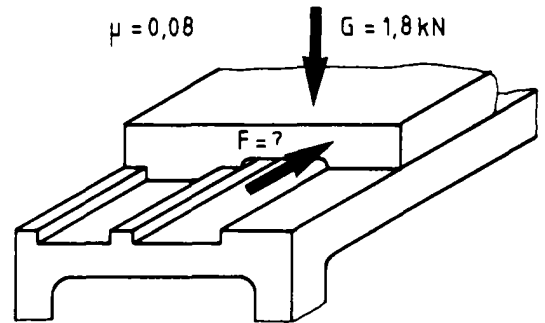
$G = \text{[ ] N}; F = \text{[ ] N}$

3



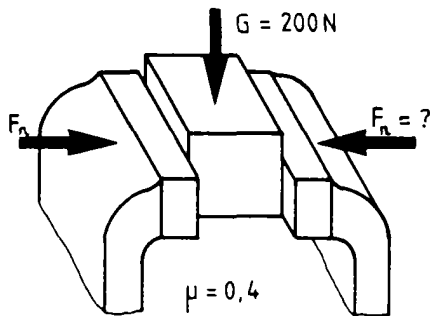
$G = \text{[ ] N}; \mu = \text{[ ]}$

4



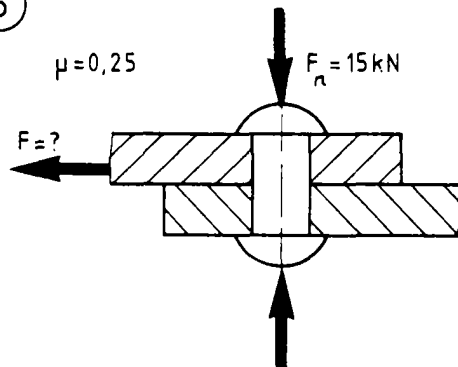
$F = \text{[ ] kN}$

5



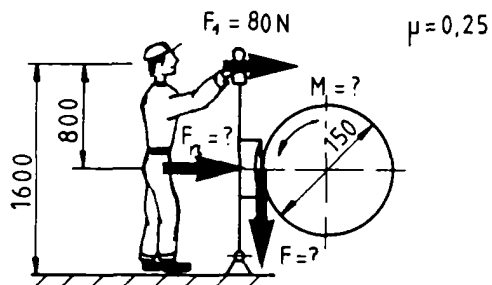
$F_n = \text{[ ] N}$

6



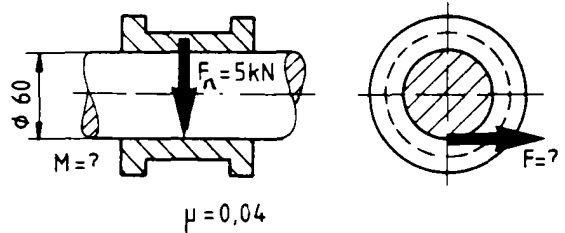
$F = \text{[ ] kN}$

7

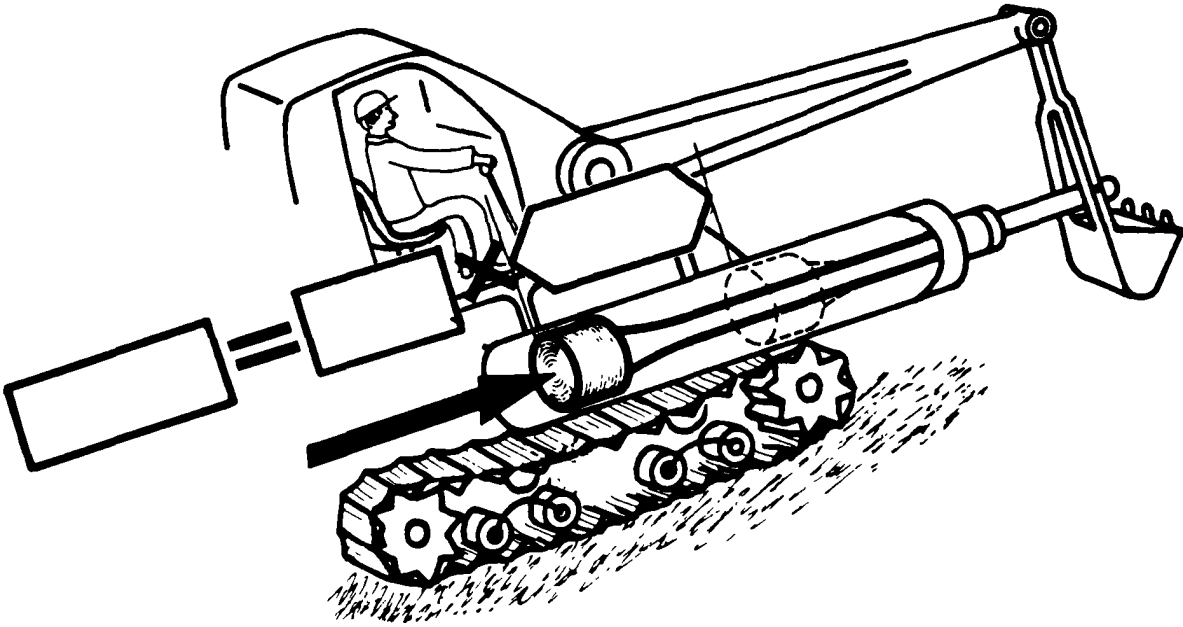


$F_n = \text{[ ] N}$   
 $F = \text{[ ] N}; M = \text{[ ] Nm}$

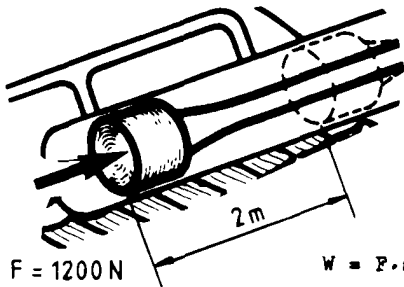
8



$F = \text{[ ] kN}; M = \text{[ ] Nm}$

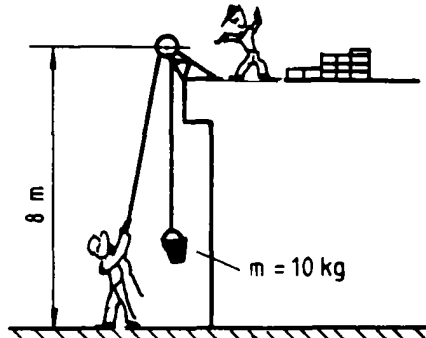


1.

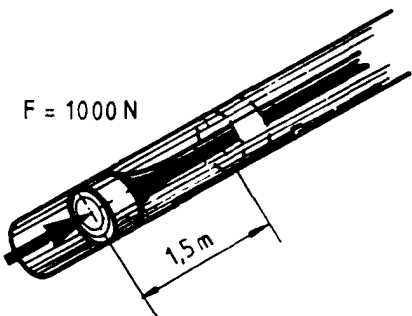
 $W = ?$ 

 $F = 1200 \text{ N}$ 
 $W = F \cdot s$ 
 $W = 1200 \text{ N} \cdot 2 \text{ m}$ 
 ~~$W = 2400 \text{ Nm} = 2400 \text{ J}$~~ 

Test:

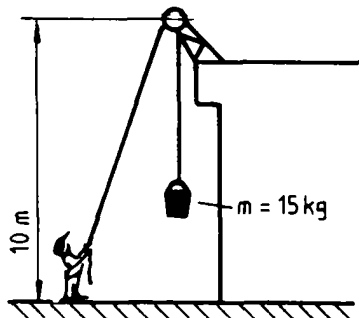
2.

 $W = ?$ 

 $m = 10 \text{ kg}$ 
 $W = G \cdot h$ 
 $W = 100 \text{ N} \cdot 8 \text{ m}$ 
 ~~$W = 800 \text{ J}$~~ 

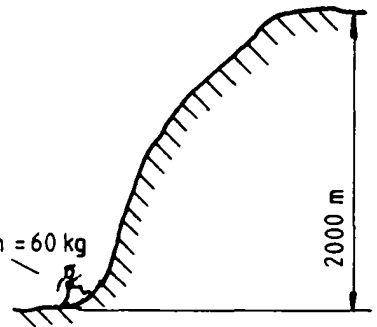
a)

 $W = ?$ 
 $F = 1000 \text{ N}$ 

 $W = \boxed{\phantom{00000}} \text{ J}$ 
 $(c) W = 1200 \text{ J}$ 

b)

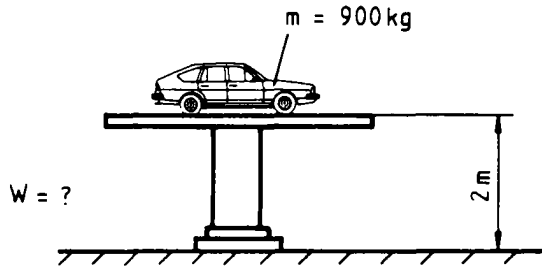
 $W = ?$ 

 $m = 15 \text{ kg}$ 
 $10 \text{ m}$ 
 $W = \boxed{\phantom{00000}} \text{ J}$ 
 $(b) W = 1500 \text{ J}$ 

c)

 $W = ?$ 
 $m = 60 \text{ kg}$ 

 $2000 \text{ m}$ 
 $W = \boxed{\phantom{00000}} \text{ kJ}$ 
 $(a) W = 1500 \text{ kJ}$

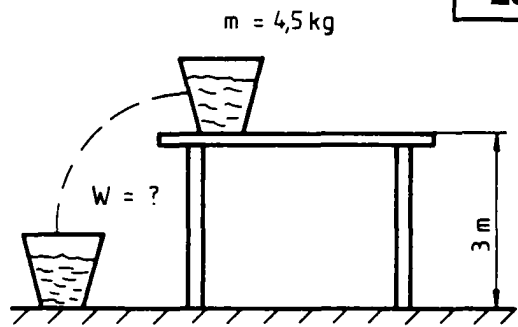


1



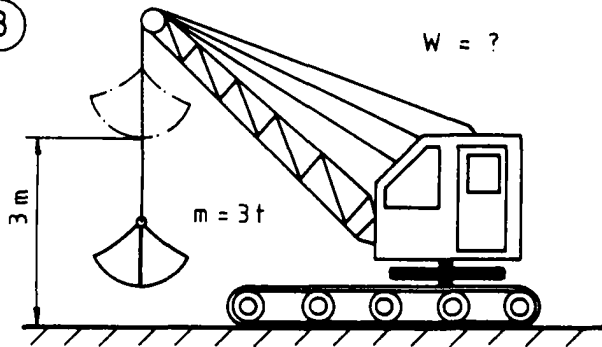
$W = \boxed{\phantom{00000}} \text{ J}$

2



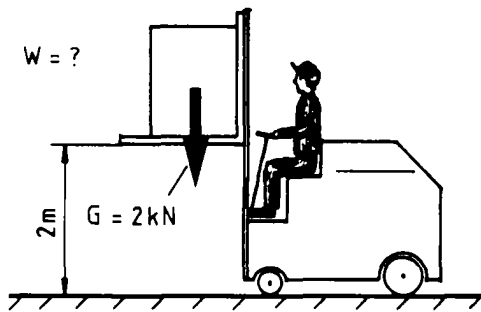
$W = \boxed{\phantom{00000}} \text{ J}$

3



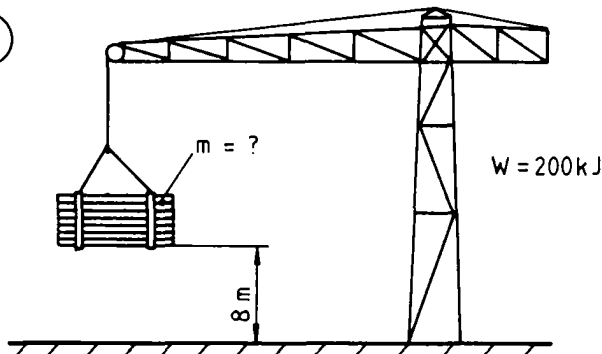
$W = \boxed{\phantom{00000}} \text{ kJ}$

4



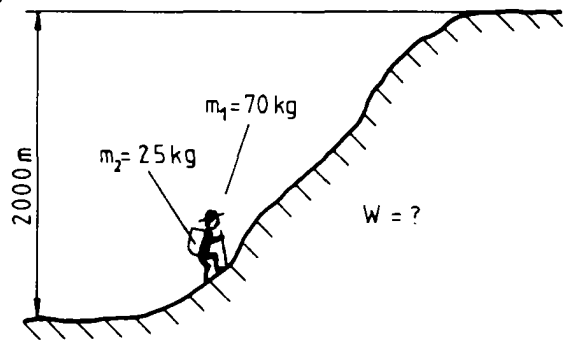
$W = \boxed{\phantom{00000}} \text{ J}$

5



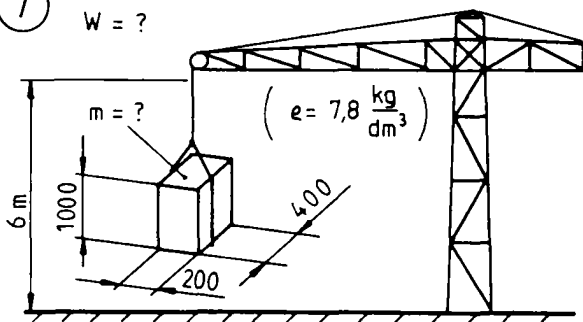
$m = \boxed{\phantom{00000}} \text{ t}$

6



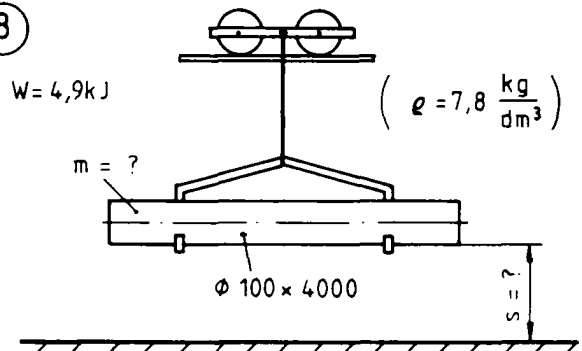
$W = \boxed{\phantom{00000}} \text{ kJ}$

7



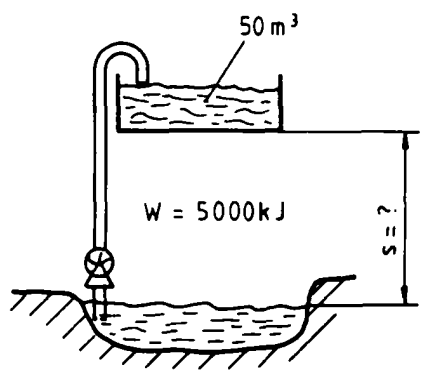
$m = \boxed{\phantom{00000}} \text{ t} ; W = \boxed{\phantom{00000}} \text{ kJ}$

8



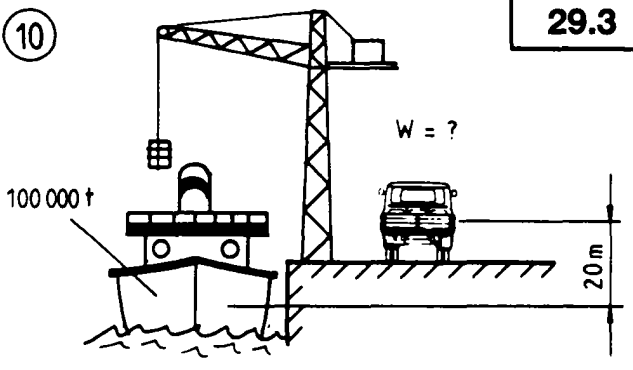
$m = \boxed{\phantom{00000}} \text{ t} ; s = \boxed{\phantom{00000}} \text{ m}$

9



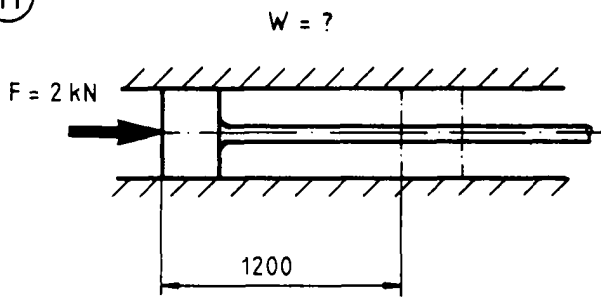
$s = \text{[ ] m}$

10



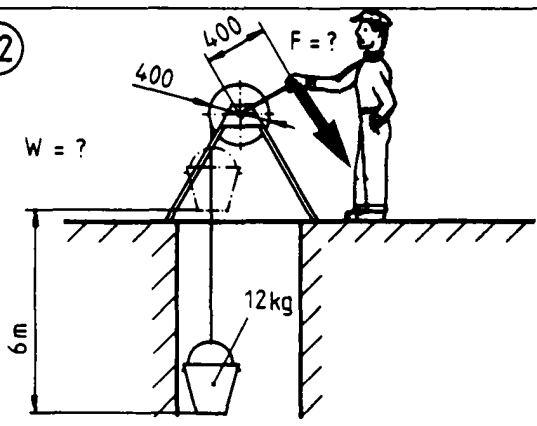
$W = \text{[ ] kJ}$

11



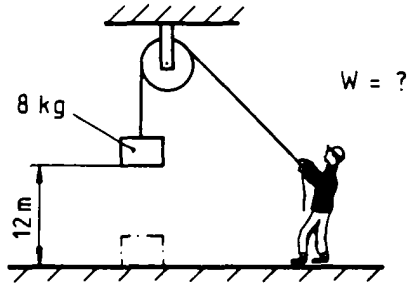
$W = \text{[ ] kJ}$

12



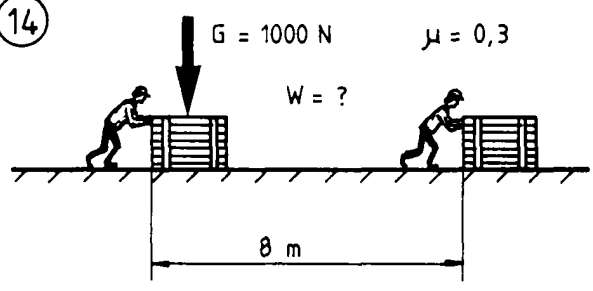
$F = \text{[ ] N}$        $W = \text{[ ] J}$

13



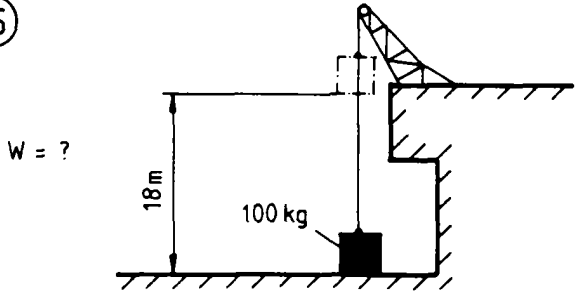
$W = \text{[ ] J}$

14



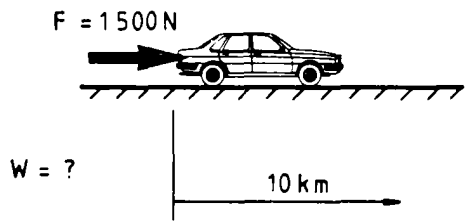
$W = \text{[ ] kJ}$

15

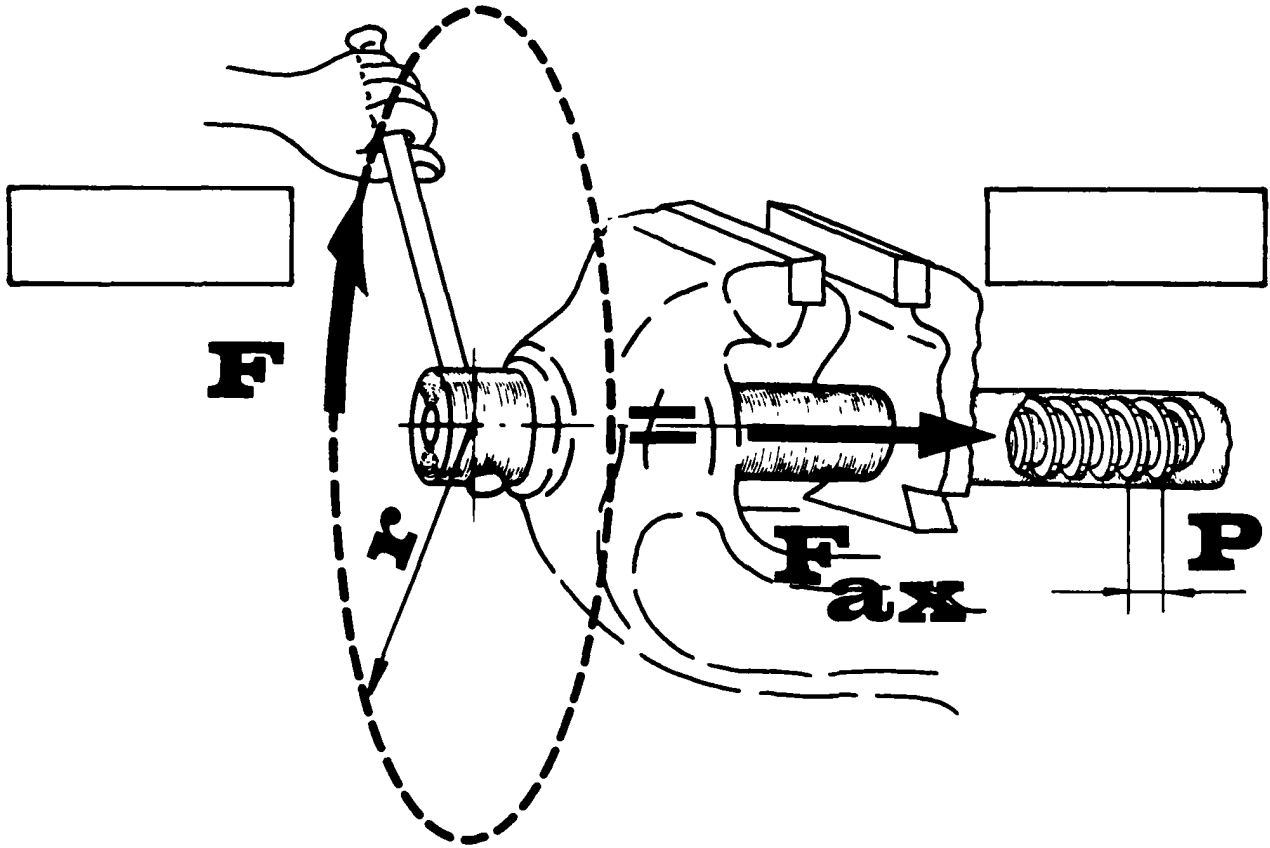


$W = \text{[ ] kJ}$

16



$W = \text{[ ] kJ}$



1.  **$F \cdot 2\pi r =$**   **.** 2.

Test

$F_{ax} = 8 \text{ kN}$   
 $P \cdot 2\pi \cdot r = F_{ax} \cdot P$   
 $F = \frac{F_{ax} \cdot P}{2\pi \cdot r}$   
 $F = \frac{8000 \text{ N} \cdot 6 \text{ mm}}{2\pi \cdot 300 \text{ mm}}$   
 $F = 25.5 \text{ N}$

$F_{ax} = ?$   
 $F_{ax} \cdot P = F \cdot 2\pi r$   
 $F_{ax} = \frac{F \cdot 2\pi r}{P}$   
 $F_{ax} = \frac{90 \text{ N} \cdot 2 \cdot \pi \cdot 300 \text{ mm}}{4 \text{ mm}}$   
 $F_{ax} = 42390 \text{ N}$

a)

$F_{ax} = 5 \text{ kN}$   
 $F = ?$

F =  N

b)

$P = 4 \text{ mm}$   
 $F_{ax} = 3140 \text{ N}$   
 $F = ?$

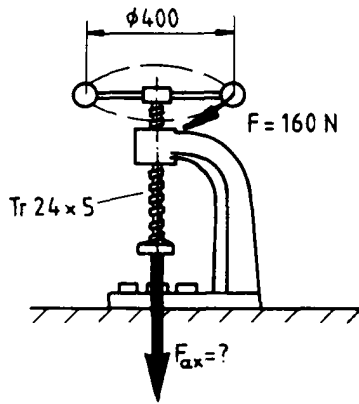
F =  N

c)

$F = 120 \text{ N}$   
 $F_{ax} = ?$

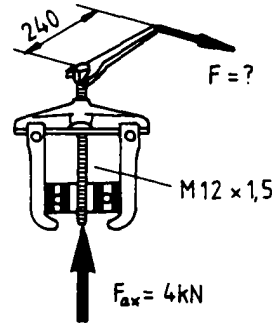
$F_{ax} =$   N

1



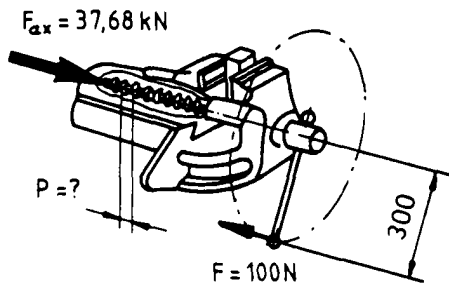
$F_{ax} = \text{[ ] N}$

2



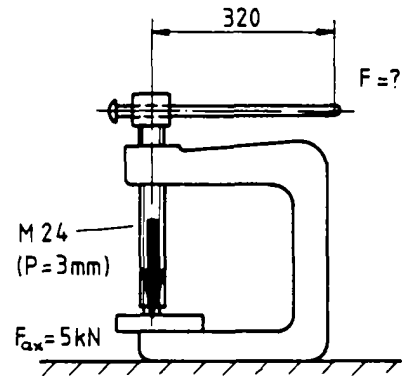
$F = \text{[ ] N}$

3



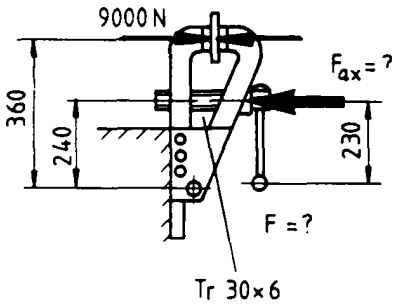
$P = \text{[ ] mm}$

4



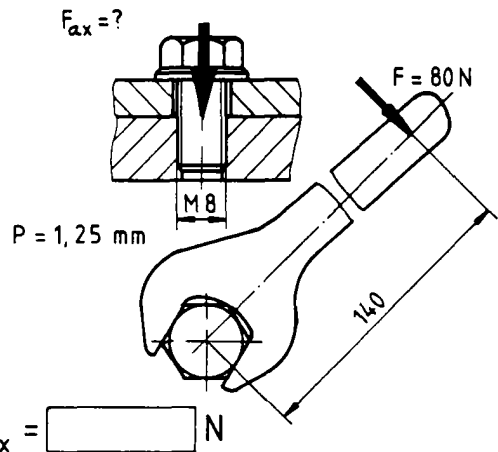
$F = \text{[ ] N}$

5



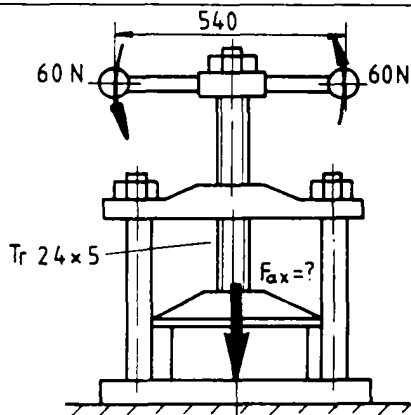
$F_{ax} = \text{[ ] N}; F = \text{[ ] N}$

6



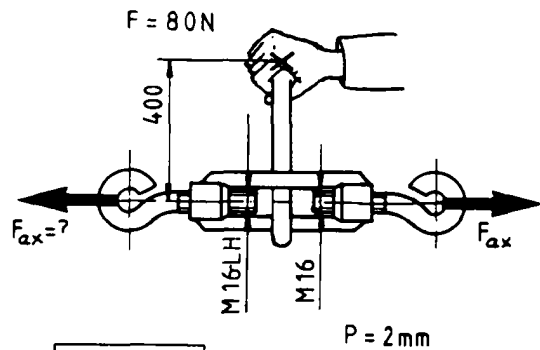
$F_{ax} = \text{[ ] N}$

7

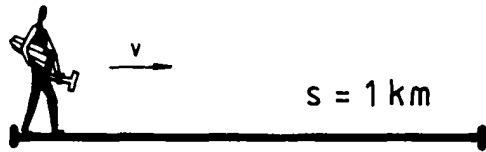
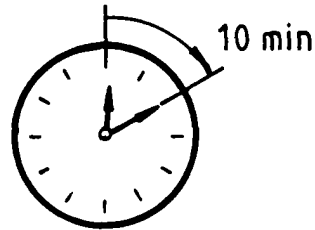


$F_{ax} = \text{[ ] N}$

8



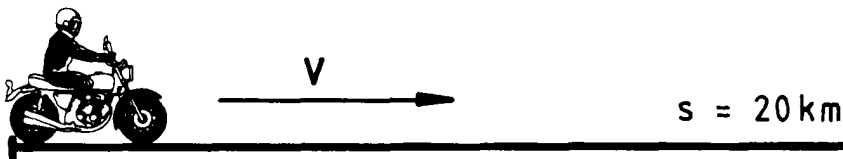
$F_{ax} = \text{[ ] N}$



$$v = \frac{\text{km}}{\text{h}}$$



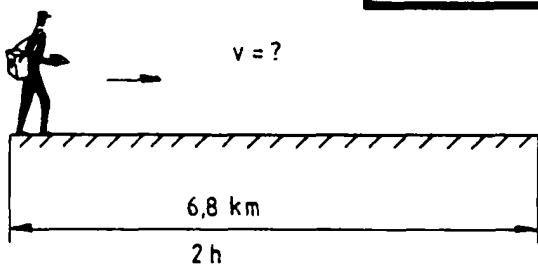
$$v = \frac{\text{km}}{\text{h}}$$



$$v = \frac{\text{km}}{\text{h}}$$

$$v = \frac{s}{t}$$

1.

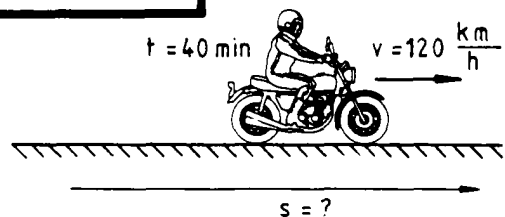


$$v = \frac{s}{t}$$

$$v = \frac{6,8 \text{ km}}{2 \text{ h}}$$

$$v = 3,4 \frac{\text{km}}{\text{h}}$$

2.

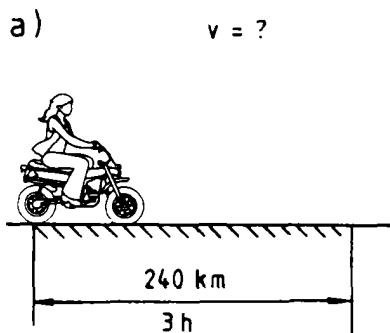


$$v = \frac{s}{t}$$

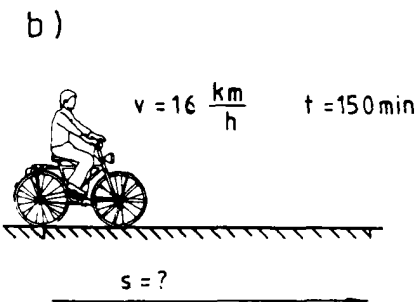
$$s = v \cdot t$$

$$s = 120 \frac{\text{km}}{\text{h}} \cdot 40 \cdot \frac{1}{60} \text{ h} = 80 \text{ km}$$

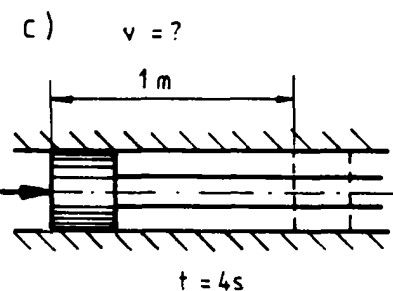
Test:



$$v = \frac{\text{km}}{\text{h}}$$

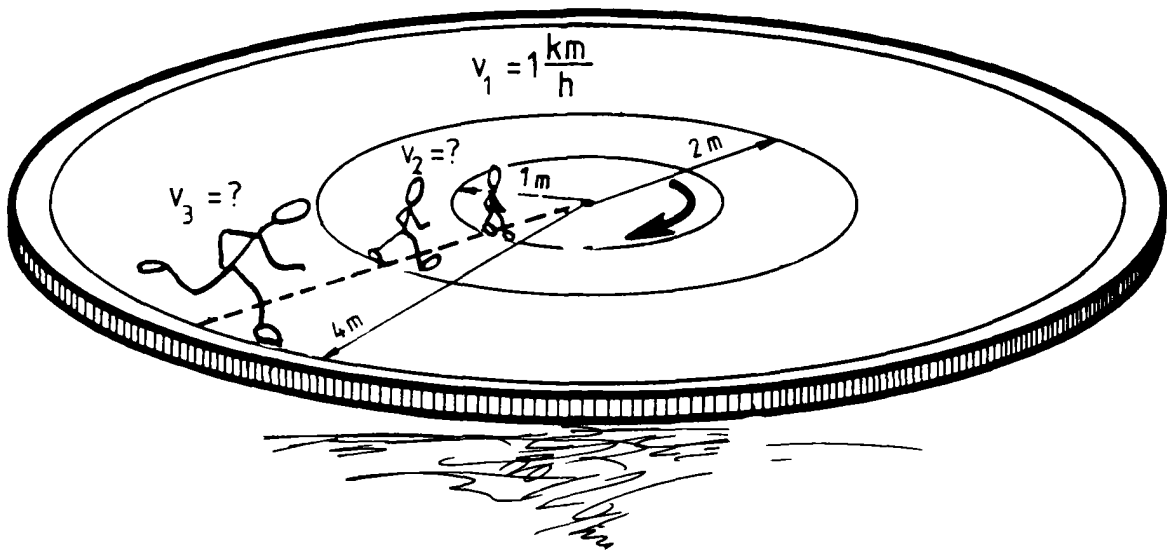
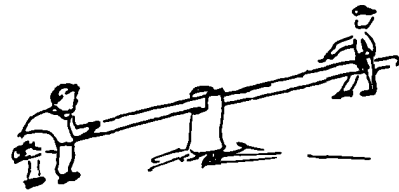
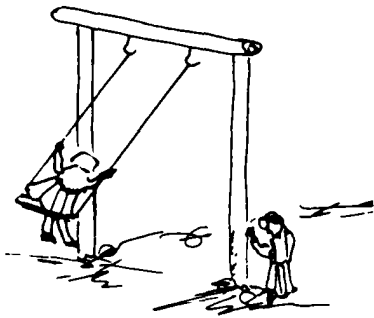


$$s = \text{ km}$$



$$v = \frac{\text{m}}{\text{s}}$$

$$v = \frac{\text{m}}{\text{min}}$$



$$v_3 = \frac{km}{h}$$

$$v_2 = \frac{km}{h}$$

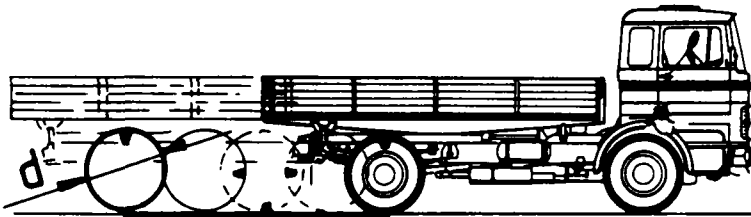
Test

<p>a)</p>	<p>b)</p> <p><math>r_1 = 24 \text{ cm}</math>  <math>r_2 = 18 \text{ cm}</math>  <math>r_3 = 12 \text{ cm}</math></p>	<p>c)</p>
<p><math>v_2 = \text{[ ]} \frac{m}{s}</math></p>	<p><math>v_2 = \text{[ ]} \frac{m}{s}</math></p>	<p><math>v_2 = \text{[ ]} \frac{m}{s}</math></p>
<p><math>v_3 = \text{[ ]} \frac{m}{s}</math></p>	<p><math>v_3 = \text{[ ]} \frac{m}{s}</math></p>	<p><math>v_3 = \text{[ ]} \frac{m}{s}</math></p>

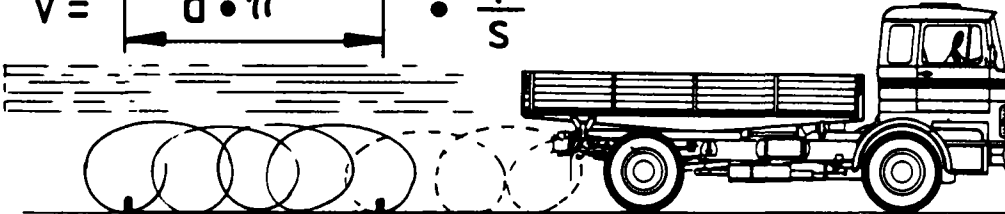
$v_3 = 4 \cdot \frac{m}{s} = 2 \cdot \frac{m}{s}$

$v_3 = 4 \cdot \frac{m}{s} = 2 \cdot \frac{m}{s}$

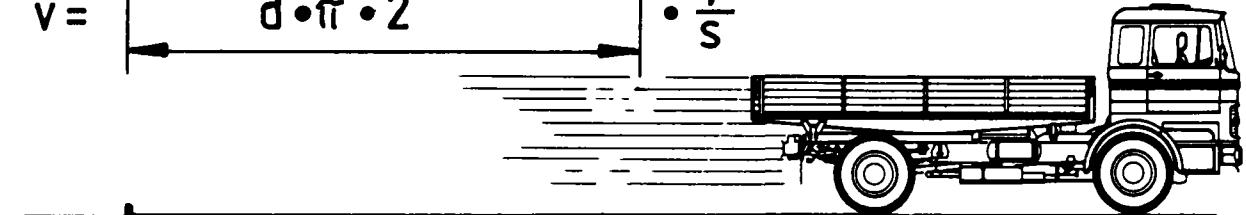
$v_3 = 4 \cdot \frac{m}{s} = 2 \cdot \frac{m}{s}$



$$v = d \cdot \pi \cdot \frac{1}{s}$$



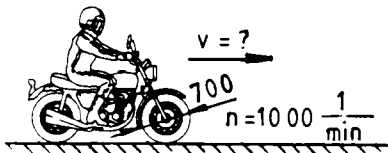
$$v = d \cdot \pi \cdot 2 \cdot \frac{1}{s}$$



$$v = d \cdot \pi \cdot n$$

$$v = d \cdot \pi \cdot n$$

1.

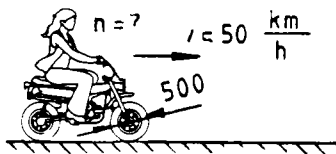


$$v = d \cdot \pi \cdot n$$

$$v = 0,7\text{m} \cdot 3,14 \cdot 1000 \frac{1}{\text{min}}$$

Test:  $v = 2198 \frac{\text{m}}{\text{min}}$

2.



$$v = 50 \frac{\text{km}}{\text{h}} = 833 \frac{\text{m}}{\text{min}}$$

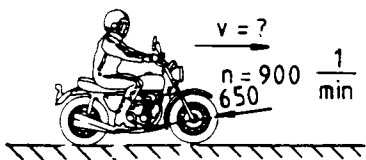
$$v = d \cdot \pi \cdot n$$

$$n = \frac{v}{d \cdot \pi}$$

$$n = \frac{833 \frac{\text{m}}{\text{min}}}{0,5\text{m} \cdot 3,14}$$

$$n = 530 \frac{1}{\text{min}}$$

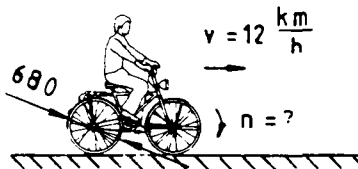
a)



$$v = \boxed{\phantom{000}} \frac{\text{km}}{\text{h}}$$

(c)  $n = 1911 \frac{1}{\text{min}}$

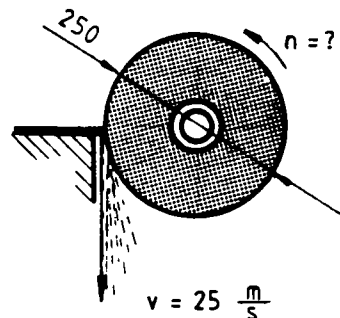
b)



$$n = \boxed{\phantom{000}} \frac{1}{\text{min}}$$

(b)  $n = 946 \frac{1}{\text{min}}$

c)

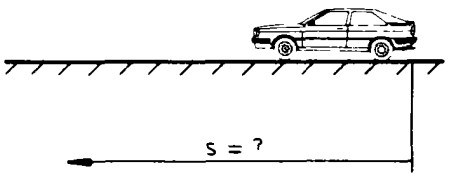
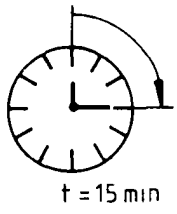


$$n = \boxed{\phantom{000}} \frac{1}{\text{min}}$$

(a)  $v = 110 \frac{\text{km}}{\text{h}}$

1

$v = 120 \frac{\text{km}}{\text{h}}$

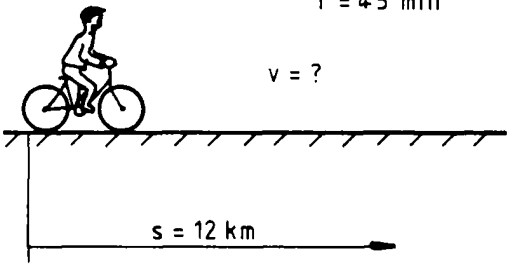


$s = \boxed{\phantom{000}} \text{ km}$

2

$t = 45 \text{ min}$

$v = ?$

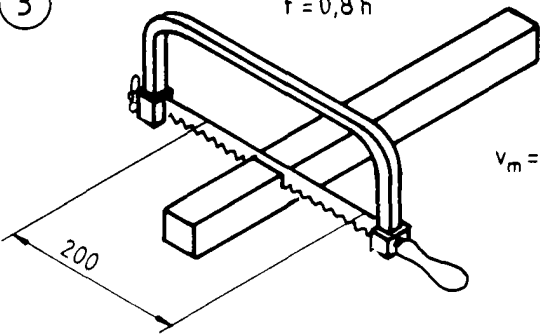


$v = \boxed{\phantom{000}} \frac{\text{km}}{\text{h}} ; v = \boxed{\phantom{000}} \frac{\text{m}}{\text{s}}$

3

$t = 0,8 \text{ h}$

$v_m = ?$



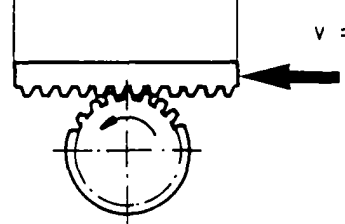
$v_m = \boxed{\phantom{000}} \frac{\text{m}}{\text{s}} ; v_m = \boxed{\phantom{000}} \frac{\text{m}}{\text{min}}$

4

800

$v = 60 \frac{\text{mm}}{\text{min}}$

$t = ?$

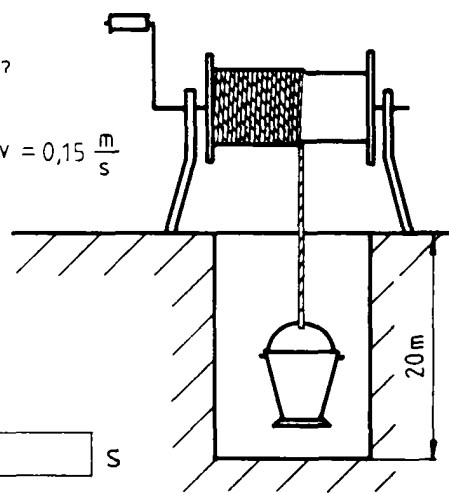


$t = \boxed{\phantom{000}} \text{ min}$

5

$t = ?$

$v = 0,15 \frac{\text{m}}{\text{s}}$



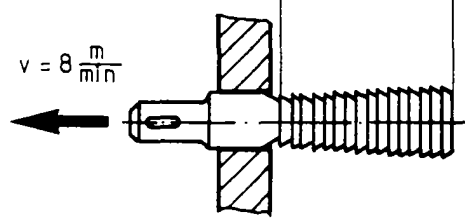
$t = \boxed{\phantom{000}} \text{ s}$

6

160

$v = 8 \frac{\text{m}}{\text{min}}$

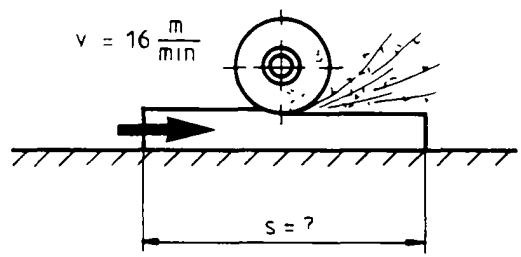
$t = \boxed{\phantom{000}} \text{ s}$



7

$t = 16 \text{ s}$

$v = 16 \frac{\text{m}}{\text{min}}$

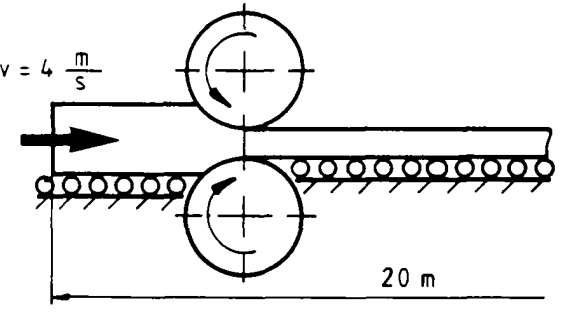


$s = \boxed{\phantom{000}} \text{ m}$

8

$t = ?$

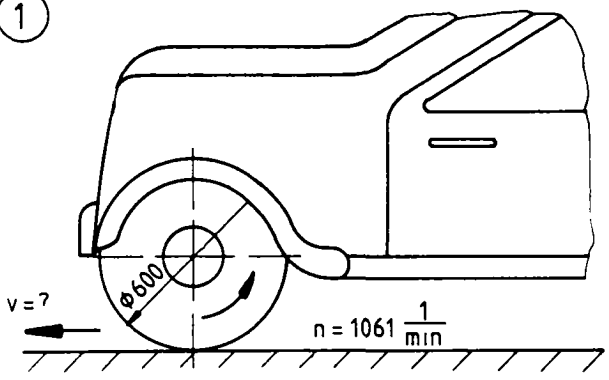
$v = 4 \frac{\text{m}}{\text{s}}$



$t = \boxed{\phantom{000}} \text{ s}$

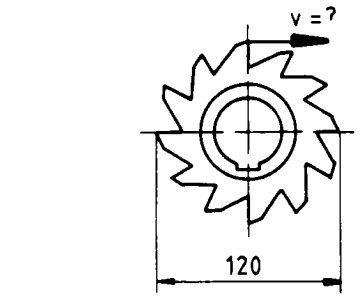


1



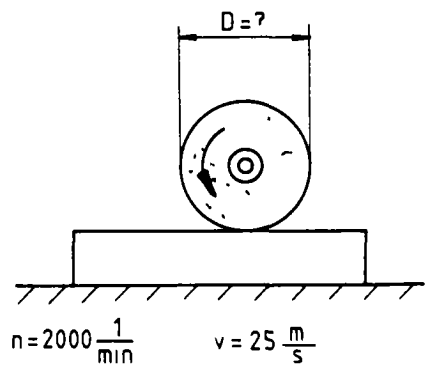
$v = \boxed{\phantom{000}} \frac{m}{s}$  ,  $v = \boxed{\phantom{000}} \frac{km}{h}$

2



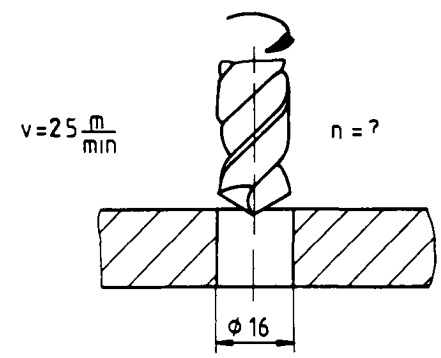
$n = 160 \frac{1}{min}$   
 $v = \boxed{\phantom{000}} \frac{m}{min}$  ,  $v = \boxed{\phantom{000}} \frac{m}{s}$

3



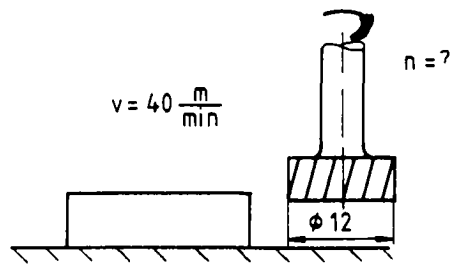
$D = \boxed{\phantom{000}} mm$

4



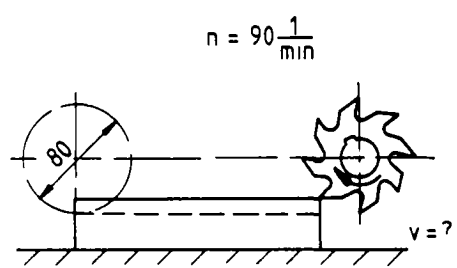
$n = 700, 438, 273, 171, 107, 67, 42, 26 \frac{1}{min}$   
 $n = \boxed{\phantom{000}} \frac{1}{min}$  ,

5



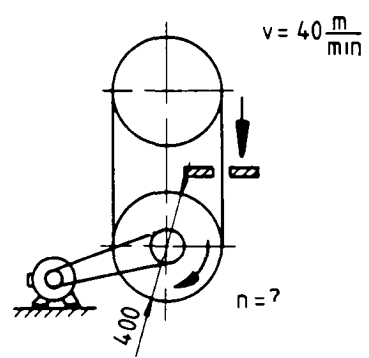
$n = \boxed{\phantom{000}} \frac{1}{min}$

6



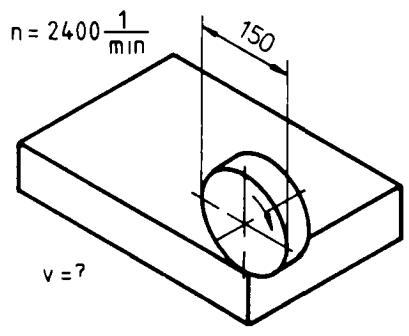
$v = \boxed{\phantom{000}} \frac{m}{min}$

7

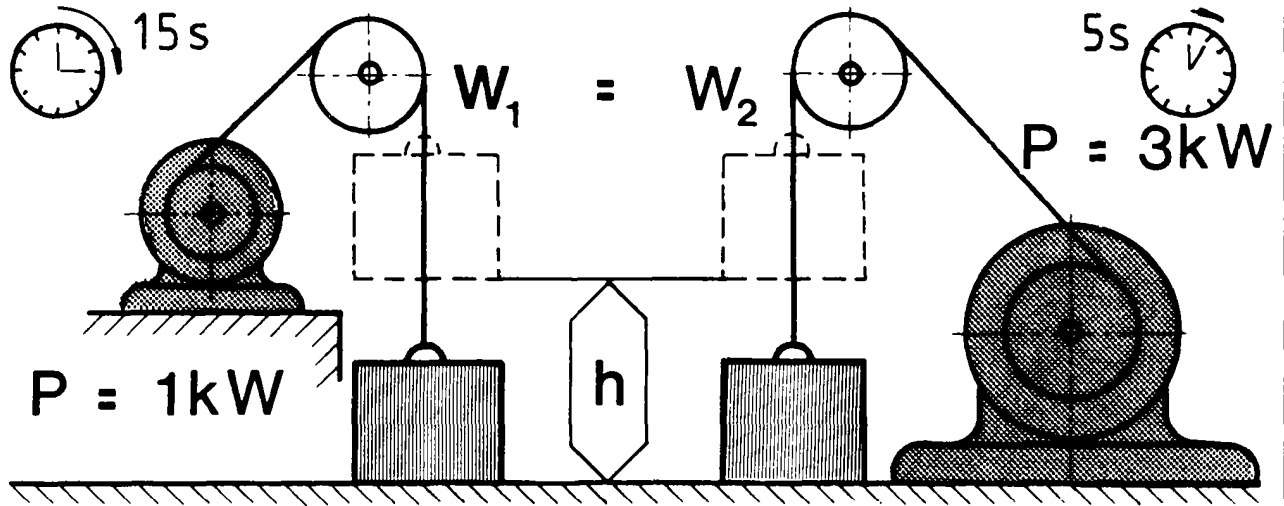


$n = \boxed{\phantom{000}} \frac{1}{min}$

8



$v = \boxed{\phantom{000}} \frac{m}{min}$  ,  $v = \boxed{\phantom{000}} \frac{m}{s}$



$$\text{[Empty Box]} = \text{[Empty Box]}$$

$$P = \text{[Empty Box]}$$

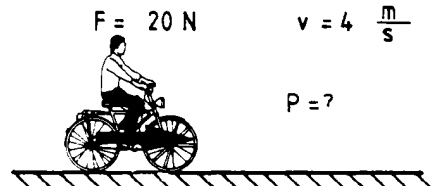
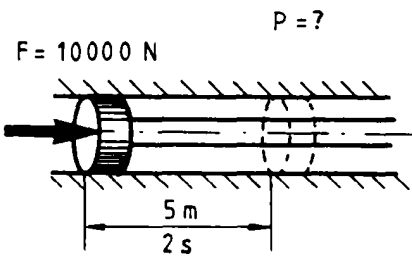
$$\frac{1\text{Nm}}{\text{s}} = 1\text{W}$$

$$P = \text{[Empty Box]}$$

1.

2.

$$P = F \cdot v$$



$$P = \frac{F \cdot s}{t}$$

$$P = \frac{10000\text{N} \cdot 5\text{m}}{2\text{s}}$$

$$P = 25000\text{W}$$

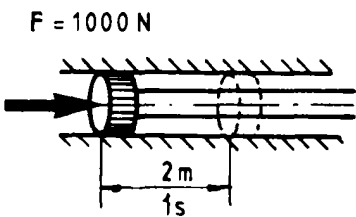
$$P = F \cdot v$$

$$P = 20\text{N} \cdot 4\frac{\text{m}}{\text{s}}$$

$$P = 80\text{W}$$

Test:

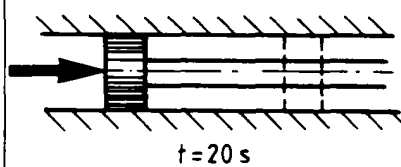
a)  $P = ?$



$$P = \text{[Box]} \text{ W}$$

b)  $P = ?$

$W = 80 \text{ kJ}$



$$P = \text{[Box]} \text{ W}$$

c)  $P = ?$

$F = 2400 \text{ N}$        $v = 120 \frac{\text{km}}{\text{h}}$



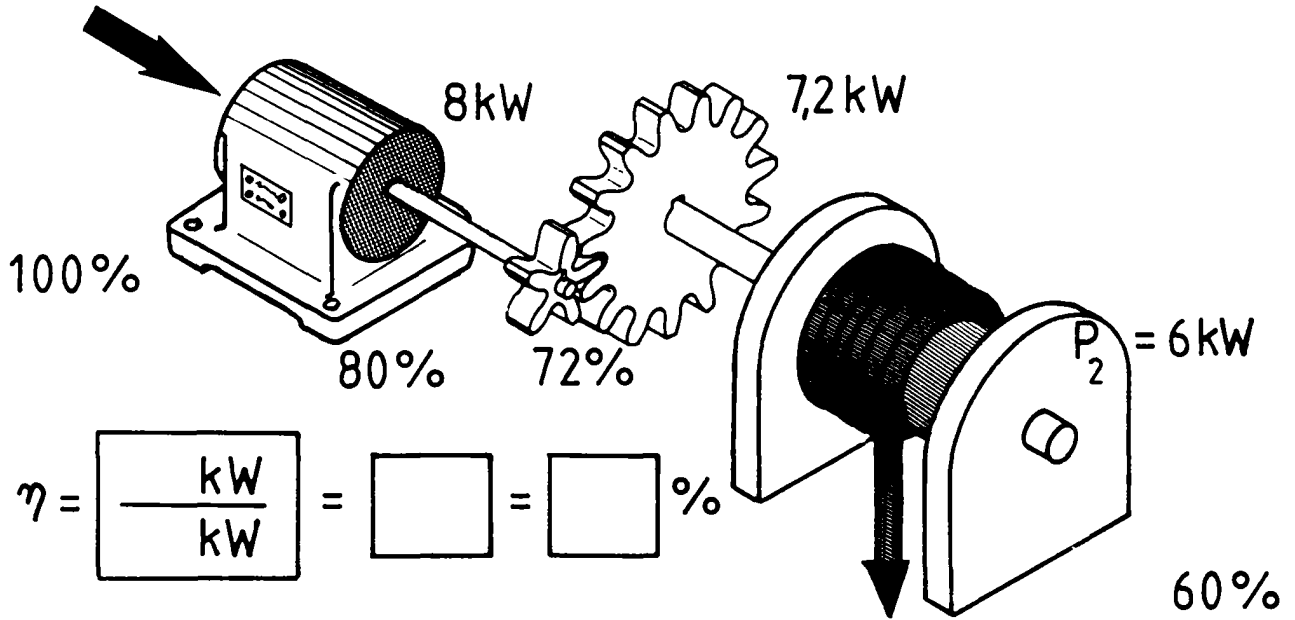
$$P = \text{[Box]} \text{ kW}$$

(c)  $P = 80\text{kW}$

(b)  $P = 4000\text{W}$

(a)  $P = 2000\text{W}$

$P_1 = 10 \text{ kW}$



$$\eta = \frac{\text{ kW } }{\text{ kW } } = \square = \square \%$$

$$= \underline{\hspace{2cm}}$$

$$\eta = \underline{\hspace{2cm}}$$

Test

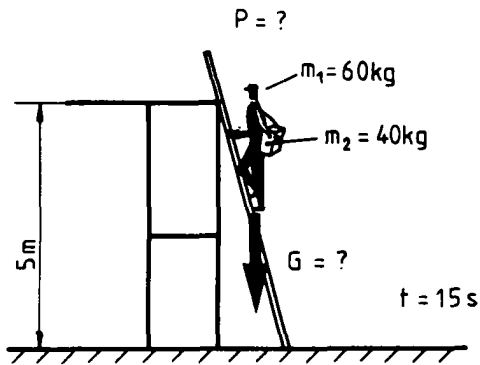
<p>a)</p>	<p>b)</p>	<p>c)</p>
<p><math>\eta = \square</math></p>	<p><math>P_1 = \square \text{ kW}</math></p>	<p><math>P_2 = \square \text{ kW}</math></p>

η = 0.84

η = 0.84

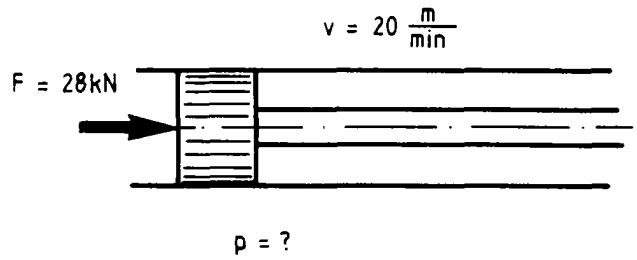
η = 0.84

1



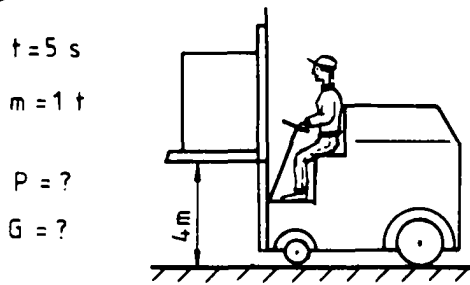
$G = \boxed{\phantom{000}} \text{ N} ; P = \boxed{\phantom{000}} \text{ W}$

2



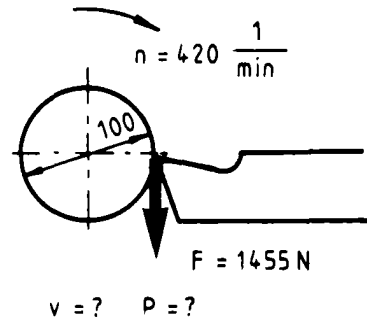
$P = \boxed{\phantom{000}} \text{ kW}$

3



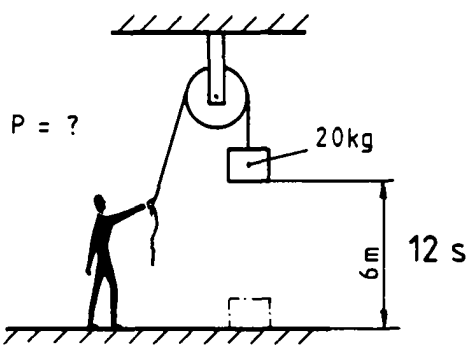
$G = \boxed{\phantom{000}} \text{ N} ; P = \boxed{\phantom{000}} \text{ kW}$

4



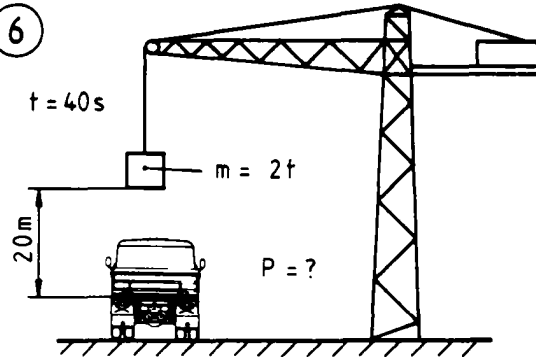
$v = \boxed{\phantom{000}} \frac{\text{m}}{\text{s}} ; P = \boxed{\phantom{000}} \text{ W}$

5



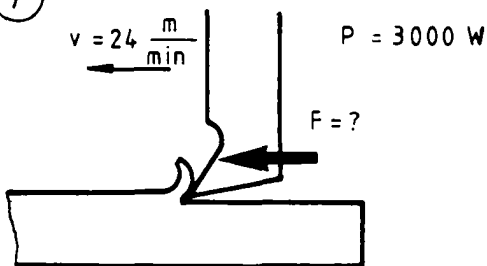
$P = \boxed{\phantom{000}} \text{ W}$

6



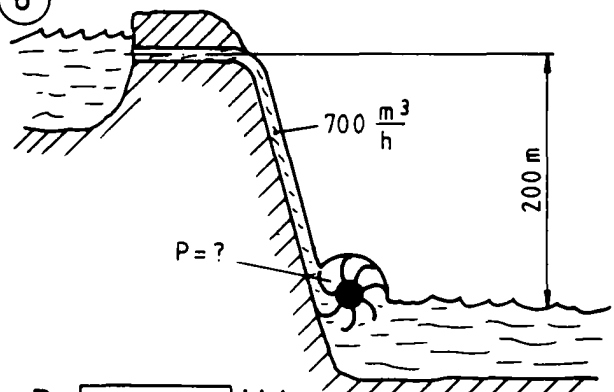
$P = \boxed{\phantom{000}} \text{ kW}$

7



$F = \boxed{\phantom{000}} \text{ N}$

8



$P = \boxed{\phantom{000}} \text{ kW}$

1

$P_1 = 6 \text{ kW}$

$P_2 = 5,1 \text{ kW}$

$\eta = ?$   
 $\eta \% = ?$

$\eta = \boxed{\phantom{000}}$  ;  $\eta = \boxed{\phantom{000}} \%$

2

$\eta = 88 \%$

$P_1 = 5 \text{ kW}$

$P_2 = ?$

$P_2 = \boxed{\phantom{000}} \text{ kW}$

3

$\eta = 0,7$

$4 \text{ kW}$

$P_2 = ?$

$P_2 = \boxed{\phantom{000}} \text{ kW}$

4

$\eta = 0,8$

$m = 12 \text{ kg}$

$v = 0,2 \frac{\text{m}}{\text{s}}$

$P_2 = ?$

$P_2 = \boxed{\phantom{000}} \text{ W}$  ;  $P_1 = \boxed{\phantom{000}} \text{ W}$

5

$t = 15 \text{ s}$   
 $m = 400 \text{ kg}$

$\eta = 0,75$

$4 \text{ m}$

$P_2 = ?$

$P_1 = ?$

$P_2 = \boxed{\phantom{000}} \text{ kW}$  ;  $P_1 = \boxed{\phantom{000}} \text{ kW}$

6

$\eta = 0,8$

$m = 1500 \text{ kg}$

$v = 2 \frac{\text{m}}{\text{s}}$

$P_2 = ?$

$P_2 = \boxed{\phantom{000}} \text{ kW}$  ;  $P_1 = \boxed{\phantom{000}} \text{ kW}$

7

$\eta = ?$  ;  $\eta \% = ?$

$42,7 \text{ kW}$

$m = 800 \text{ kg}$

$v = 4 \frac{\text{m}}{\text{s}}$

$\eta = \boxed{\phantom{000}}$  ;  $\eta = \boxed{\phantom{000}} \%$

8

$\eta = 0,8$

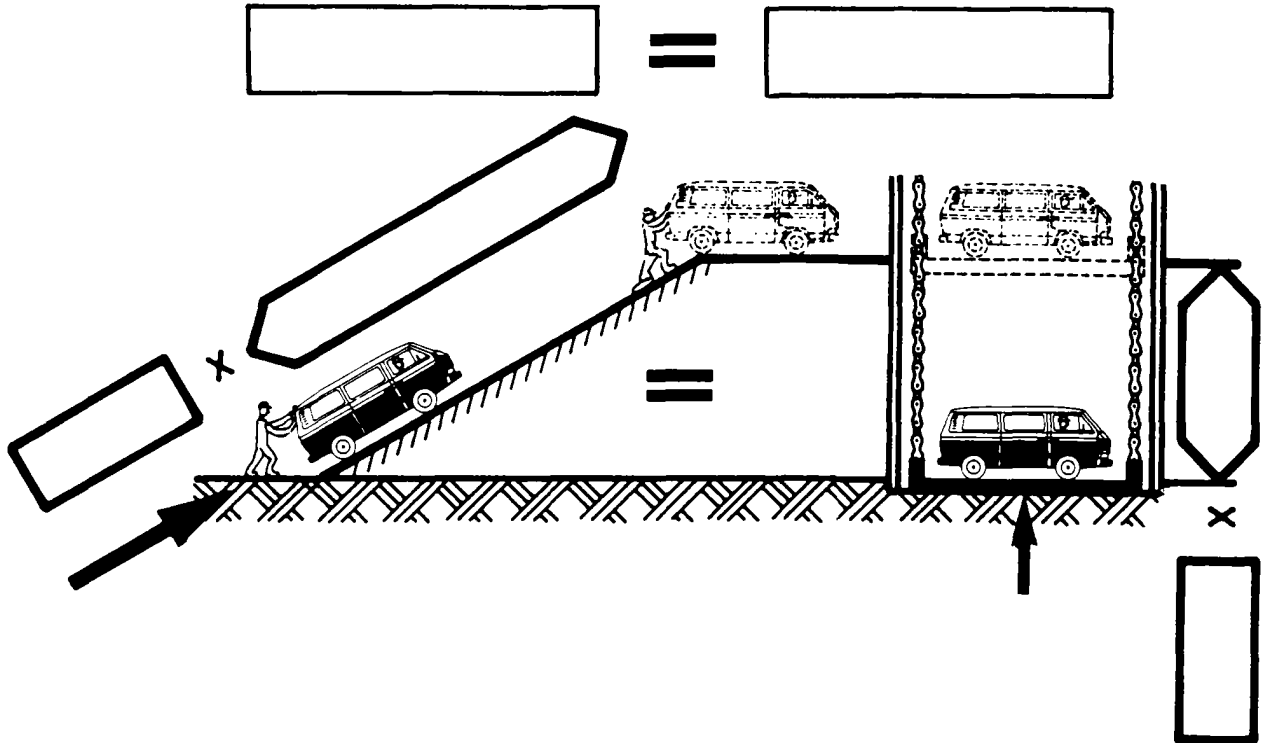
$m = 20 \text{ kg}$

$4 \text{ m}$

$t = 10 \text{ s}$

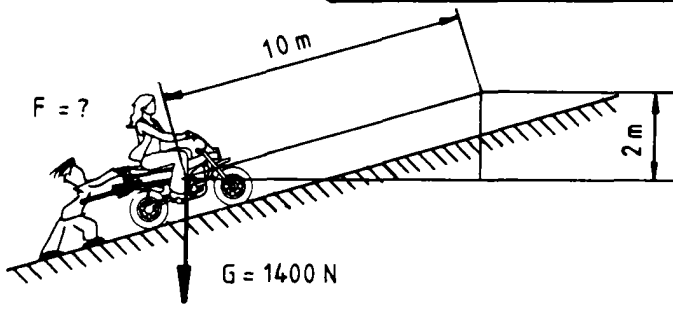
$F = ?$   
 $P_1 = ?$   
 $P_2 = ?$

$P_2 = \boxed{\phantom{000}} \text{ W}$   
 $P_1 = \boxed{\phantom{000}} \text{ W}$  ;  $F = \boxed{\phantom{000}} \text{ N}$



**× = ×**

**F · s = G · h**



$$F \cdot s = G \cdot h$$

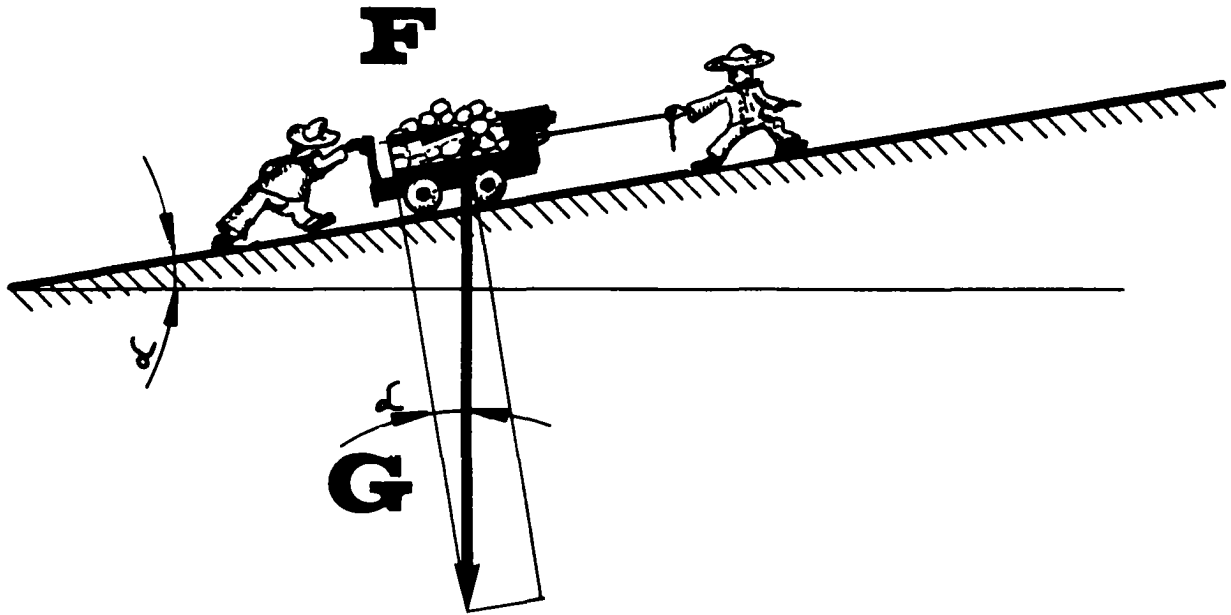
$$F = \frac{G \cdot h}{s}$$

$$F = \frac{1400\text{N} \cdot 2\text{m}}{10\text{m}}$$

$$F = 280\text{N}$$

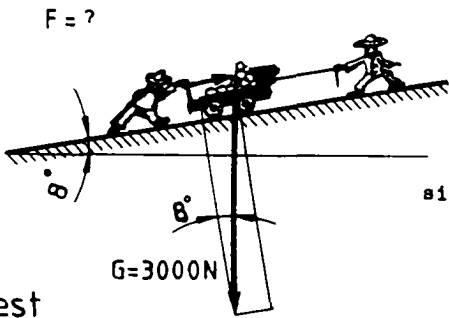
Test:

<p>a)</p>	<p>b)</p>	<p>c)</p>
<p>F = <input style="width: 80px;" type="text"/> N</p>	<p>F = <input style="width: 80px;" type="text"/> N</p>	<p>F = <input style="width: 80px;" type="text"/> N</p>



**$\sin \alpha = \frac{F}{G}$**

1.



Test

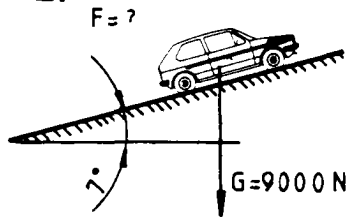
$$\sin \alpha = \frac{F}{G}$$

$$F = G \cdot \sin \alpha$$

$$F = 3000 \text{ N} \cdot \sin 8^\circ$$

$$F = 418 \text{ N}$$

2.



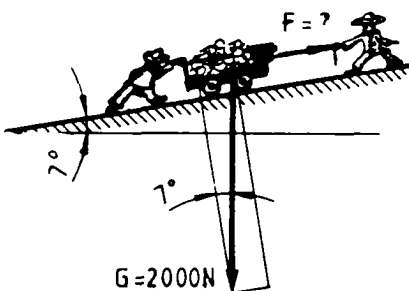
$$\sin \alpha = \frac{F}{G}$$

$$F = G \sin \alpha$$

$$F = 9000 \text{ N} \cdot \sin 7^\circ$$

$$F = 1097 \text{ N}$$

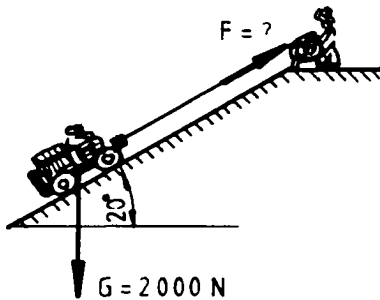
a)



$F = \boxed{\phantom{00000}} \text{ N}$

(a)  $F = 5162 \text{ N}$

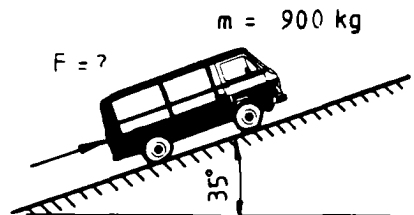
b)



$F = \boxed{\phantom{00000}} \text{ N}$

(b)  $F = 684 \text{ N}$

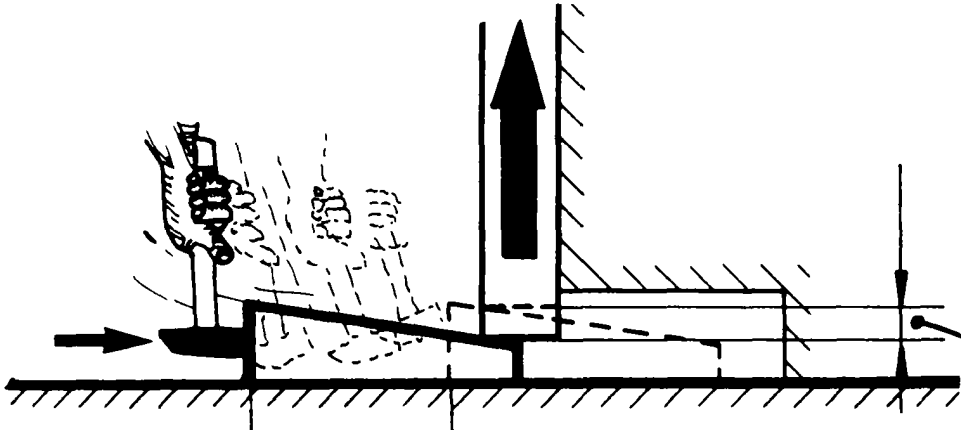
c)



$F = \boxed{\phantom{00000}} \text{ N}$

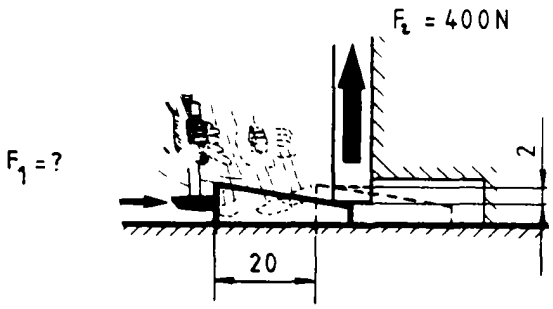
(c)  $F = 244 \text{ N}$

[ ] = [ ]



[ ] × [ ] = [ ] × [ ]

**$F_1 \cdot s = F_2 \cdot h$**



$$F_1 \cdot s = F_2 \cdot h$$

$$F_1 = \frac{F_2 \cdot h}{s}$$

$$F_1 = \frac{400\text{N} \cdot 2\text{mm}}{20\text{mm}}$$

$$F_1 = 40\text{N}$$

=====

Test:

<p>a)</p>	<p>b)</p>	<p>c)</p>
<p><math>F_1 =</math> [ ] N</p>	<p><math>F_2 =</math> [ ] N</p>	<p><math>F_2 =</math> [ ] N</p>

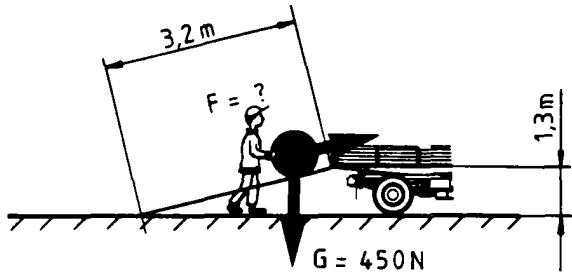
NO00S = z\_d (c)

NO01 = z\_d (b)

NO1 = z\_d (a)

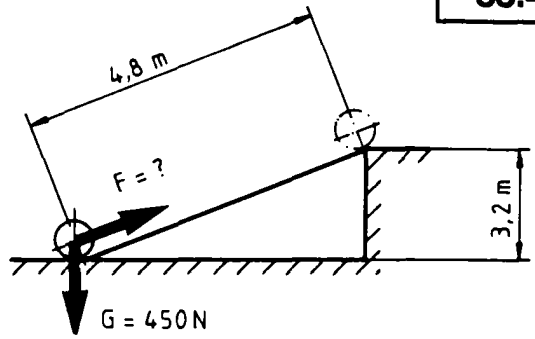


1



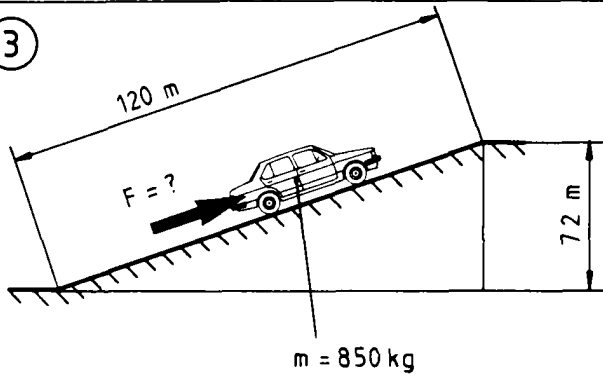
$F = \boxed{\phantom{000}} \text{ N}$

2



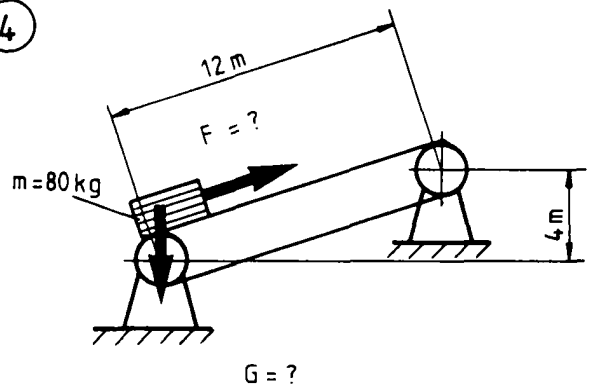
$F = \boxed{\phantom{000}} \text{ N}$

3



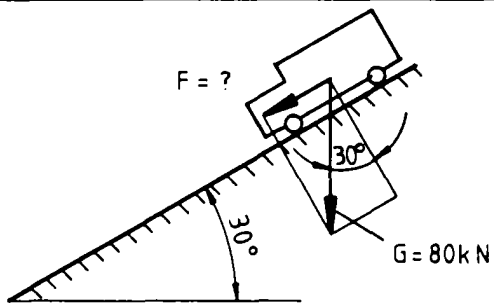
$F = \boxed{\phantom{000}} \text{ N}$

4



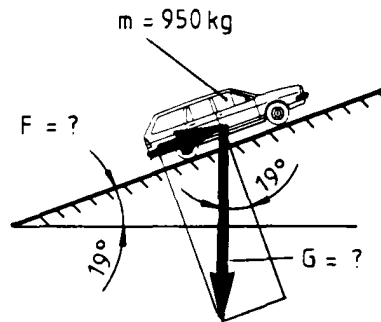
$G = \boxed{\phantom{000}} \text{ N} ; F = \boxed{\phantom{000}} \text{ N}$

5



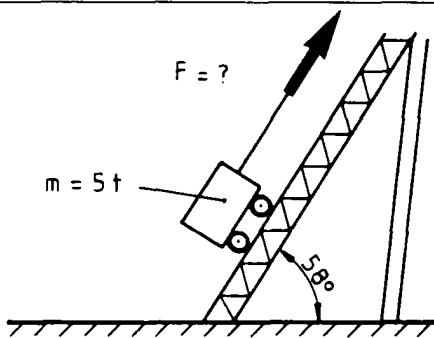
$F = \boxed{\phantom{000}} \text{ kN}$

6



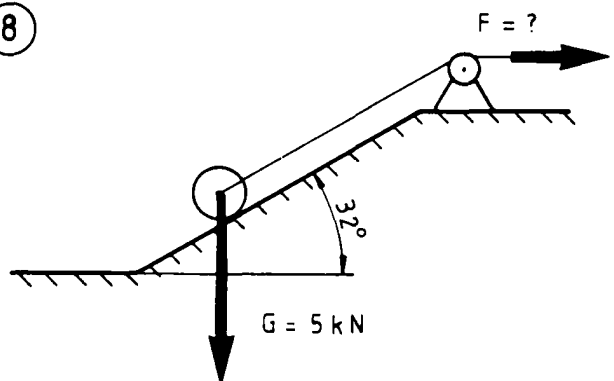
$G = \boxed{\phantom{000}} \text{ N} ; F = \boxed{\phantom{000}} \text{ N}$

7



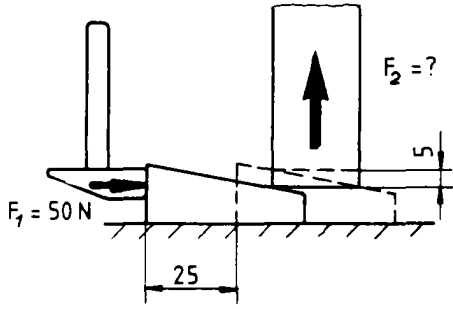
$F = \boxed{\phantom{000}} \text{ kN}$

8



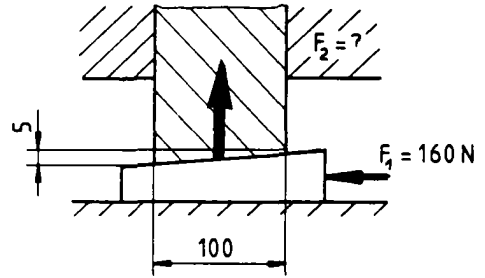
$F = \boxed{\phantom{000}} \text{ kN}$

1



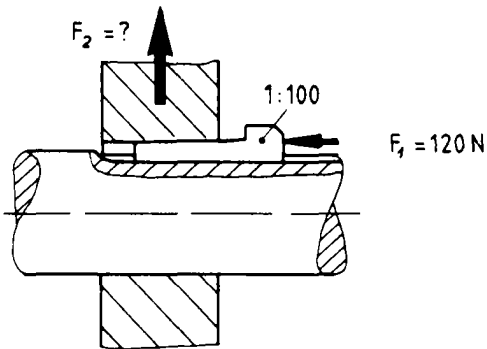
$F_2 = \text{[ ]} \text{ N}$

2



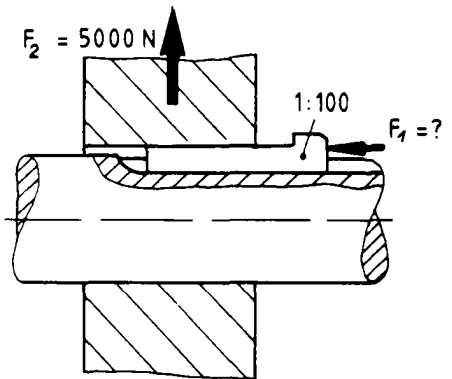
$F_2 = \text{[ ]} \text{ N}$

3



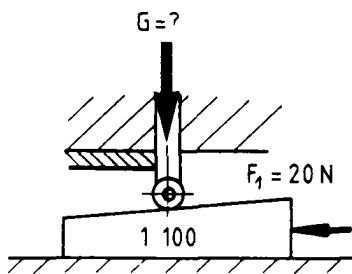
$F_2 = \text{[ ]} \text{ N}$

4



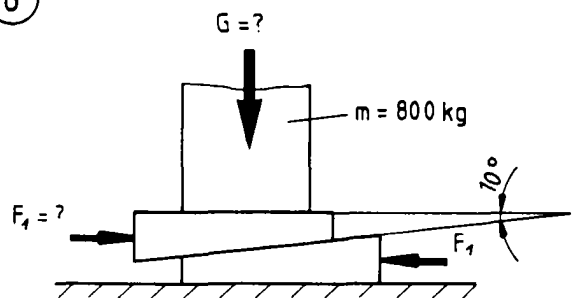
$F_1 = \text{[ ]} \text{ N}$

5



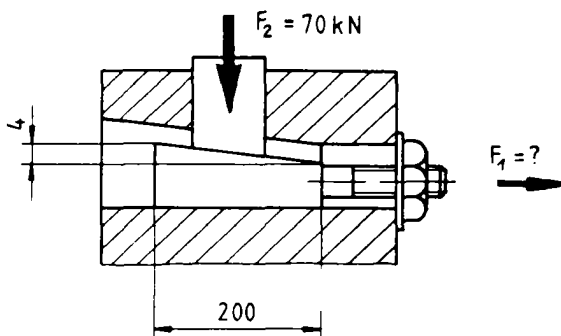
$G = \text{[ ]} \text{ N}$

6



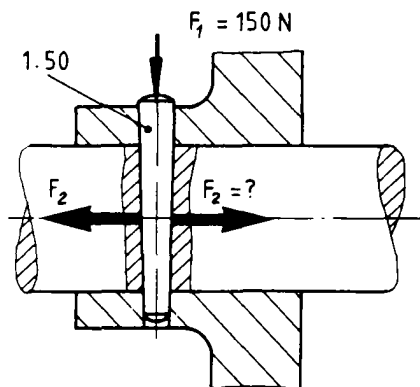
$G = \text{[ ]} \text{ N}; F_1 = \text{[ ]} \text{ N}$

7

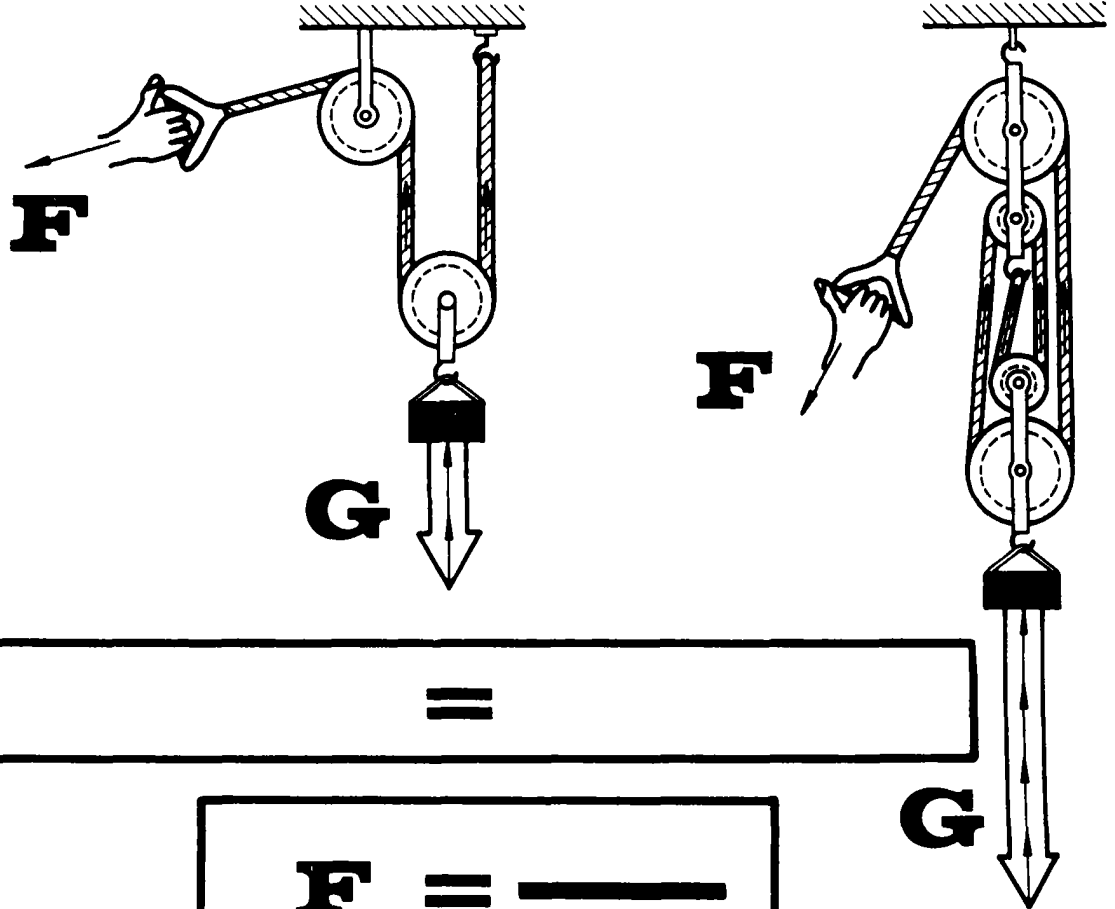


$F_1 = \text{[ ]} \text{ N}$

8



$F_2 = \text{[ ]} \text{ N}$

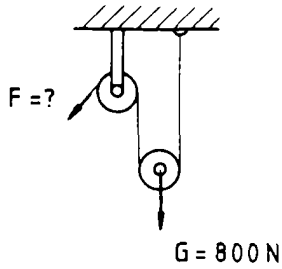


=

**F = \_\_\_\_\_**

1.

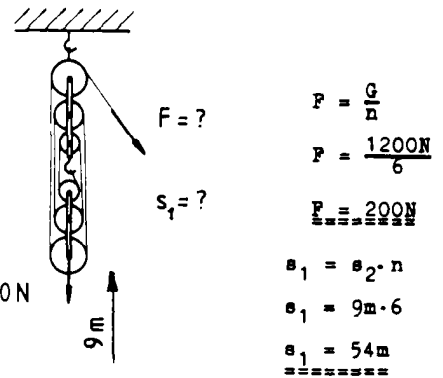
2.



$$F = \frac{G}{2}$$

$$F = \frac{800 \text{ N}}{2}$$

$$F = 400 \text{ N}$$



$$F = \frac{G}{n}$$

$$F = \frac{1200 \text{ N}}{6}$$

$$F = 200 \text{ N}$$

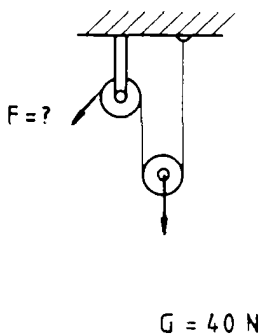
$$s_1 = s_2 \cdot n$$

$$s_1 = 9 \text{ m} \cdot 6$$

$$s_1 = 54 \text{ m}$$

Test:

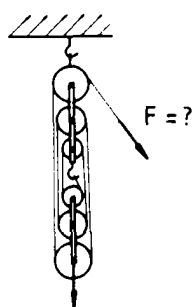
a)



G = 40 N

F =  N

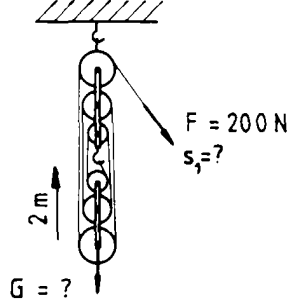
b)



G = 800 N

F =  N

c)

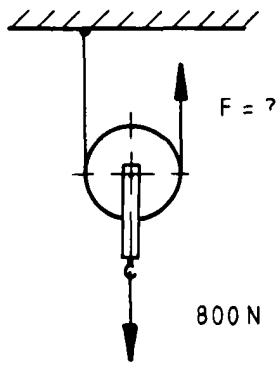


G = ?

$s_1 =$   m

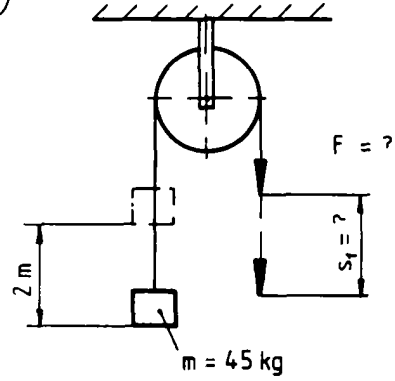
G =  N

1



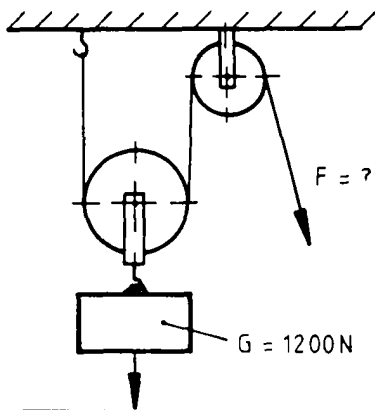
$F = \boxed{\phantom{000}} \text{ N}$

2



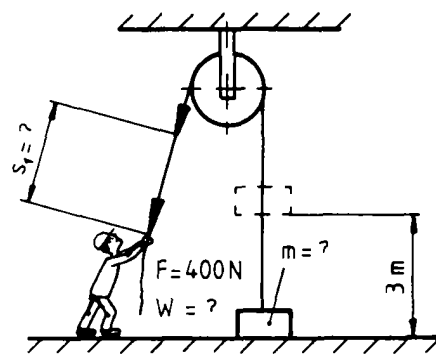
$F = \boxed{\phantom{000}} \text{ N} ; s_1 = \boxed{\phantom{000}} \text{ m}$

3



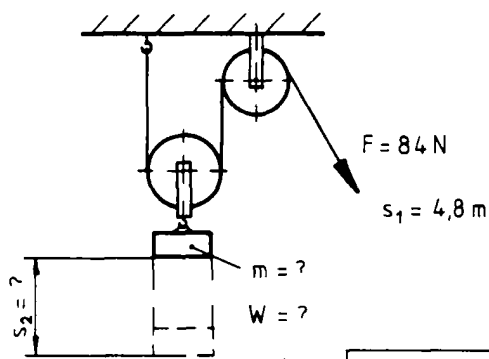
$F = \boxed{\phantom{000}} \text{ N}$

4



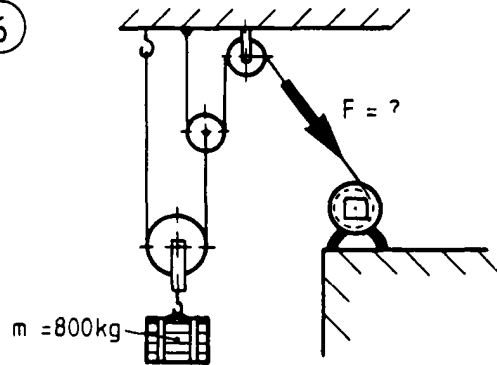
$W = \boxed{\phantom{000}} \text{ J}$   
 $s_1 = \boxed{\phantom{000}} \text{ m} ; m = \boxed{\phantom{000}} \text{ kg}$

5



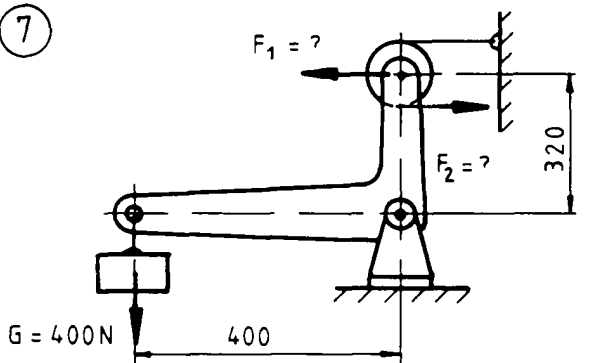
$W = \boxed{\phantom{000}} \text{ J}$   
 $m = \boxed{\phantom{000}} \text{ kg} ; s_2 = \boxed{\phantom{000}} \text{ m}$

6



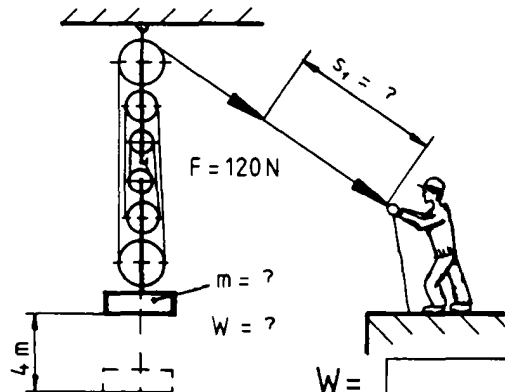
$F = \boxed{\phantom{000}} \text{ N}$

7

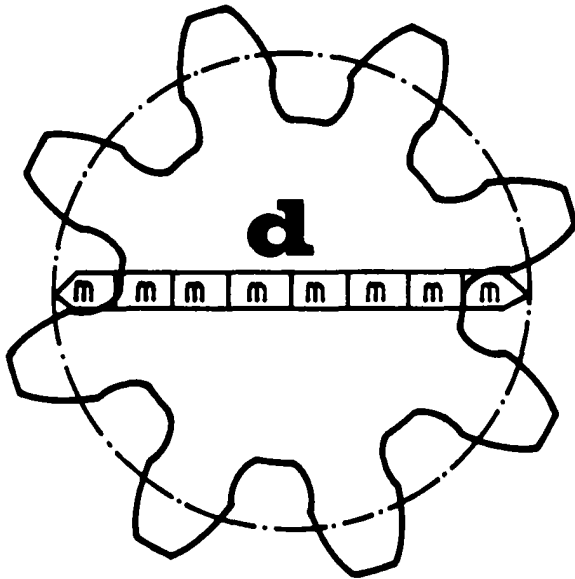


$F_1 = \boxed{\phantom{000}} \text{ N} , F_2 = \boxed{\phantom{000}} \text{ N}$

8

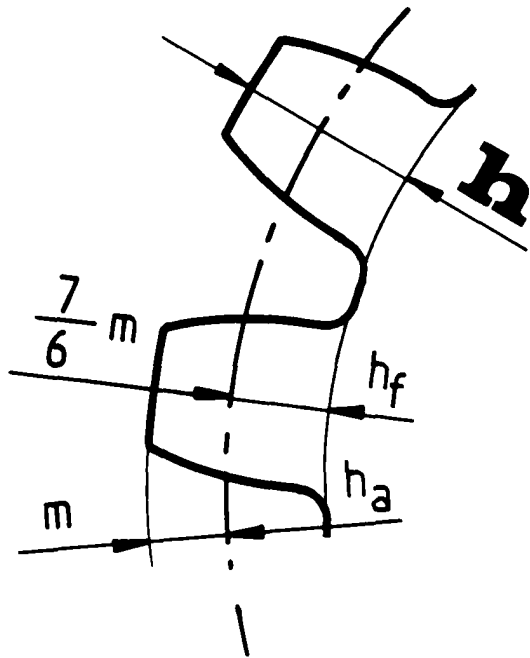


$W = \boxed{\phantom{000}} \text{ J}$   
 $m = \boxed{\phantom{000}} \text{ kg} ; s_1 = \boxed{\phantom{000}} \text{ m}$

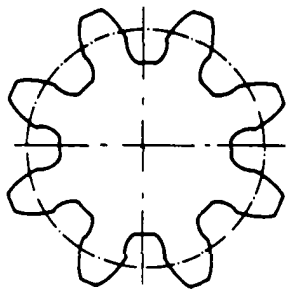


$$d = \quad \cdot$$

$$h = - m$$



$d = ?$   
 $h = ?$   
 $h_a = ?$   
 $h_f = ?$



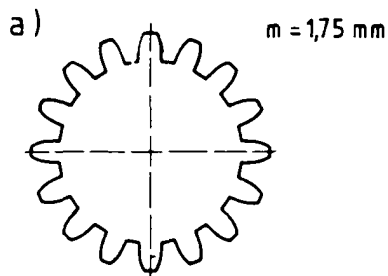
$m = 4 \text{ mm}$

$d = m \cdot z$   
 $d = 4 \text{ mm} \cdot 8$   
 $d = 32 \text{ mm}$

$h = \frac{13}{6} m$   
 $h = \frac{13}{6} \cdot 4 \text{ mm}$   
 $h = 8,67 \text{ mm}$

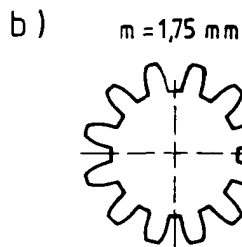
$h_a = m$   
 $h_a = 4 \text{ mm}$   
 $h_f = \frac{7}{6} m$   
 $h_f = 4,67 \text{ mm}$

Test:



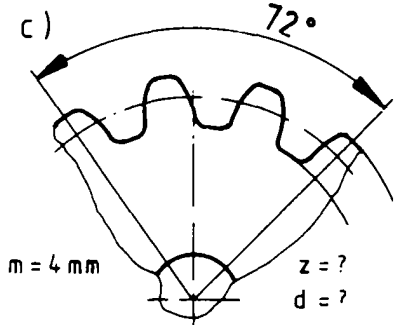
$d = \quad \text{mm}$

$h = \quad \text{mm}$



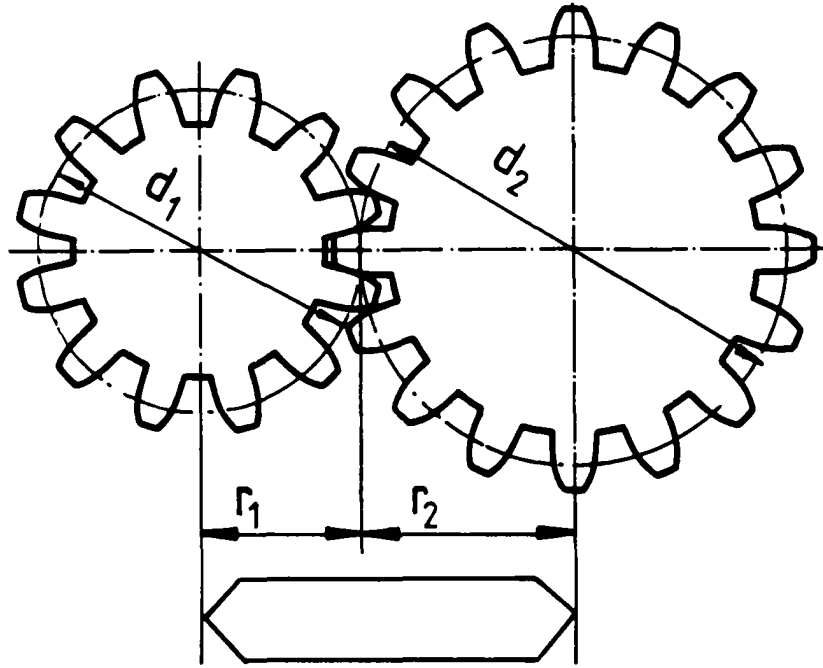
$d = \quad \text{mm}$

$h = \quad \text{mm}$



$z = \quad$

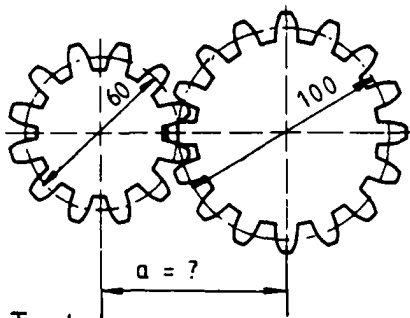
$d = \quad \text{mm}$



**= +**

1.

**a = — + —**



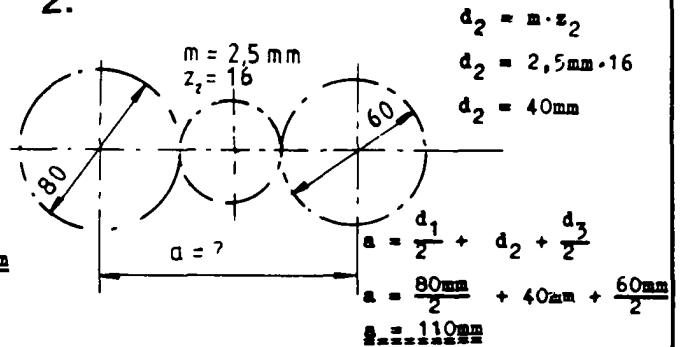
Test:

$$a = \frac{d_1}{2} + \frac{d_2}{2}$$

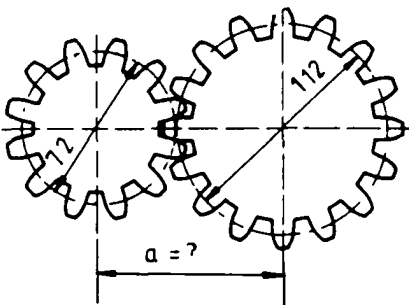
$$a = \frac{60\text{mm}}{2} + \frac{100\text{mm}}{2}$$

$$a = 80\text{mm}$$

2.



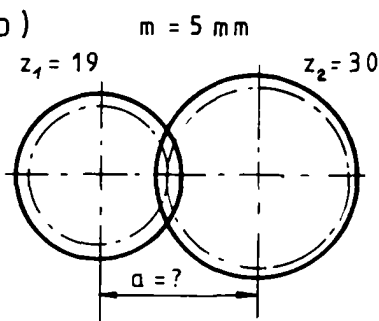
a)



a =  mm

c) a = 123 mm

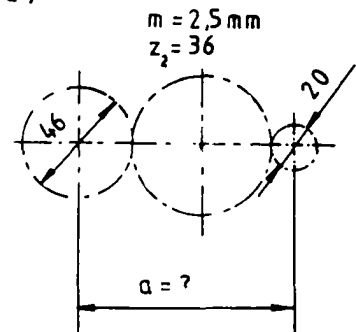
b)



a =  mm

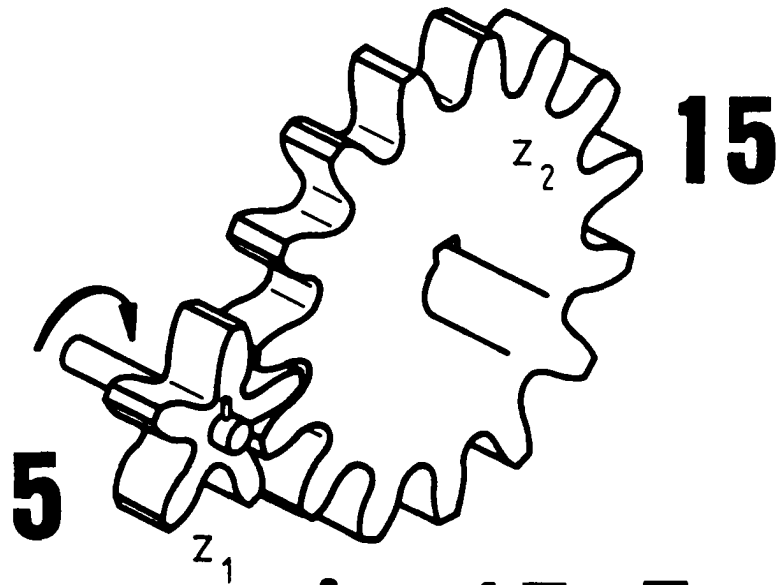
b) a = 122,5 mm

c)



a =  mm

a) a = 92 mm



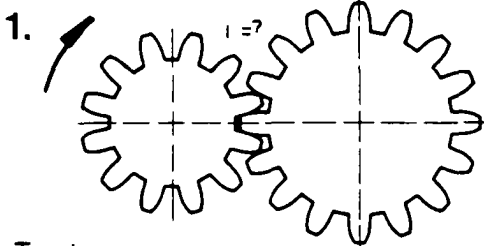
**$i = 15 : 5$**

$i = 3 : 1$

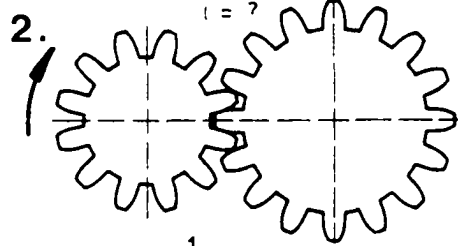
**$i = \underline{\hspace{2cm}}$**

**$i = \underline{\hspace{2cm}}$**

**$= \underline{\hspace{10cm}}$**



$i = \frac{z_2}{z_1}$   
 $i = \frac{12}{9}$   
 $i = 1.333$



$i = \frac{n_1}{n_2}$   
 $i = \frac{400 \frac{1}{\text{min}}}{300 \frac{1}{\text{min}}}$   
 $i = 1.333$   
 $n_1 = 400 \frac{1}{\text{min}}$        $n_2 = 300 \frac{1}{\text{min}}$

Test

a)  $i = ?$

$n_1 = 160 \frac{1}{\text{min}}$        $n_2 = 120 \frac{1}{\text{min}}$

$i = \underline{\hspace{2cm}}$

b)  $i = 1.8$

$n_1 = 1400 \frac{1}{\text{min}}$

$n_2 = ?$

$n_2 = \underline{\hspace{2cm}} \frac{1}{\text{min}}$

c)  $i = ?$

$n_1 = 800 \frac{1}{\text{min}}$

$z_1 = 17$        $z_2 = 34$

$i = \underline{\hspace{2cm}}$

$n_2 = \underline{\hspace{2cm}} \frac{1}{\text{min}}$

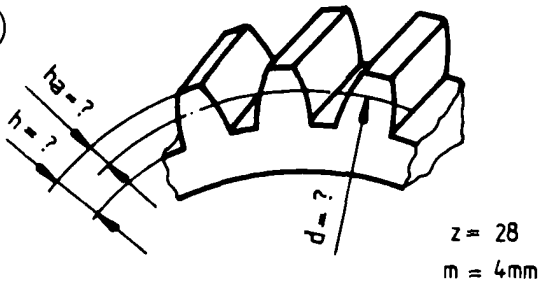
c)  $i = 2, n_2 = 400 \frac{1}{\text{min}}$

b)  $n_2 = 778 \frac{1}{\text{min}}$

a)  $i = 1.33$

$m = 5 \text{ mm}$

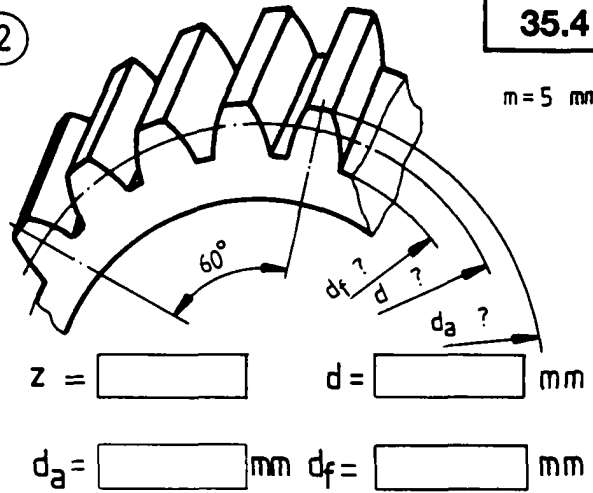
1



$d = \text{[ ]} \text{ mm}$

$h = \text{[ ]} \text{ mm} \quad h_a = \text{[ ]} \text{ mm}$

2

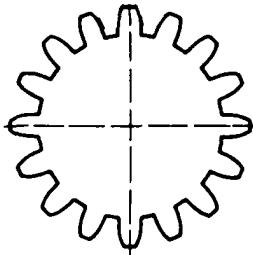


$z = \text{[ ]} \quad d = \text{[ ]} \text{ mm}$

$d_a = \text{[ ]} \text{ mm} \quad d_f = \text{[ ]} \text{ mm}$

3

$m = 175 \text{ mm}$

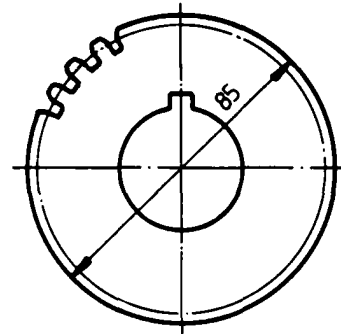


$z = \text{[ ]}$

$h_a = \text{[ ]} \text{ mm}; h_f = \text{[ ]} \text{ mm}$

4

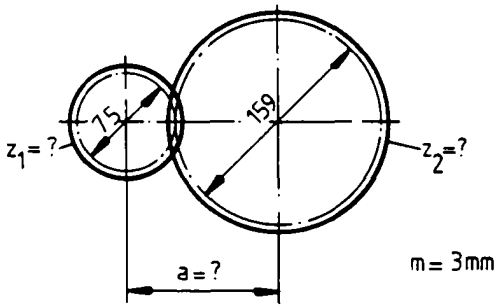
$z = 32$   
 $m = ?$   
 $d = ?$   
 $d_f = ?$



$m = \text{[ ]} \text{ mm}$

$d = \text{[ ]} \text{ mm} \quad d_f = \text{[ ]} \text{ mm}$

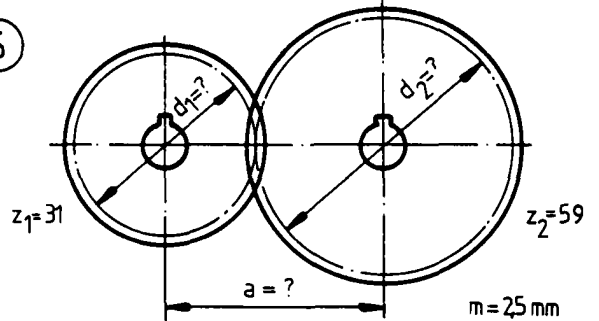
5



$z_1 = \text{[ ]}$

$z_2 = \text{[ ]} \quad a = \text{[ ]} \text{ mm}$

6

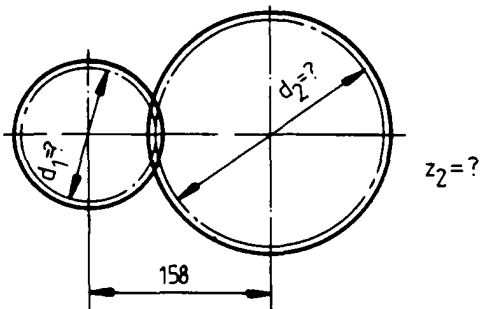


$d_1 = \text{[ ]} \text{ mm}$

$d_2 = \text{[ ]} \text{ mm} \quad a = \text{[ ]} \text{ mm}$

7

$m = 4 \text{ mm}$   
 $z_1 = 31$

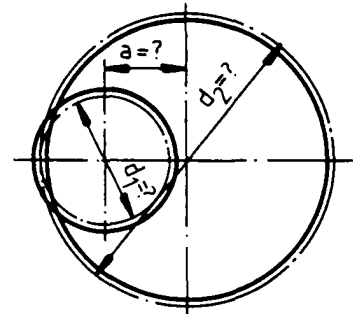


$d_1 = \text{[ ]} \text{ mm}$

$d_2 = \text{[ ]} \text{ mm} \quad z_2 = \text{[ ]}$

8

$z_1 = 31$   
 $z_2 = 92$   
 $m = 2,5 \text{ mm}$

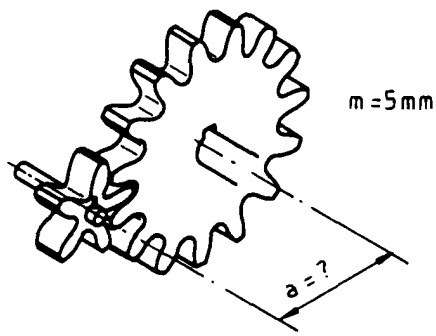


$d_1 = \text{[ ]} \text{ mm}$

$d_2 = \text{[ ]} \text{ mm} \quad a = \text{[ ]} \text{ mm}$

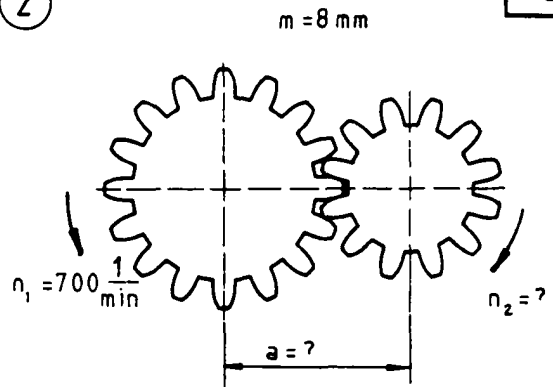


1



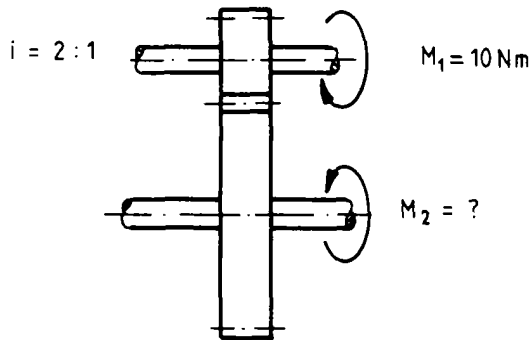
$a = \text{[ ] mm}$

2



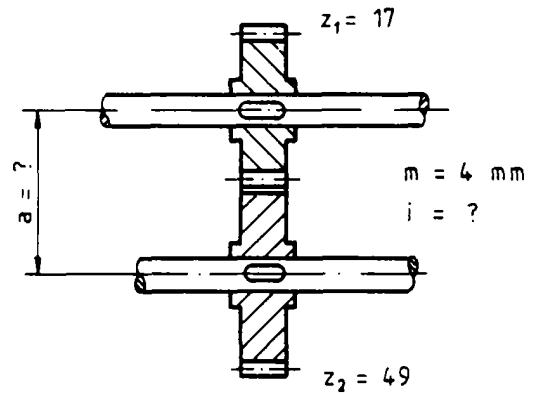
$a = \text{[ ] mm}; n_2 = \text{[ ] } \frac{1}{\text{min}}$

3



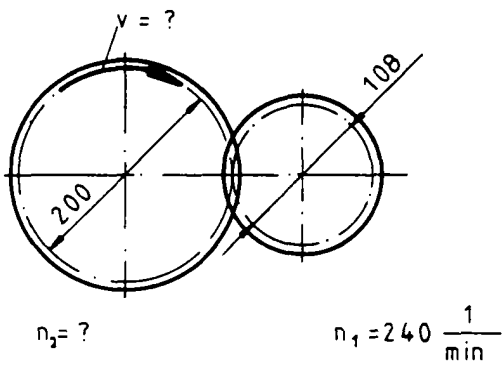
$M_2 = \text{[ ] Nm}$

4



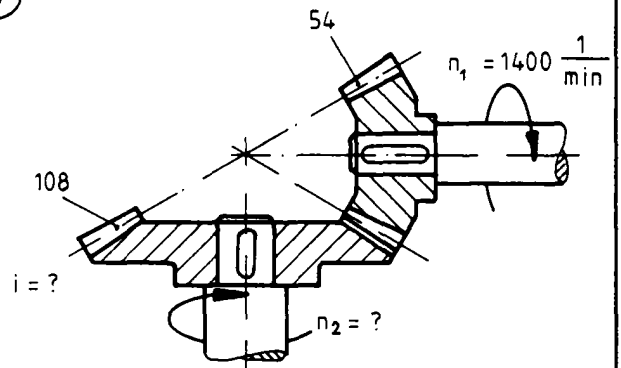
$a = \text{[ ] mm}; i = \text{[ ]}$

5



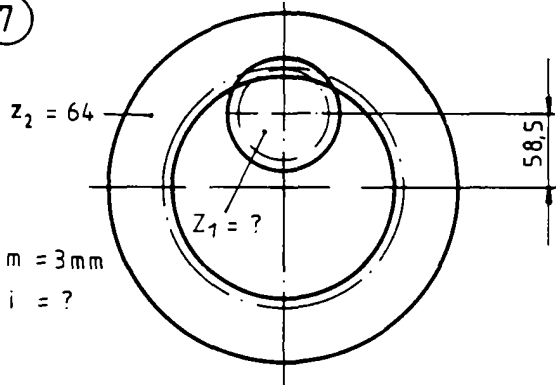
$n_2 = \text{[ ] } \frac{1}{\text{min}}; v = \text{[ ] } \frac{\text{m}}{\text{s}}$

6



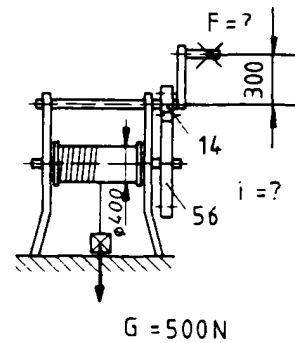
$i = \text{[ ]}; n_2 = \text{[ ] } \frac{1}{\text{min}}$

7

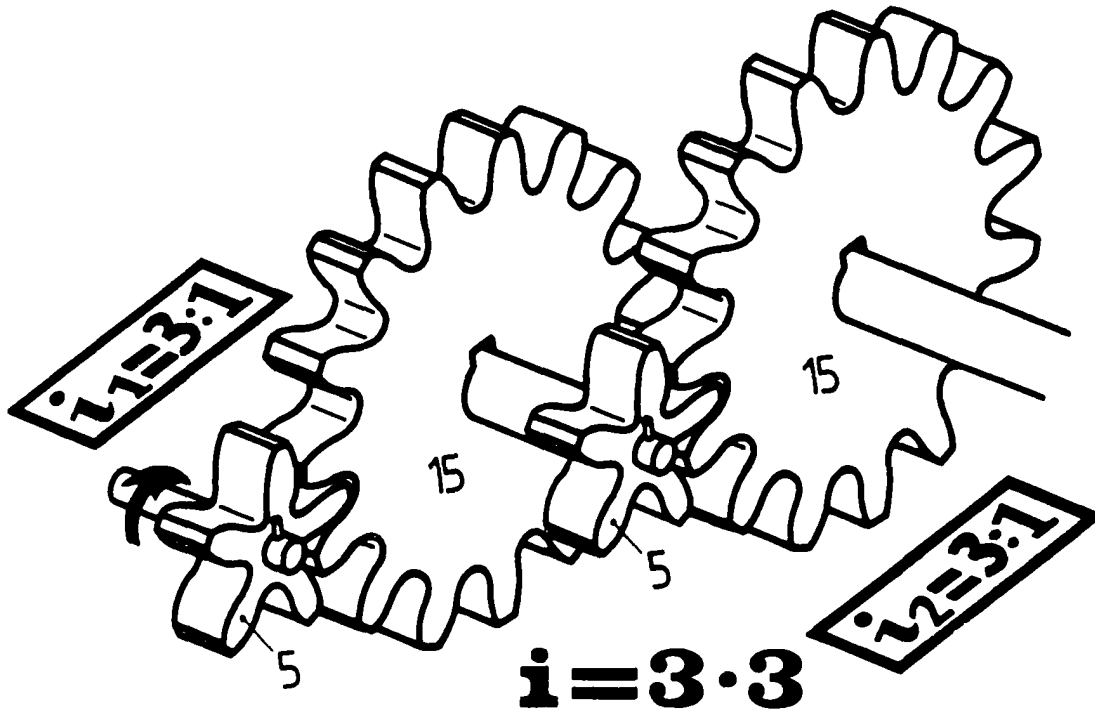


$z_1 = \text{[ ]}; i = \text{[ ]}$

8



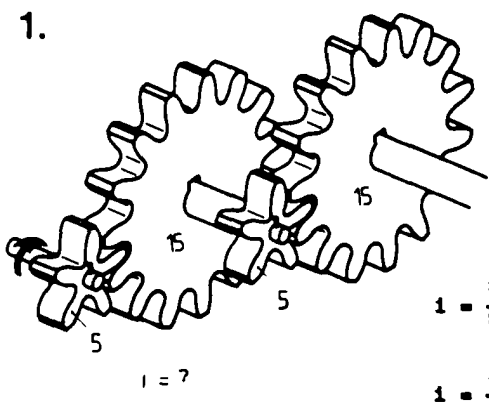
$i = \text{[ ]}; F = \text{[ ] N}$



$$i = \dots$$

$$i = \frac{z_2 \cdot z_4}{z_1 \cdot z_3}$$

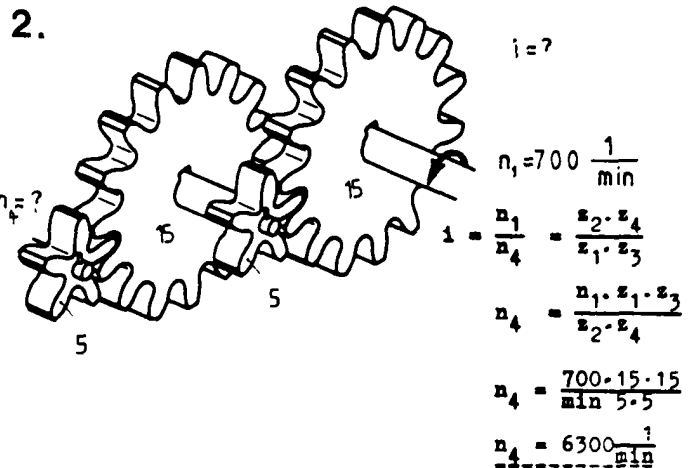
$$i = \frac{n_1}{n_4}$$



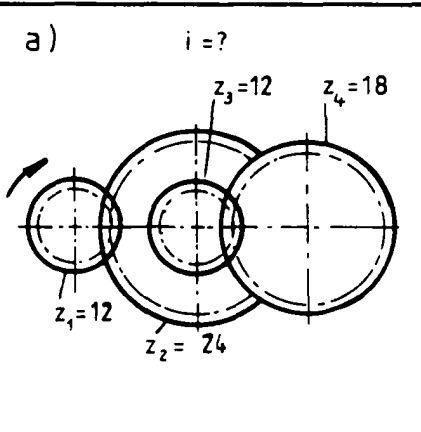
$$i = \frac{z_2 \cdot z_4}{z_1 \cdot z_3}$$

$$i = \frac{15 \cdot 15}{5 \cdot 5}$$

$$i = 9$$

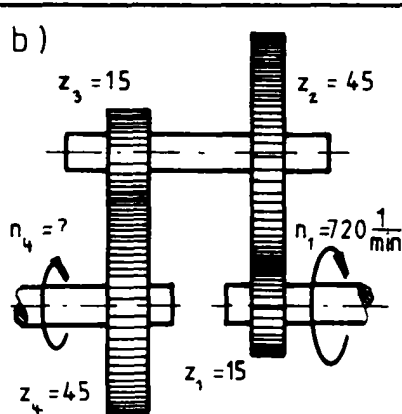


Test



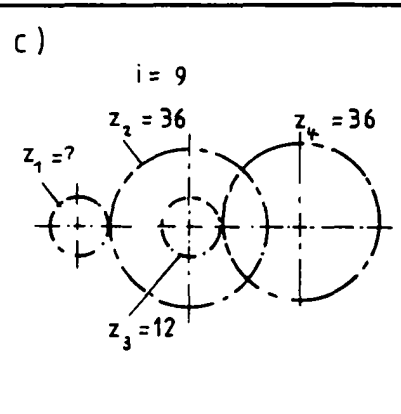
$$i = \boxed{\phantom{000}}$$

z1 = 12 (c)



$$n_4 = \boxed{\phantom{000}} \frac{1}{\text{min}}$$

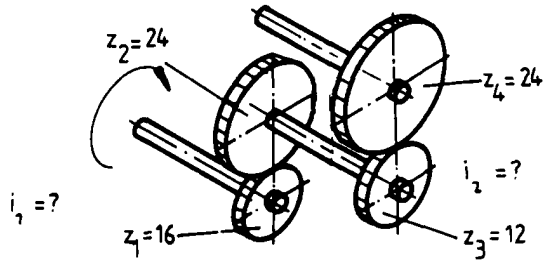
n1 = 720 1/min (b)



$$z_1 = \boxed{\phantom{000}}$$

i = 9 (c)

1



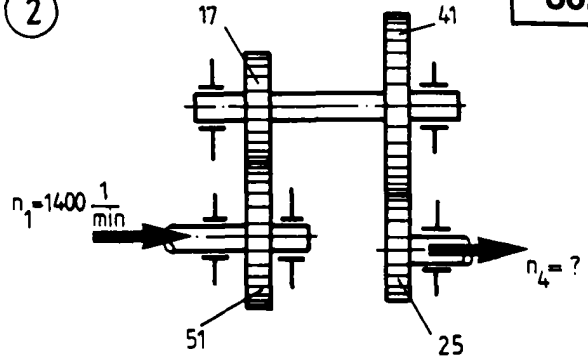
$i_1 = \boxed{\phantom{000}}$

$i_2 = \boxed{\phantom{000}}$

$i = \boxed{\phantom{000}}$

$i = \boxed{\phantom{000}}$

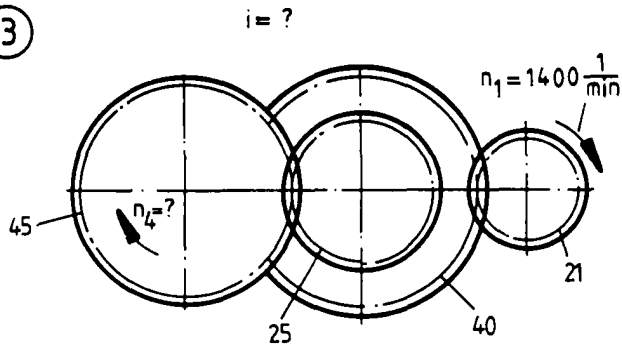
2



$n_4 = \boxed{\phantom{000}} \frac{1}{\text{min}}$

$i = \boxed{\phantom{000}}$

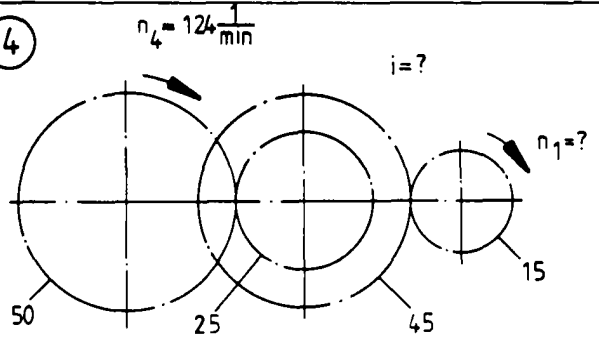
3



$i = \boxed{\phantom{000}}$

$n_4 = \boxed{\phantom{000}} \frac{1}{\text{min}}$

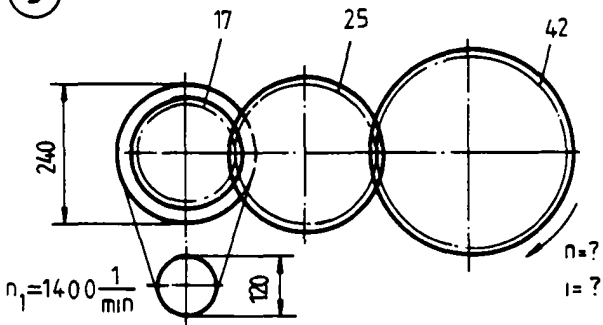
4



$i = \boxed{\phantom{000}}$

$n_1 = \boxed{\phantom{000}} \frac{1}{\text{min}}$

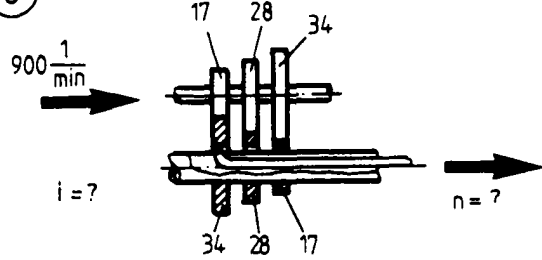
5



$i = \boxed{\phantom{000}}$

$n = \boxed{\phantom{000}} \frac{1}{\text{min}}$

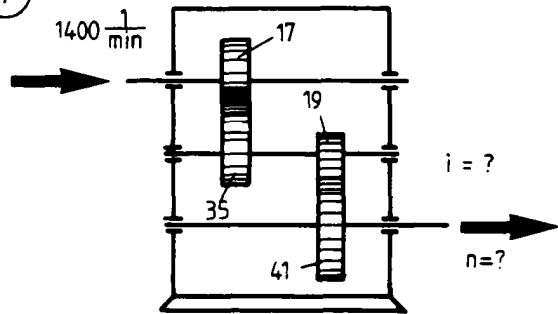
6



$i = \boxed{\phantom{000}}$

$n = \boxed{\phantom{000}} \frac{1}{\text{min}}$

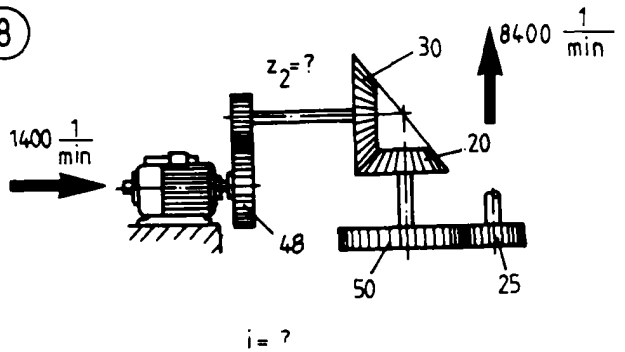
7



$i = \boxed{\phantom{000}}$

$n = \boxed{\phantom{000}} \frac{1}{\text{min}}$

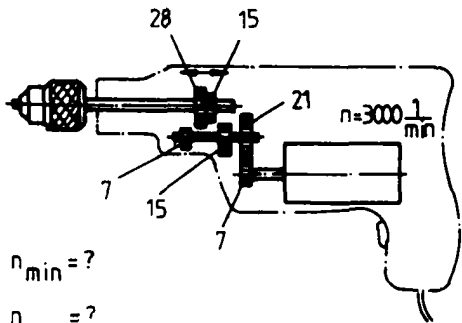
8



$i = \boxed{\phantom{000}}$

$z_2 = \boxed{\phantom{000}}$

9

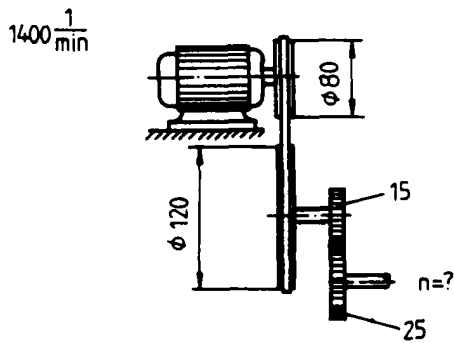


$n_{min} = ?$

$n_{max} = ?$

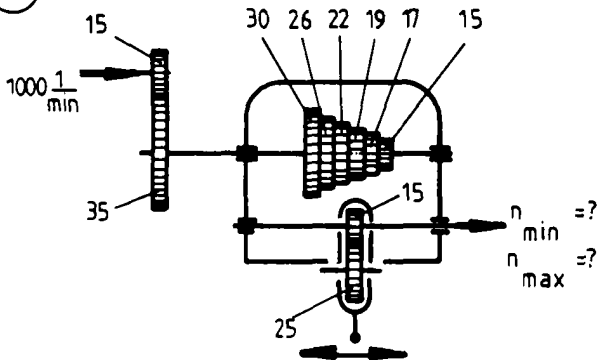
$n_{min} = \boxed{\phantom{000}} \frac{1}{min}; n_{max} = \boxed{\phantom{000}} \frac{1}{min}$

10



$n = \boxed{\phantom{000}} \frac{1}{min}$

11

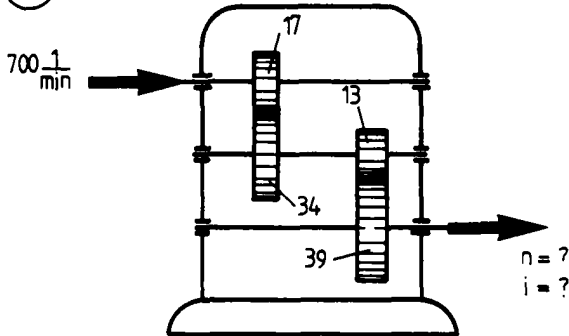


$n_{min} = ?$

$n_{max} = ?$

$n_{min} = \boxed{\phantom{000}} \frac{1}{min}; n_{max} = \boxed{\phantom{000}} \frac{1}{min}$

12

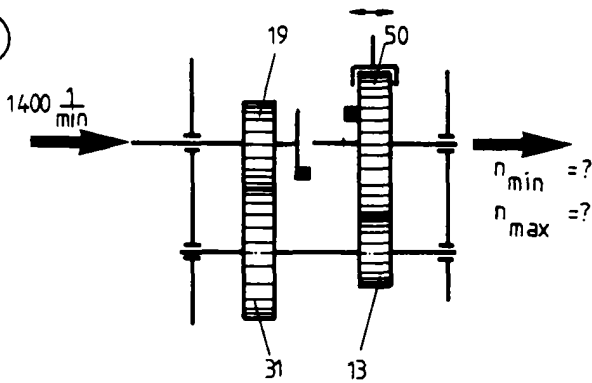


$n = ?$

$i = ?$

$i = \boxed{\phantom{000}}; n = \boxed{\phantom{000}} \frac{1}{min}$

13

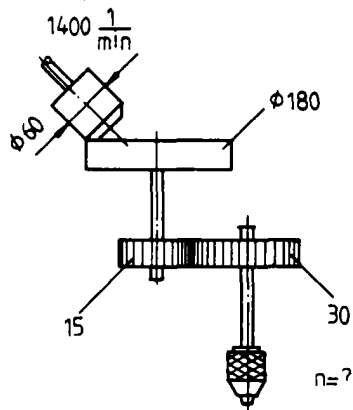


$n_{min} = ?$

$n_{max} = ?$

$n_{min} = \boxed{\phantom{000}} \frac{1}{min}; n_{max} = \boxed{\phantom{000}} \frac{1}{min}$

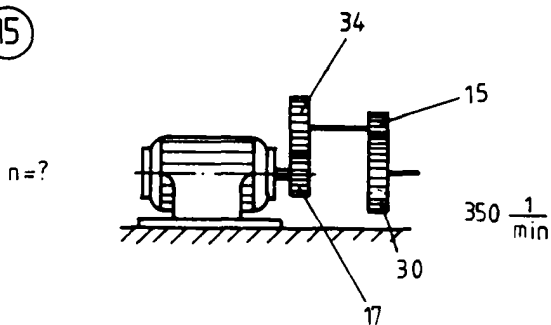
14



$n = ?$

$n = \boxed{\phantom{000}} \frac{1}{min}$

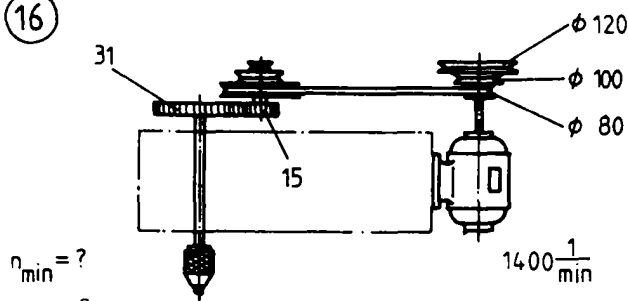
15



$n = ?$

$n = \boxed{\phantom{000}} \frac{1}{min}$

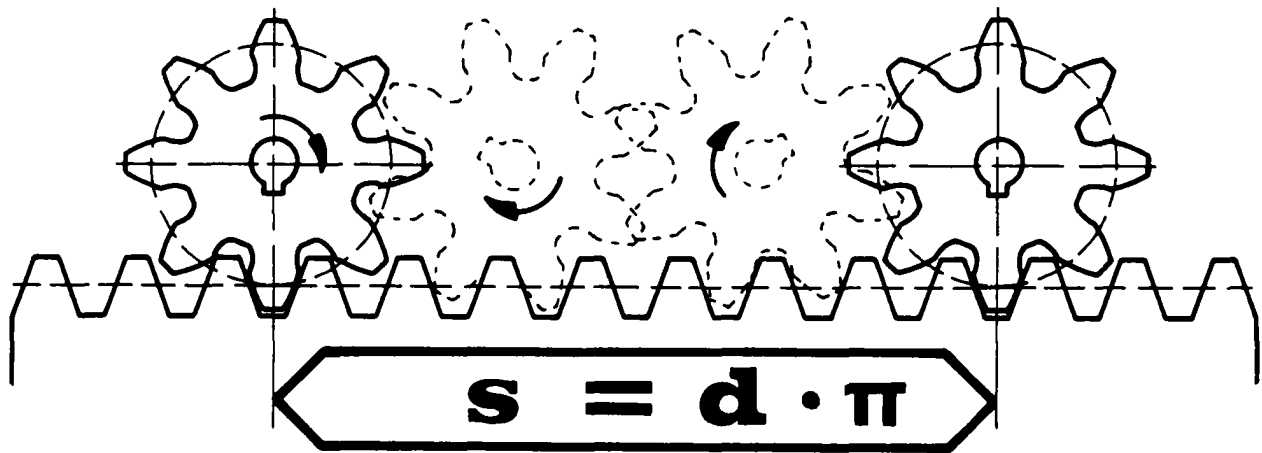
16



$n_{min} = ?$

$n_{max} = ?$

$n_{min} = \boxed{\phantom{000}} \frac{1}{min}; n_{max} = \boxed{\phantom{000}} \frac{1}{min}$

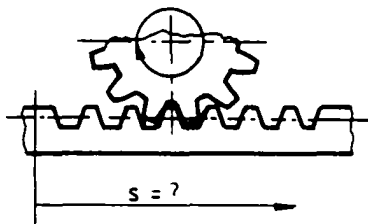


**=**

**$s = \cdot \cdot$**

1.

$z = 12$   
 $m = 4 \text{ mm}$

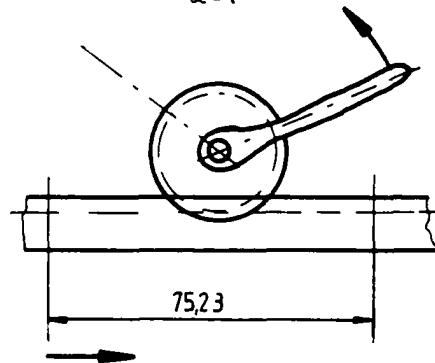


$s = m \cdot z \cdot \pi$   
 $s = 4 \text{ mm} \cdot 12 \cdot 3,14$   
 $s = 150,72 \text{ mm}$

Test

2.

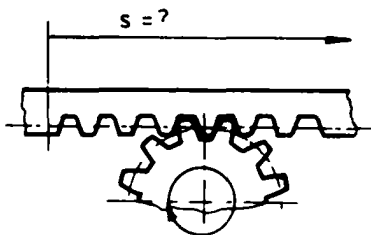
$z = 15$        $m = 5 \text{ mm}$   
 $\alpha = ?$



$s = m \cdot z \cdot \pi$   
 $s = 5 \text{ mm} \cdot 15 \cdot 3,14$   
 $s = 235,5 \text{ mm}$   
 $\frac{\alpha}{360^\circ} = \frac{75,23 \text{ mm}}{235,5 \text{ mm}}$   
 $\alpha = \frac{75,23 \cdot 360^\circ}{235,5}$   
 $\alpha = 115^\circ$

a)

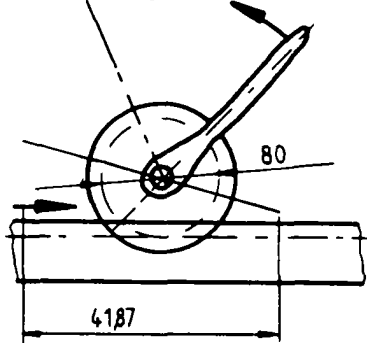
$z = 12$        $m = 6 \text{ mm}$



$s = \text{[ ] mm}$

b)

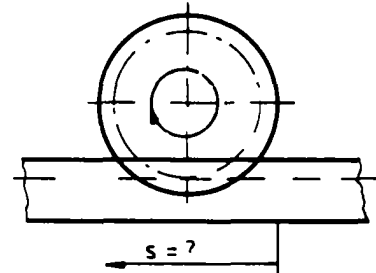
$\alpha = ?$



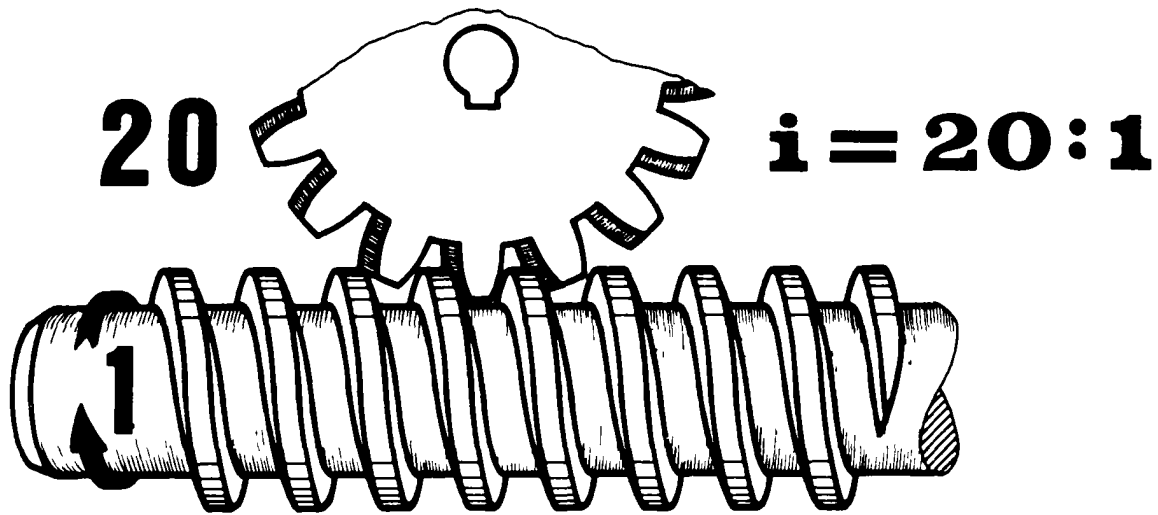
$\alpha = \text{[ ]}^\circ$

c)

$m = 4 \text{ mm}$   
 $z = 21$



$s = \text{[ ] mm}$



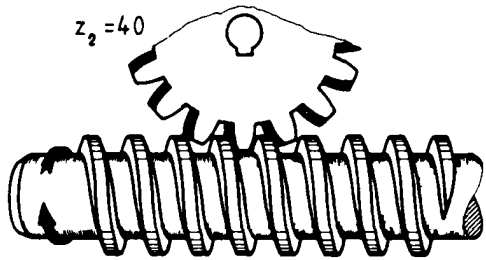
$=$  \_\_\_\_\_

$i =$  \_\_\_\_\_

$i =$  \_\_\_\_\_

1.

$i = ?$

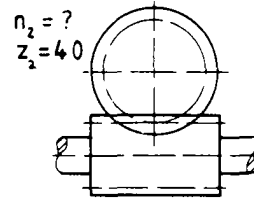


$i = \frac{z_2}{z_1}$   
 $i = \frac{40}{2}$   
 $i = 20$

Test:  $z_1 = 2$

2.

$i = ?$



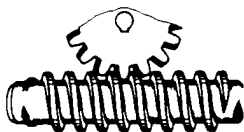
$n_1 = 1400 \frac{1}{\text{min}}$   $z_1 = 2$

$i = \frac{z_2}{z_1}$   
 $i = \frac{40}{2}$   
 $i = 20$   
 $i = \frac{n_1}{n_2}$   
 $n_2 = \frac{n_1}{i}$   
 $n_2 = \frac{1400}{20}$   
 $n_2 = 70 \frac{1}{\text{min}}$

a)

$i = ?$

$z_2 = 40$



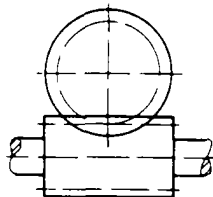
$z_1 = 2$

$i =$

b)

$i = ?$

$n_2 = 70 \frac{1}{\text{min}}$

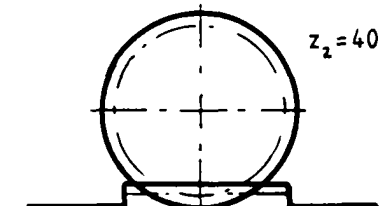


$n_1 = 1400 \frac{1}{\text{min}}$

$i =$

c)  $i = ?$

$n_2 = ?$



$z_1 = 1$

$n_1 = 1400 \frac{1}{\text{min}}$

$i =$

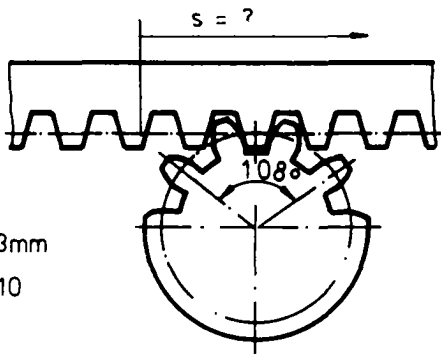
$n_2 =$    $\frac{1}{\text{min}}$

c)  $i = 40, n_2 = 35 \frac{1}{\text{min}}$

b)  $i = 20$

a)  $i = 20$

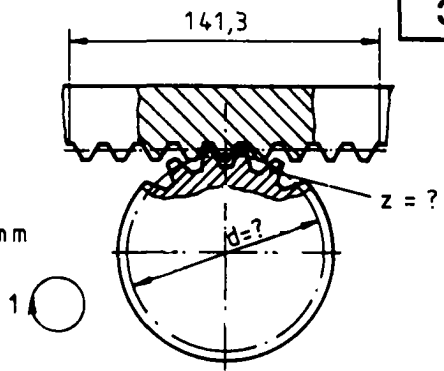
1



$m = 3\text{ mm}$   
 $z = 10$

$s = \text{[ ] mm}$

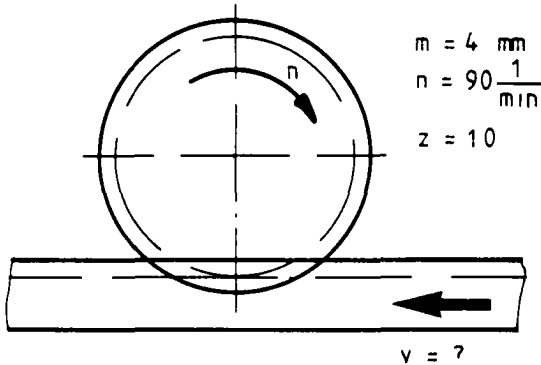
2



$m = 3\text{ mm}$

$d = \text{[ ] mm} ; z = \text{[ ]}$

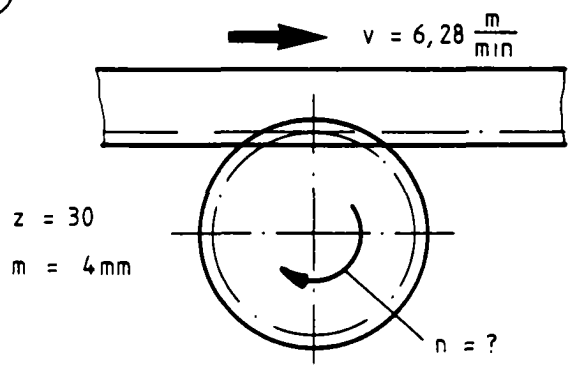
3



$m = 4\text{ mm}$   
 $n = 90 \frac{1}{\text{min}}$   
 $z = 10$

$v = \text{[ ] } \frac{\text{m}}{\text{min}}$

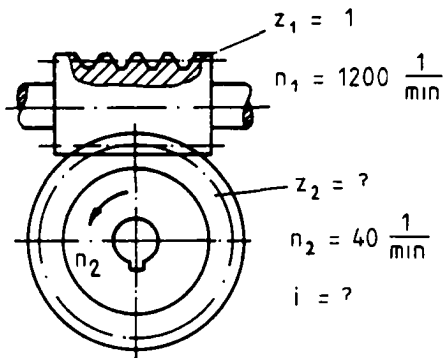
4



$z = 30$   
 $m = 4\text{ mm}$

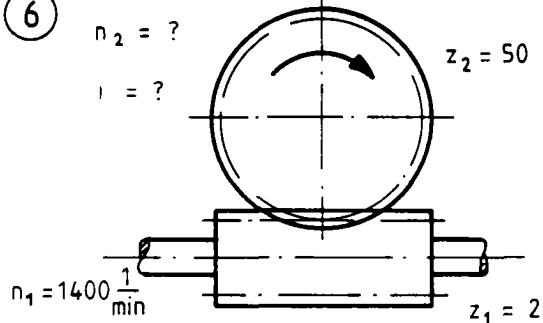
$n = \text{[ ] } \frac{1}{\text{min}}$

5



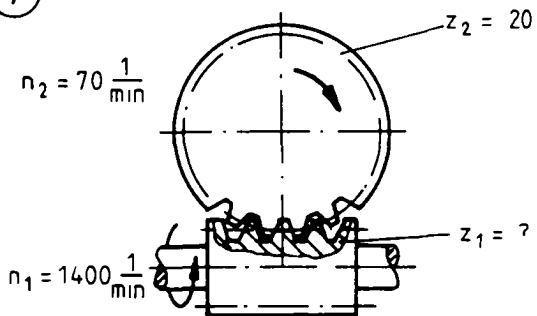
$i = \text{[ ]} ; z_2 = \text{[ ]}$

6



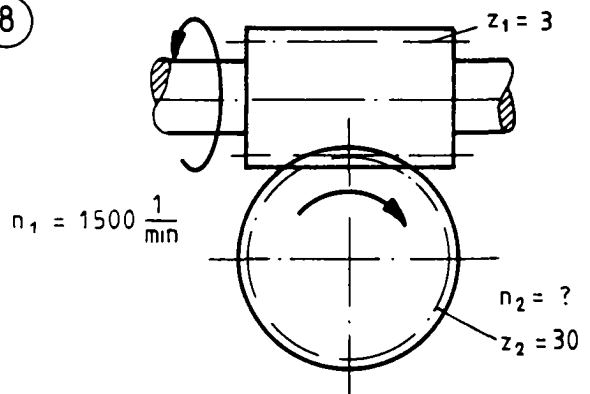
$i = \text{[ ]} ; n_2 = \text{[ ] } \frac{1}{\text{min}}$

7



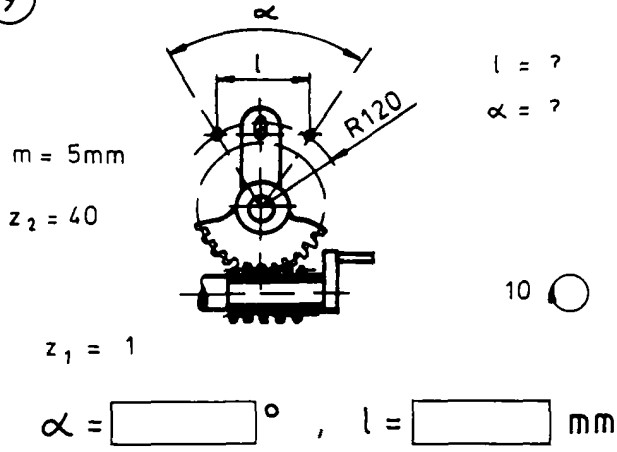
$z_1 = \text{[ ]}$

8

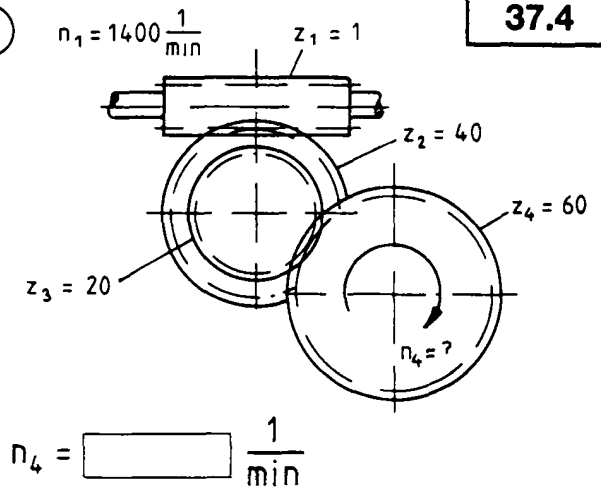


$n_2 = \text{[ ] } \frac{1}{\text{min}}$

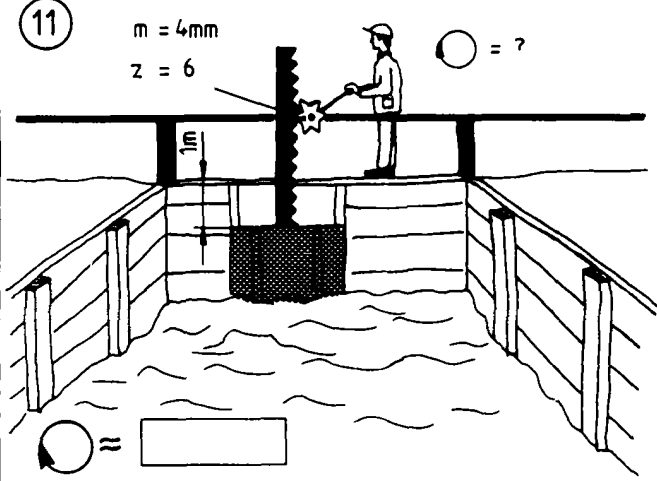
9



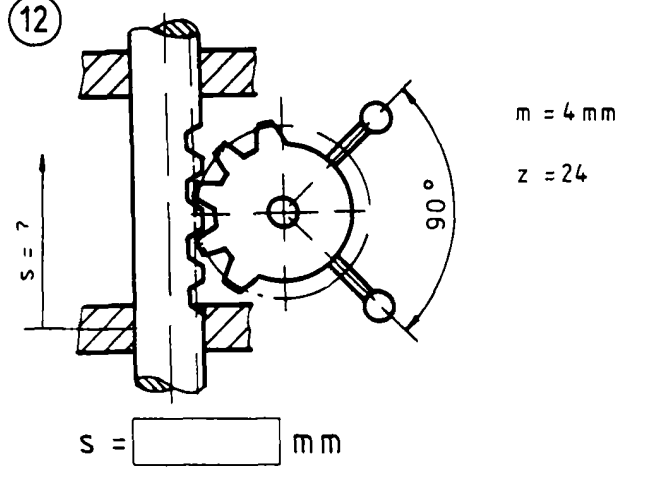
10



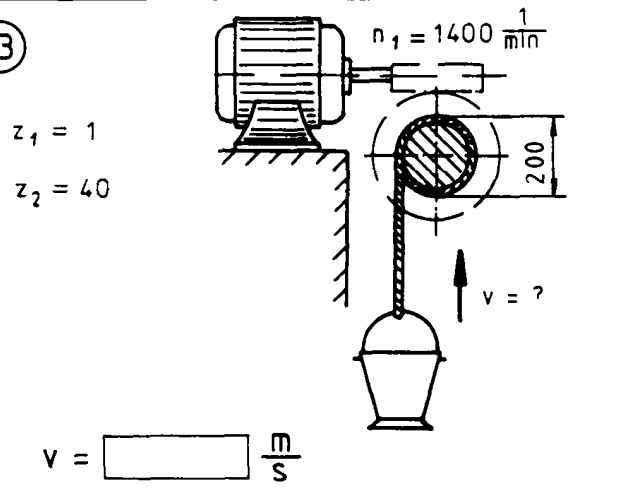
11



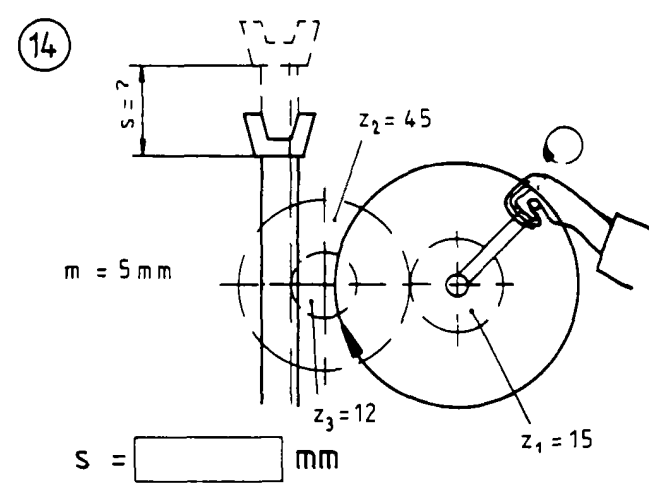
12



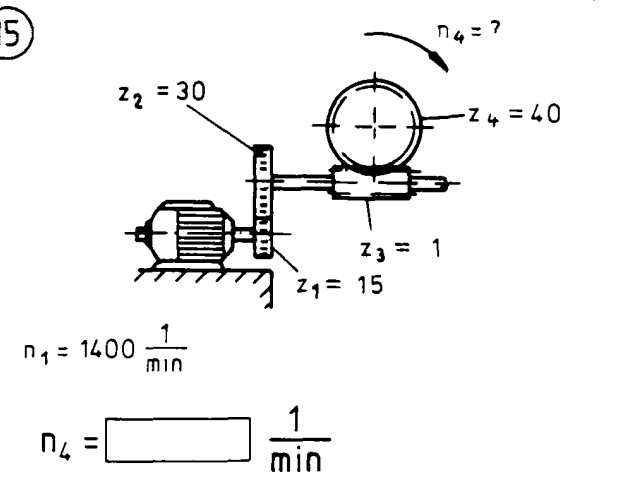
13



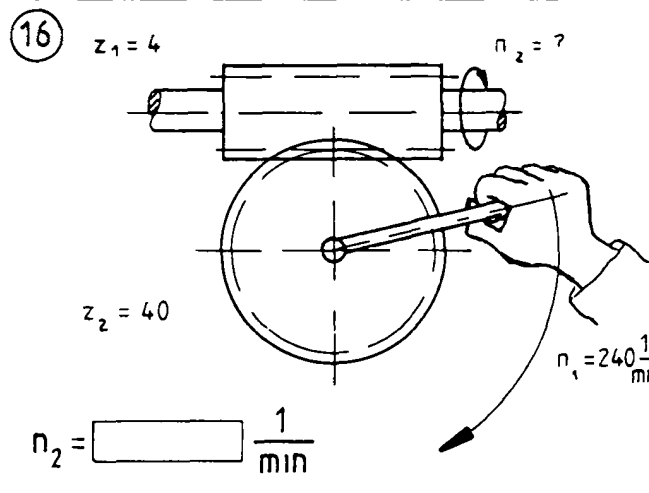
14



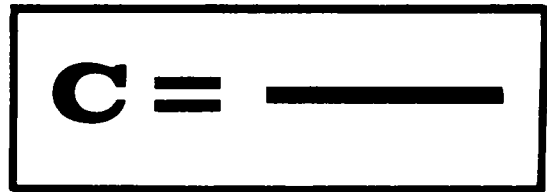
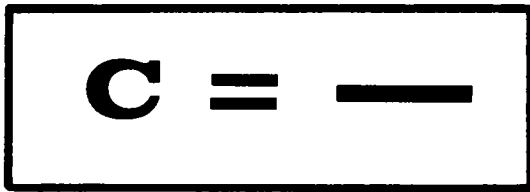
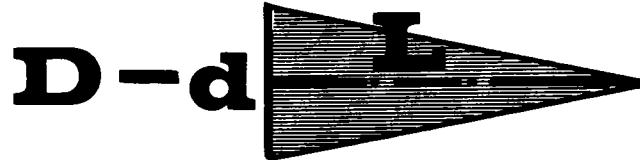
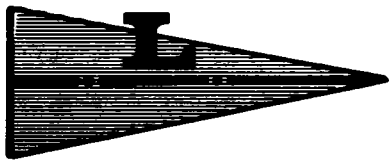
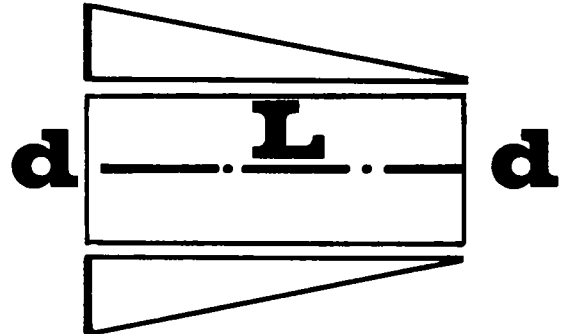
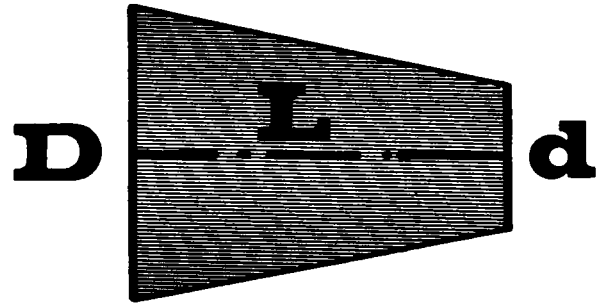
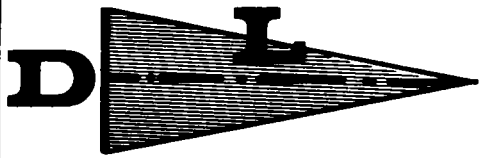
15



16





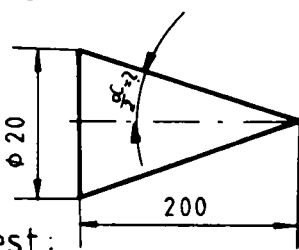


1. C = ?

$$c = \frac{D}{L}$$

$$c = \frac{20\text{mm}}{200\text{mm}}$$

$$C = 1 : 10$$



Test:

$$\tan \frac{\alpha}{2} = \frac{D}{2L}$$

$$\tan \frac{\alpha}{2} = \frac{20\text{mm}}{2 \cdot 200\text{mm}}$$

$$\tan \frac{\alpha}{2} = 0,05$$

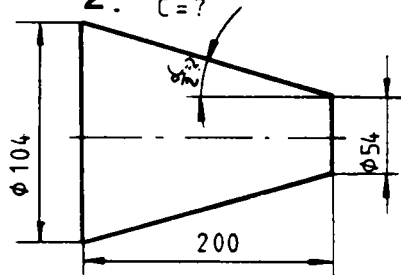
$$\frac{\alpha}{2} = 2,86^\circ$$

2. C = ?

$$c = \frac{D-d}{L}$$

$$c = \frac{104\text{mm} - 54\text{mm}}{200\text{mm}}$$

$$C = 1 : 4$$

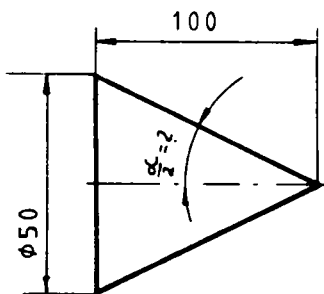


$$\tan \frac{\alpha}{2} = \frac{c}{2}$$

$$\tan \frac{\alpha}{2} = \frac{0,25}{2} = 0,125$$

$$\frac{\alpha}{2} = 7,13^\circ$$

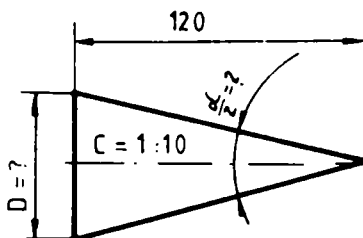
a) C = ?



$$C = \text{[ ]}$$

$$\frac{\alpha}{2} = \text{[ ]}^\circ$$

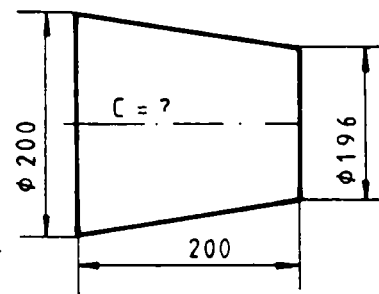
b)



$$\frac{\alpha}{2} = \text{[ ]}^\circ$$

$$D = \text{[ ]} \text{ mm}$$

c)

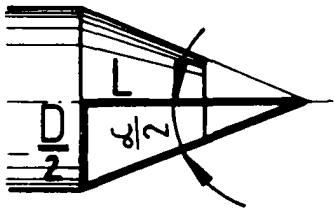
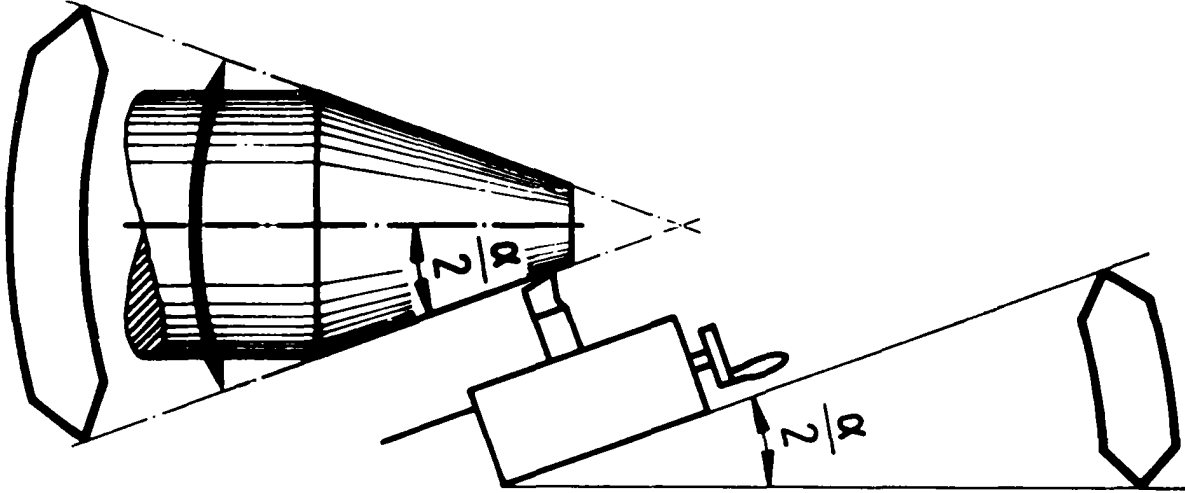


$$C = \text{[ ]}$$

a) C = 1 : 50

b) D = 12mm, alpha/2 = 2,86 degrees

c) C = 1 : 2, alpha/2 = 14 degrees



$$\tan \frac{\alpha}{2} = \frac{D-d}{2L}$$

1.

2.

$C = ? ; \frac{\alpha}{2} = ?$

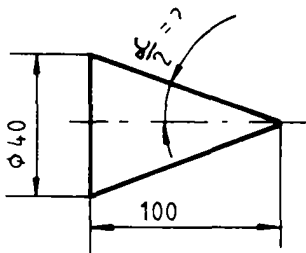
$c = \frac{D}{L}$   
 $c = \frac{90\text{mm}}{200\text{mm}}$   
 $c = 0,45$   
 $\tan \frac{\alpha}{2} = \frac{D}{2L}$   
 $\tan \frac{\alpha}{2} = \frac{90\text{mm}}{200\text{mm} \cdot 2}$   
 $\frac{\alpha}{2} = 12,68^\circ$

$C = ?$

$c = \frac{D-d}{L}$   
 $c = \frac{104\text{mm} - 100\text{mm}}{200\text{mm}}$   
 $c = 1 : 50$   
 $\tan \frac{\alpha}{2} = \frac{c}{2}$   
 $\tan \frac{\alpha}{2} = \frac{1}{2 \cdot 50}$   
 $\tan \frac{\alpha}{2} = 0,01$   
 $\frac{\alpha}{2} = 0,5729^\circ$

Test

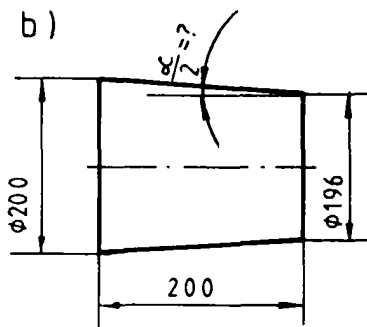
a)



$C =$

$\frac{\alpha}{2} =$   °

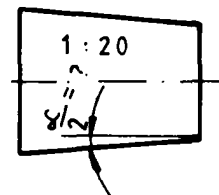
b)



$C =$

$\frac{\alpha}{2} =$   °

c)



$\frac{\alpha}{2} =$   °

c)  $C = 0,4 ; \frac{\alpha}{2} = 1,43^\circ$

b)  $C = 1 : 50 ; \frac{\alpha}{2} = 0,5729^\circ$

a)  $C = 0,4 ; \frac{\alpha}{2} = 11,3^\circ$

1

$\frac{\alpha}{2} = \text{[ ]}^\circ$        $\triangle 1:$

2

$L = \text{[ ]} \text{ mm}$        $\frac{\alpha}{2} = \text{[ ]}^\circ$

3

$D = \text{[ ]} \text{ mm}$        $\frac{\alpha}{2} = \text{[ ]}^\circ$

4

$L = \text{[ ]} \text{ mm}$        $\frac{\alpha}{2} = \text{[ ]}^\circ$

5

$C = \text{[ ]}$        $x = \text{[ ]} \text{ mm}$

6

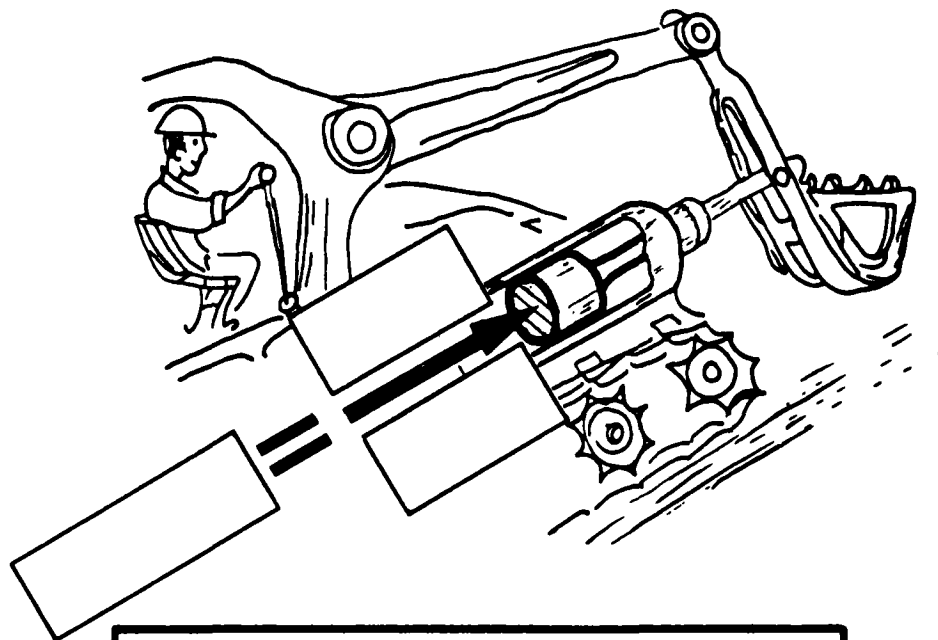
$C = \text{[ ]}$        $\frac{\alpha}{2} = \text{[ ]}^\circ$

7

$x = \text{[ ]} \text{ mm}$

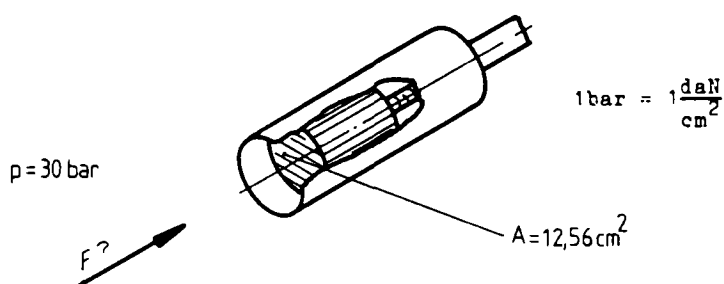
8

$x = \text{[ ]} \text{ mm}$        $L = \text{[ ]} \text{ mm}$



$$= \text{—————}$$

$$p = \text{—————}$$



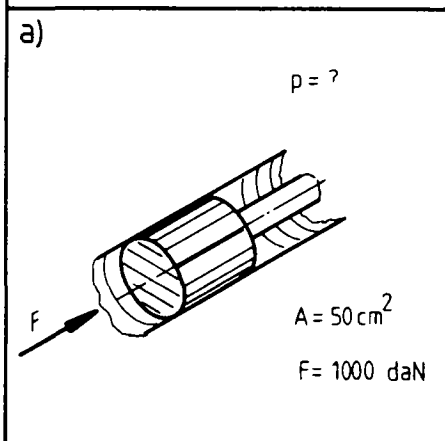
$$p = \frac{F}{A}$$

$$F = p \cdot A$$

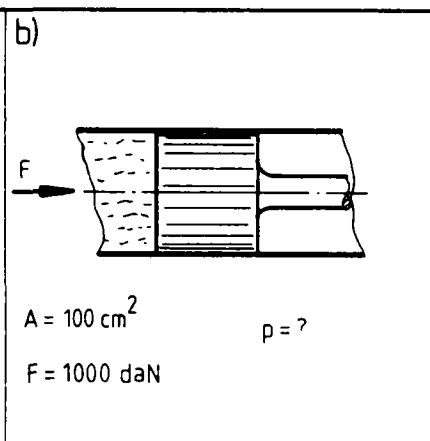
$$F = 30 \frac{\text{daN}}{\text{cm}^2} \cdot 12,56 \text{ cm}^2$$

$$F = 377 \text{ daN}$$

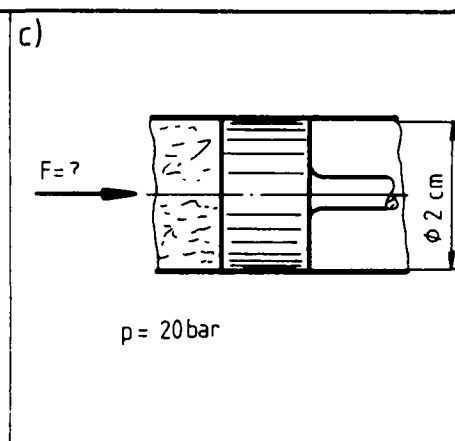
Test:



$$p = \text{[ ]} \frac{\text{daN}}{\text{cm}^2}$$

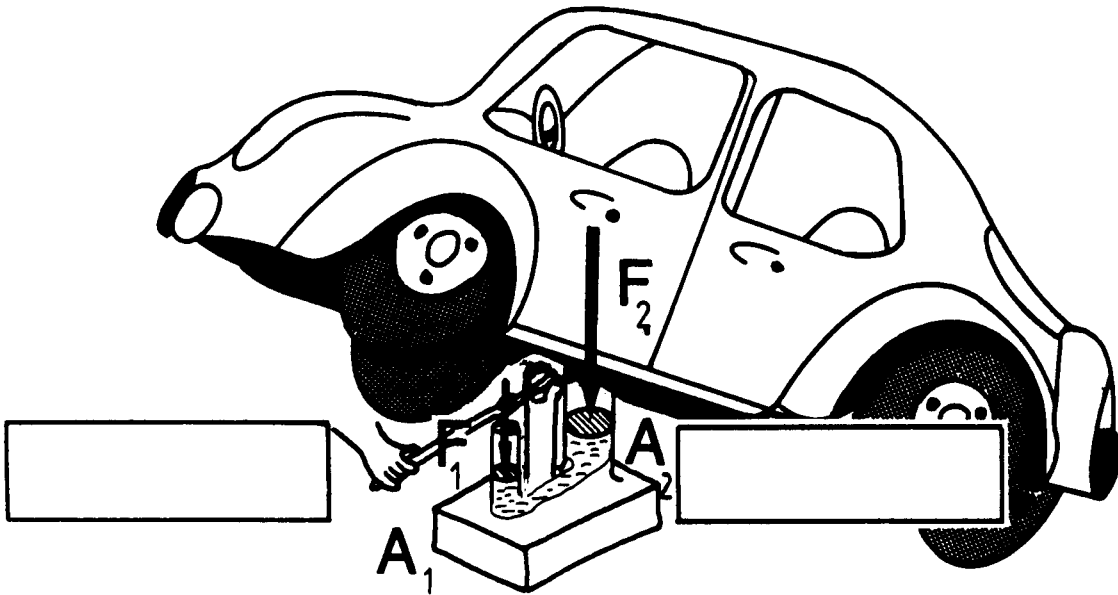
 (c)  $p = 20 \text{ daN/cm}^2$ 


$$p = \text{[ ]} \text{ bar}$$

 (d)  $p = 10 \text{ bar}$ 


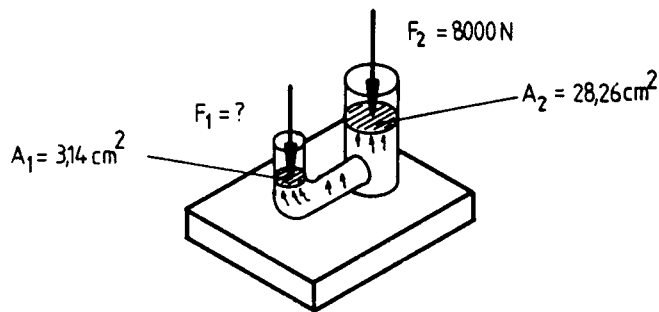
$$F = \text{[ ]} \text{ daN}$$

 (a)  $p = 20 \text{ daN/cm}^2$



$$P_1 = P_2$$

$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

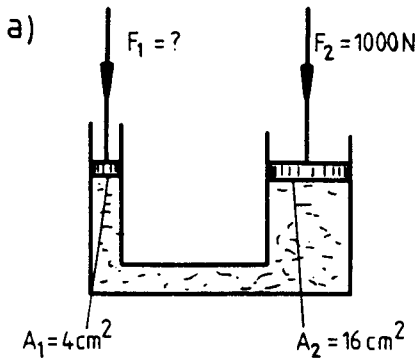


$$\frac{F_1}{A_1} = \frac{F_2}{A_2}$$

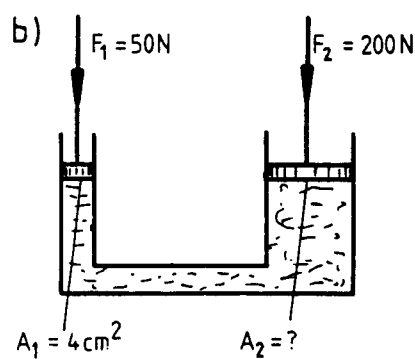
$$P_1 = \frac{F_2 \cdot A_1}{A_2}$$

$$F_1 = \frac{8000 \cdot 3,14 \text{ cm}^2}{28,26 \text{ cm}^2}$$

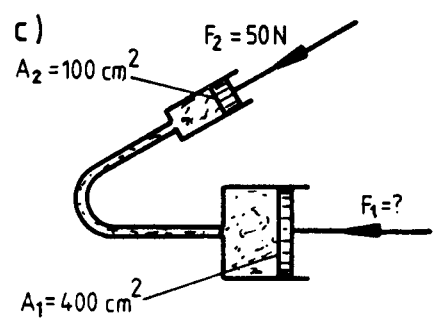
$$F_1 = 889 \text{ N}$$



$$F_1 = \boxed{\phantom{000}} \text{ N}$$

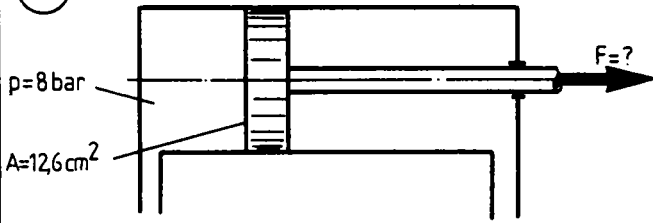


$$A_2 = \boxed{\phantom{000}} \text{ cm}^2$$



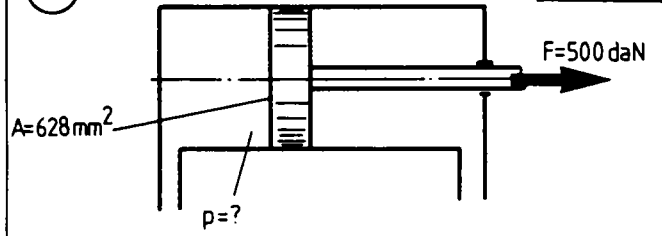
$$F_1 = \boxed{\phantom{000}} \text{ N}$$

1



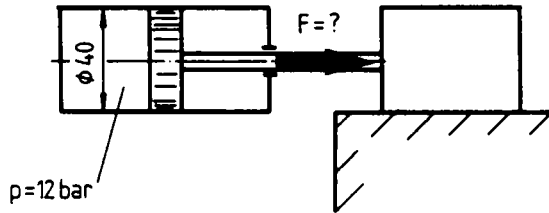
$F = \text{[ ]} \text{ N}$

2



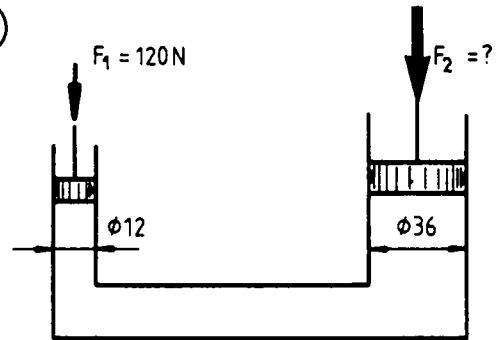
$p = \text{[ ]} \text{ bar}$

3



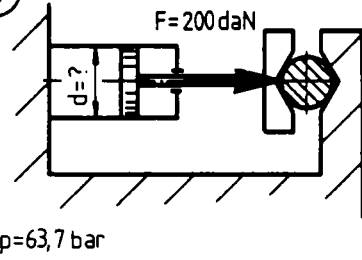
$F = \text{[ ]} \text{ daN}$

4



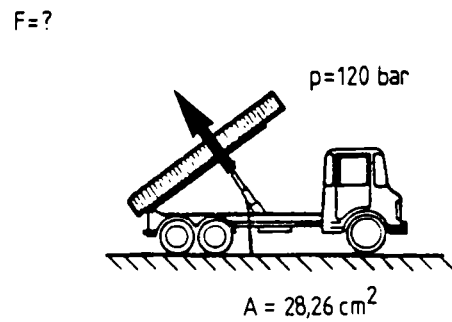
$F_2 = \text{[ ]} \text{ N}$

5



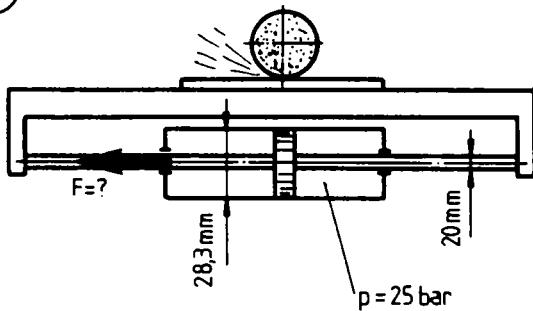
$d = \text{[ ]} \text{ mm}$

6



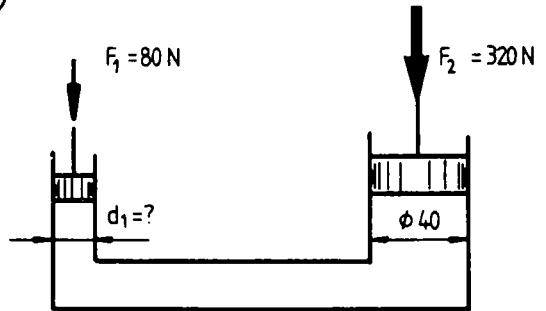
$F = \text{[ ]} \text{ kN}$

7



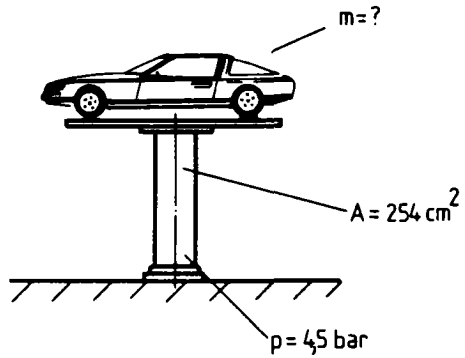
$F = \text{[ ]} \text{ daN}$

8



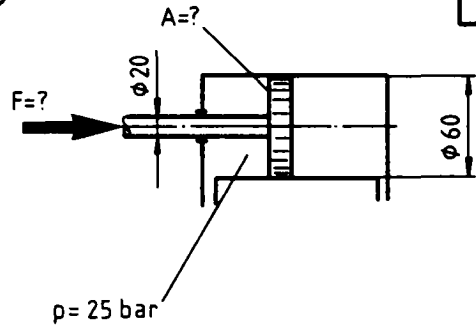
$d_1 = \text{[ ]} \text{ mm} ; p = \text{[ ]} \text{ bar}$

9



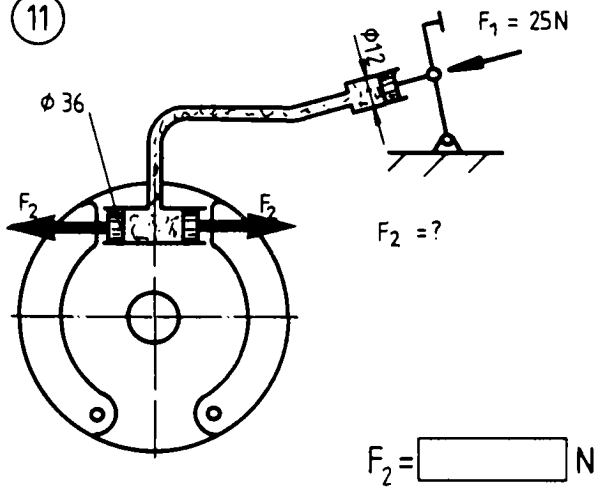
$m = \text{[ ] kg}$

10



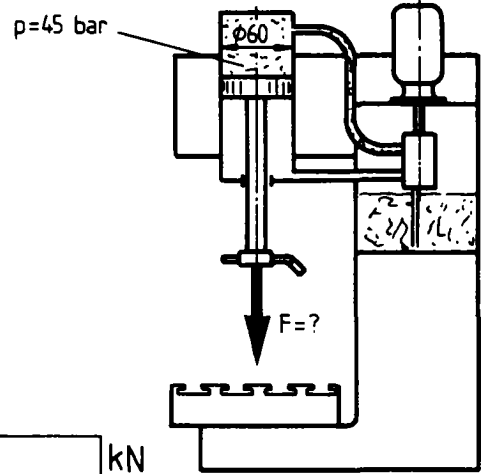
$A = \text{[ ] cm}^2 ; F = \text{[ ] daN}$

11



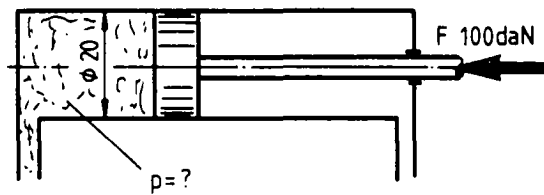
$F_2 = \text{[ ] N}$

12



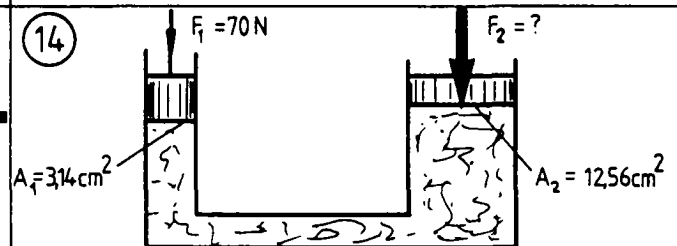
$F = \text{[ ] kN}$

13



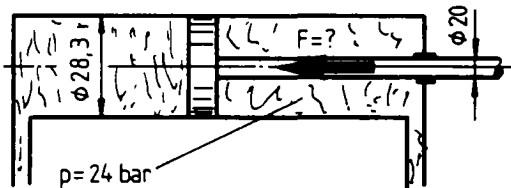
$p = \text{[ ] bar}$

14



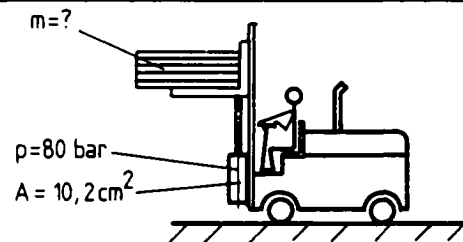
$F_2 = \text{[ ] N}$

15



$F = \text{[ ] N}$

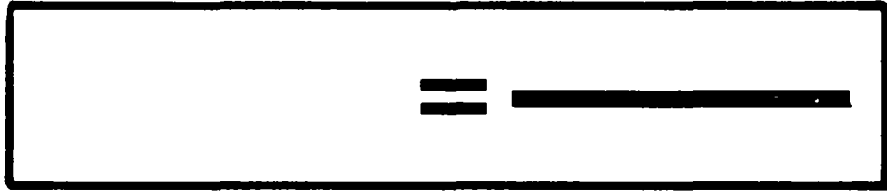
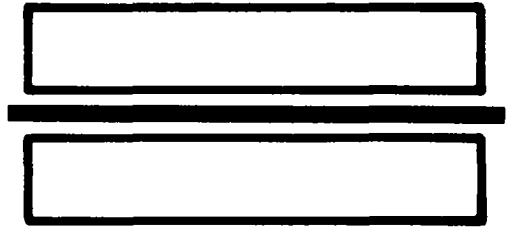
16



$m = \text{[ ] kg}$



$$F = A \cdot \sigma$$



$$\sigma = \frac{F}{A}$$

$$\sigma = \frac{F}{A}$$

$$F = \sigma \cdot A$$

$$F = 100 \frac{N}{mm^2} \cdot 4 mm \cdot 20 mm$$

$$F = 8000 N$$

$$\sigma = 100 \frac{N}{mm^2}$$

1.



$$F = 10000 N$$

$$A = 78,5 mm^2$$

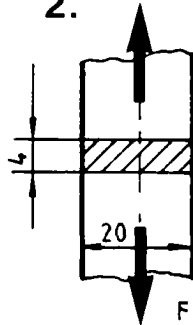
$$\sigma = ?$$

$$\sigma = \frac{F}{A}$$

$$\sigma = \frac{10000 N}{78,5 mm^2}$$

$$\sigma = 127 \frac{N}{mm^2}$$

2.



$$F = ?$$

Test:

a)

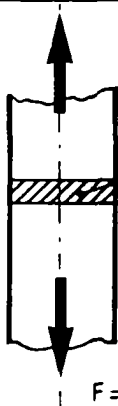


$$F = 314 N$$

$$A = 3,14 mm^2$$

$$\sigma = ?$$

b)

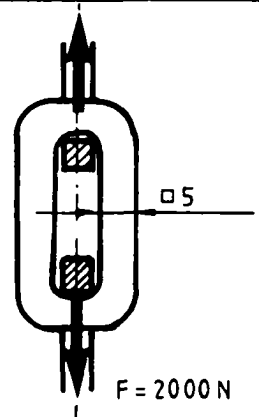


$$F = ?$$

$$A = 20 mm^2$$

$$\sigma = 100 \frac{N}{mm^2}$$

c)



$$A = ?$$

$$\sigma = ?$$

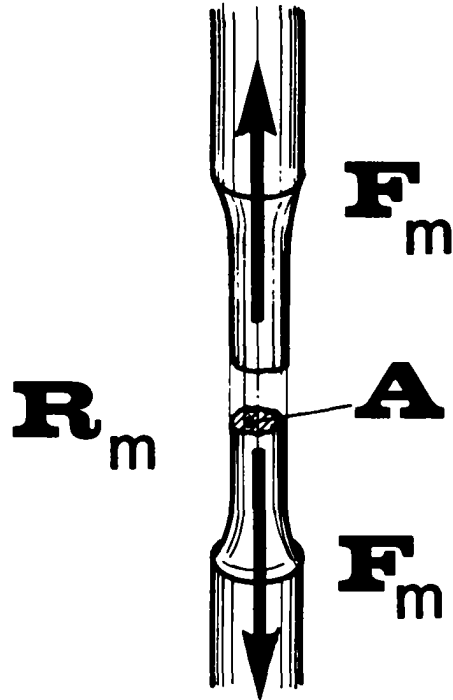
$$F = 2000 N$$

$$\sigma = \boxed{\phantom{000}} \frac{N}{mm^2}$$

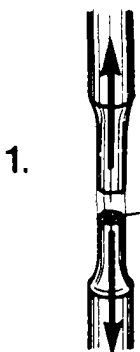
$$F = \boxed{\phantom{000}} N$$

$$A = \boxed{\phantom{000}} mm^2, \sigma = \boxed{\phantom{000}} \frac{N}{mm^2}$$





$$= \text{-----}$$



$$R_m = \text{-----}$$

$A = 78,5 \text{ mm}^2$

$R_m = 370 \frac{\text{N}}{\text{mm}^2}$   
 $F_m = ?$

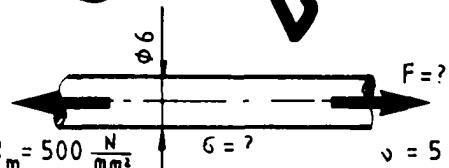
$R_m = \frac{F_m}{A}$

$F_m = R_m \cdot A$   
 $F_m = 370 \frac{\text{N}}{\text{mm}^2} \cdot 78,5 \text{ mm}^2$

$F_m = 29045 \text{ N}$

2.

$$\delta = \frac{R_m}{\nu}$$



$R_m = 500 \frac{\text{N}}{\text{mm}^2}$   
 $\sigma = ?$

$\sigma = \frac{R_m}{\nu}$   
 $\sigma = \frac{500 \text{ N}}{5 \text{ mm}^2}$

$F = \sigma \cdot A$

$F = 100 \frac{\text{N}}{\text{mm}^2} \cdot 6^2 \text{ mm}^2 \cdot \frac{3,14}{4} = 2826 \text{ N}$

Test:

a)



St 50  
 $R_m = ?$

$A = 19,6 \text{ mm}^2$

$F_m = ?$

b)



$F = 25000 \text{ N}$

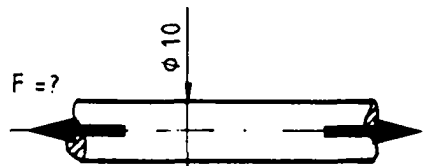
$R_m = 500 \frac{\text{N}}{\text{mm}^2}$

$A = ?$

$F_m = ?$

c)

$\sigma = \frac{R_m}{3}$



$F = ?$

$A = ?$

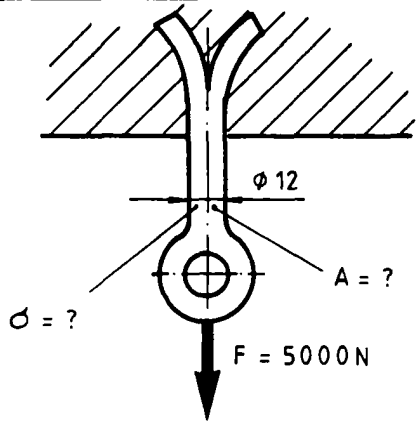
$R_m = 370 \frac{\text{N}}{\text{mm}^2}$

$R_m = \text{ } \frac{\text{N}}{\text{mm}^2}; F_m = \text{ } \text{ kN}$

$A = \text{ } \text{ mm}^2$

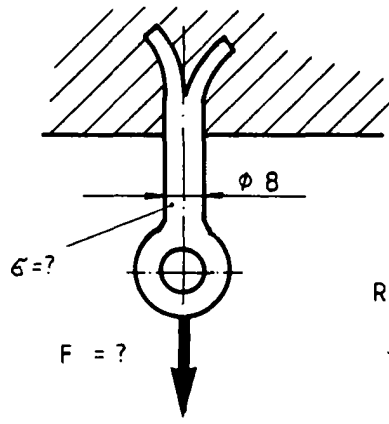
$A = \text{ } \text{ mm}^2; F = \text{ } \text{ N}$

1



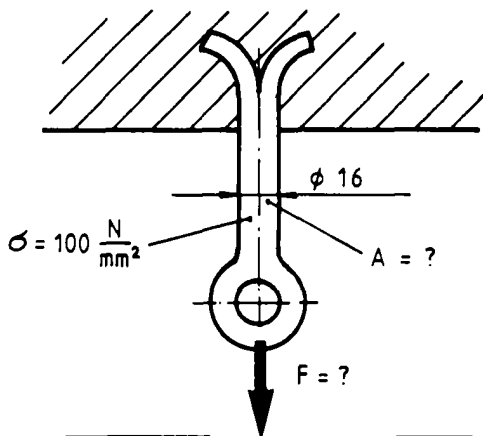
$A = \text{[ ] mm}^2 ; \sigma = \text{[ ] } \frac{\text{N}}{\text{mm}^2}$

2



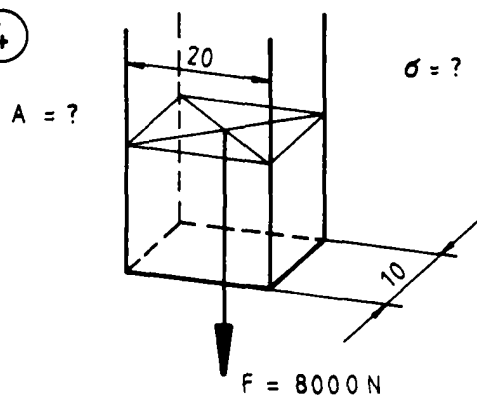
$\sigma = \text{[ ] } \frac{\text{N}}{\text{mm}^2} ; F = \text{[ ] N}$

3



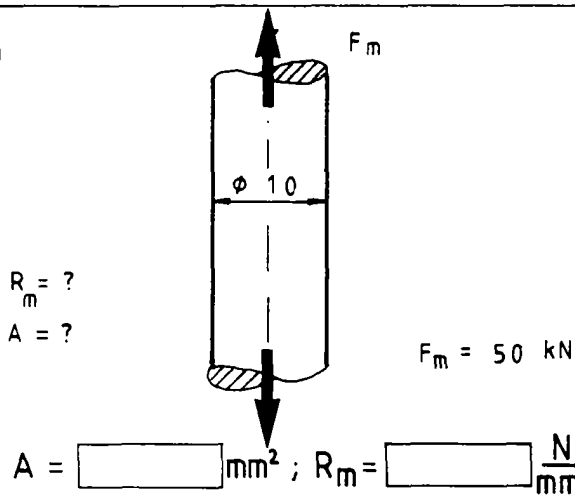
$A = \text{[ ] mm}^2 ; F = \text{[ ] kN}$

4



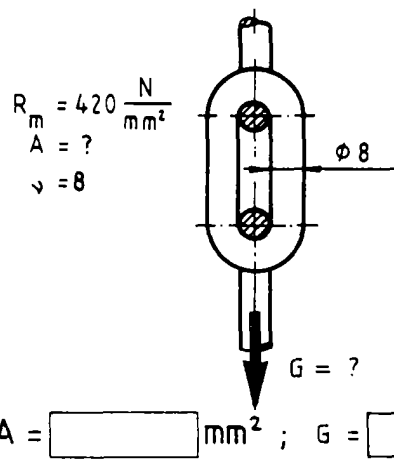
$A = \text{[ ] mm}^2 ; \sigma = \text{[ ] } \frac{\text{N}}{\text{mm}^2}$

5



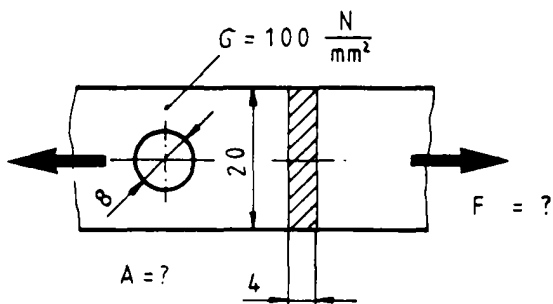
$A = \text{[ ] mm}^2 ; R_m = \text{[ ] } \frac{\text{N}}{\text{mm}^2}$

6



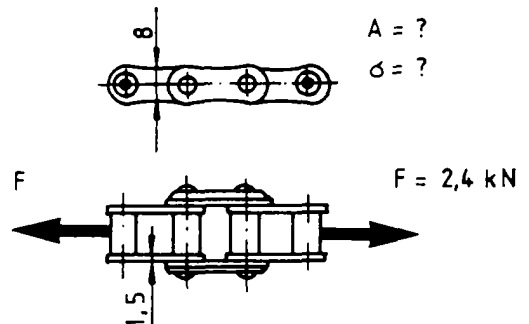
$A = \text{[ ] mm}^2 ; G = \text{[ ] N}$

7



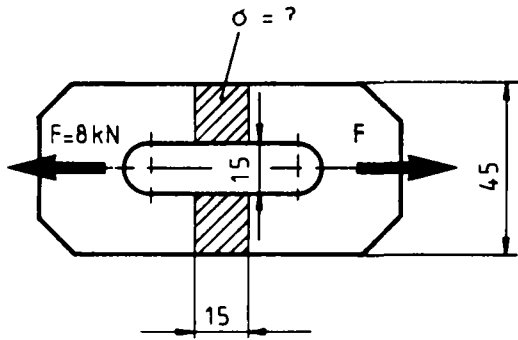
$A = \text{[ ] mm}^2 ; F = \text{[ ] N}$

8



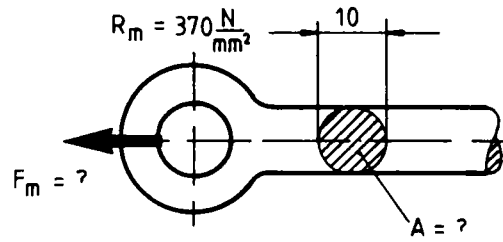
$A = \text{[ ] mm}^2 ; \sigma = \text{[ ] } \frac{\text{N}}{\text{mm}^2}$

9



$\sigma = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

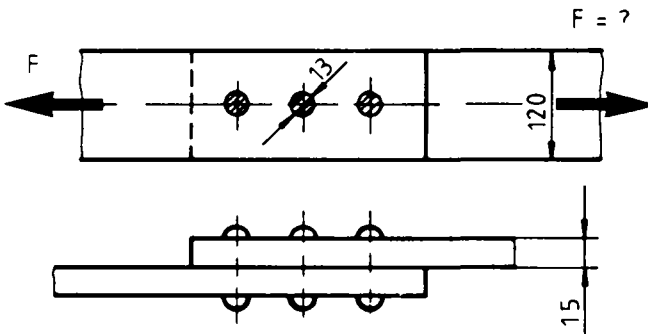
10



$A = \text{[ ]} \text{mm}^2; F_m = \text{[ ]} \text{N}$

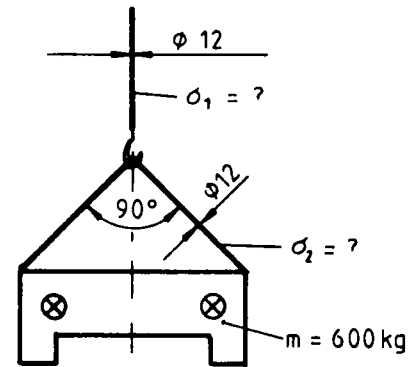
11

$\sigma = 85 \frac{\text{N}}{\text{mm}^2}$



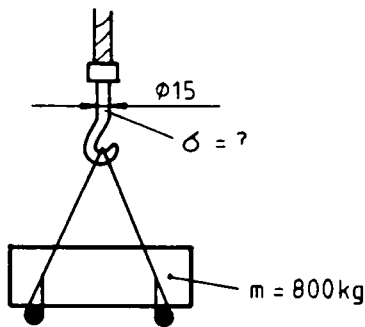
$F = \text{[ ]} \text{kN}$

12



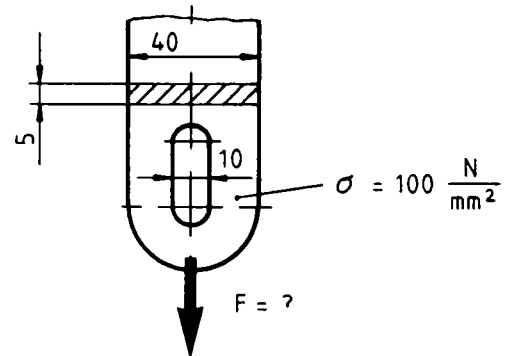
$\sigma_1 = \text{[ ]} \frac{\text{N}}{\text{mm}^2}; \sigma_2 = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

13



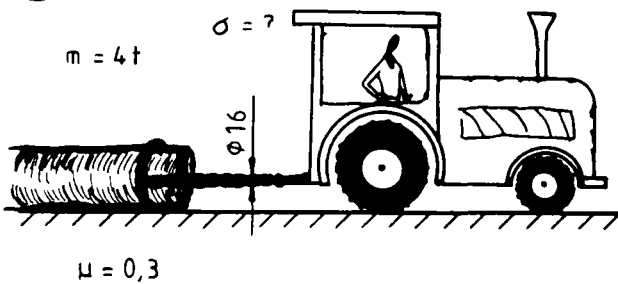
$\sigma = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

14



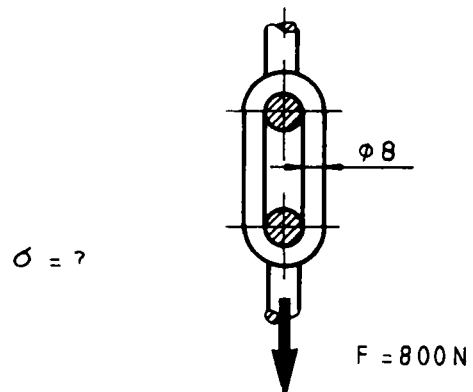
$F = \text{[ ]} \text{N}$

15

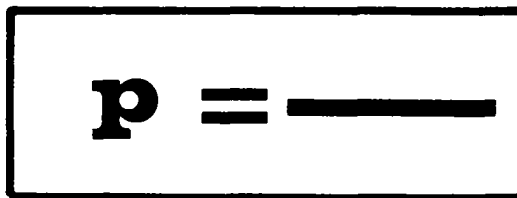
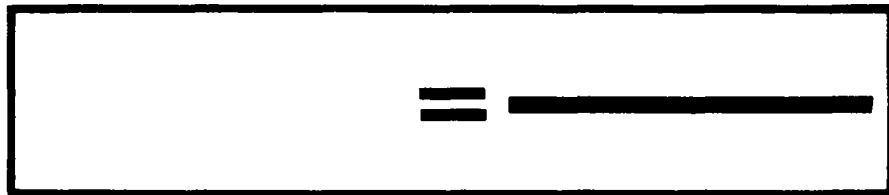
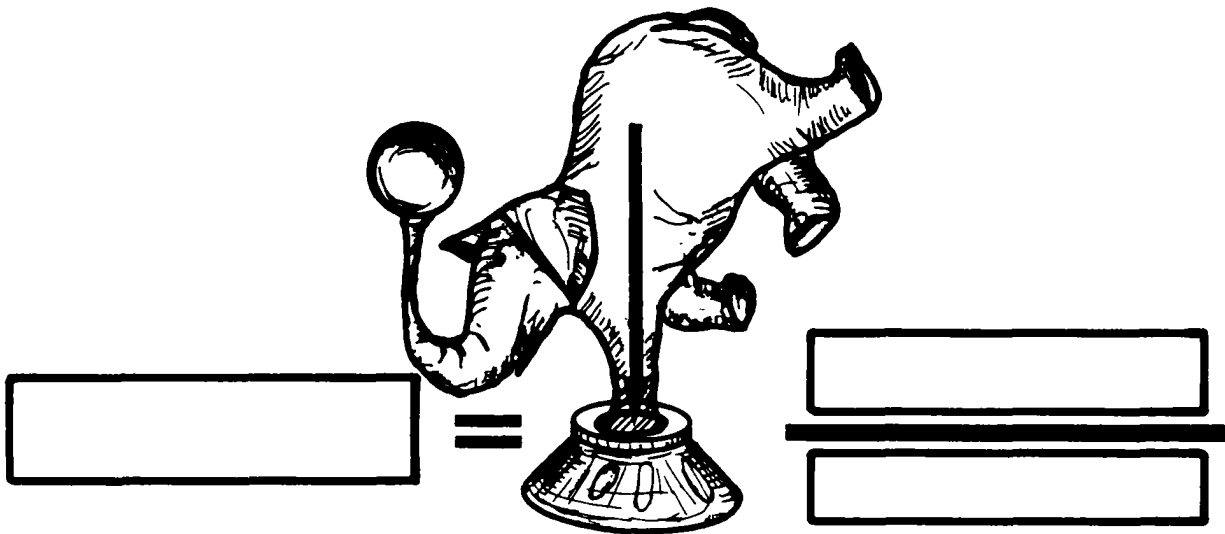


$\sigma = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

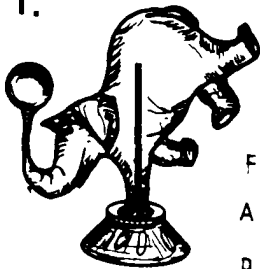
16



$\sigma = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$



1.



$F = 80 \text{ kN}$   
 $A = 300 \text{ cm}^2$   
 $p = ?$

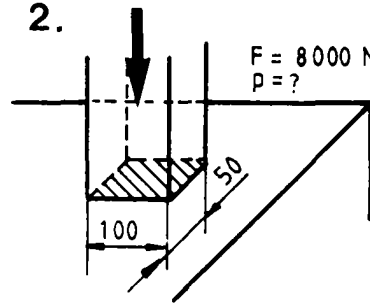
$$p = \frac{F}{A}$$

$$p = \frac{80000 \text{ N}}{300 \text{ cm}^2}$$

$$p = 267 \frac{\text{N}}{\text{cm}^2}$$

Test:

2.



$F = 8000 \text{ N}$   
 $p = ?$

$$p = \frac{F}{A}$$

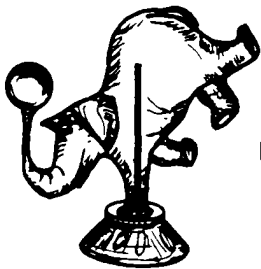
$$A = 10 \text{ cm} \cdot 5 \text{ cm}$$

$$A = 50 \text{ cm}^2$$

$$p = \frac{8000 \text{ N}}{50 \text{ cm}^2}$$

$$p = 160 \frac{\text{N}}{\text{cm}^2}$$

a)

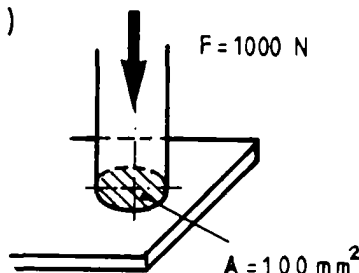


$F = 50 \text{ kN}$   
 $A = 500 \text{ cm}^2$   
 $p = ?$

$p = \frac{\text{N}}{\text{cm}^2}$

(c)  $p = 42 \text{ N/cm}^2$

b)



$F = 1000 \text{ N}$

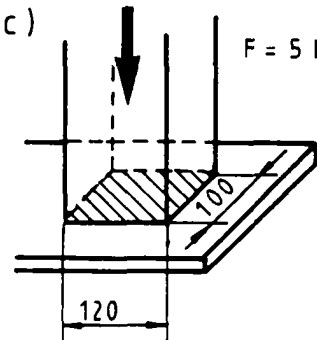
$A = 100 \text{ mm}^2$

$p = ?$

$p = \frac{\text{N}}{\text{mm}^2}$

(b)  $p = 10 \text{ N/mm}^2$

c)

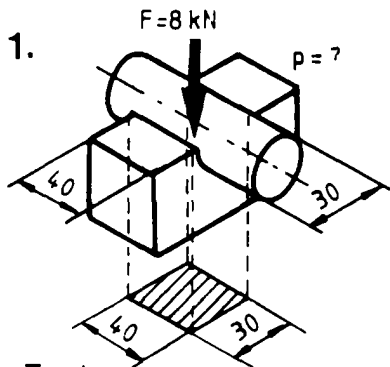
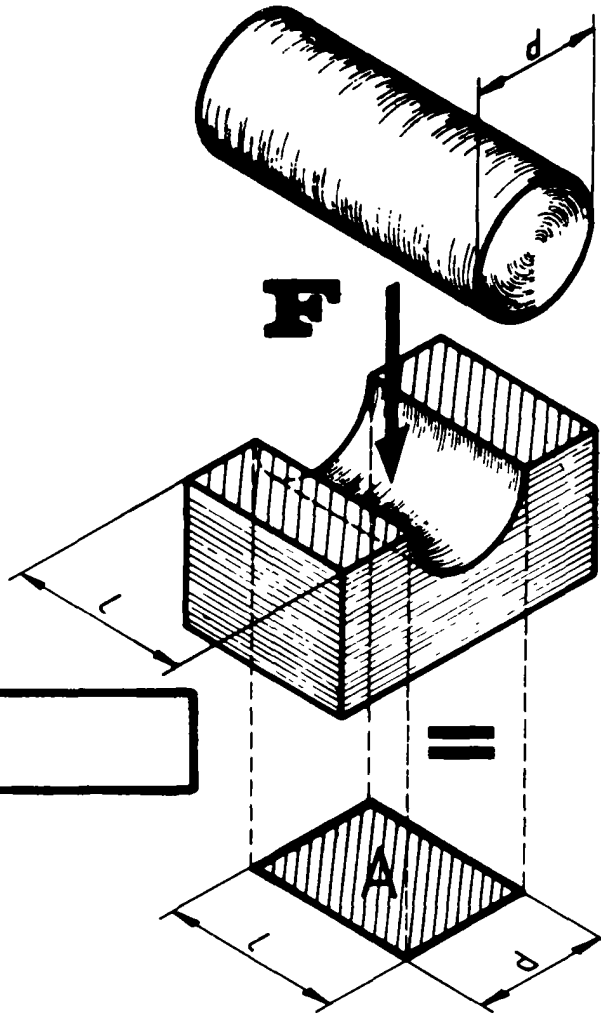


$F = 5 \text{ kN}$

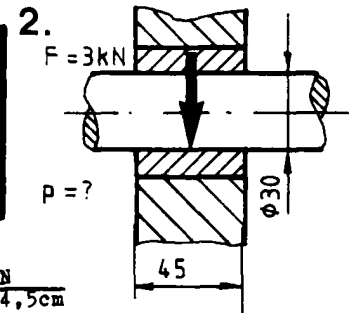
$p = ?$

$p = \frac{\text{N}}{\text{cm}^2}$

(a)  $p = 100 \text{ N/cm}^2$



**p =**                     



$$p = \frac{F}{A}$$

$$p = \frac{8000\text{N}}{3\text{cm} \cdot 4\text{cm}}$$

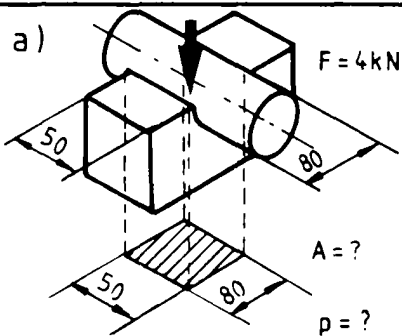
$$p = 667 \frac{\text{N}}{\text{cm}^2}$$

$$p = \frac{F}{A}$$

$$p = \frac{3000\text{N}}{3\text{cm} \cdot 4,5\text{cm}}$$

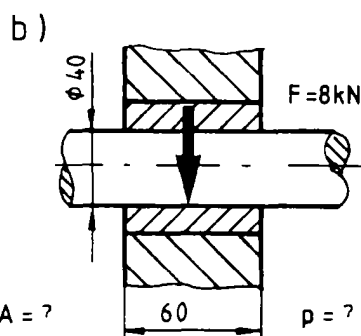
$$p = 222 \frac{\text{N}}{\text{cm}^2}$$

Test:



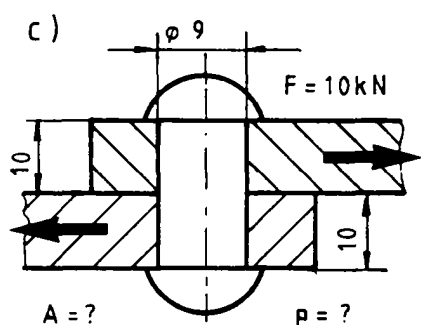
A =  mm<sup>2</sup>

p =   $\frac{\text{N}}{\text{mm}^2}$



A =  mm<sup>2</sup>

p =   $\frac{\text{N}}{\text{mm}^2}$

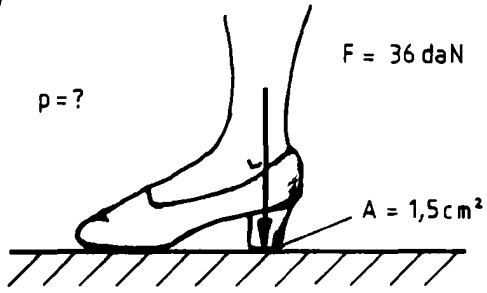


A =  mm<sup>2</sup>

p =   $\frac{\text{N}}{\text{mm}^2}$

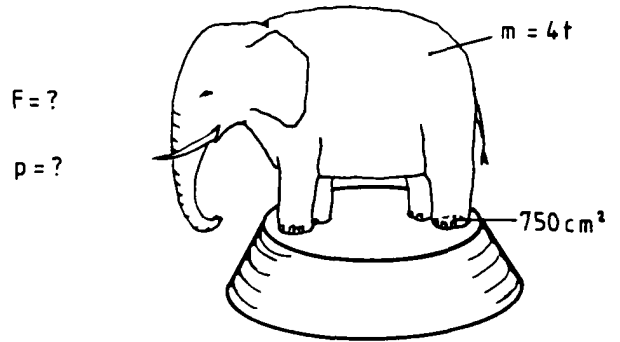
a) A = 4000 mm<sup>2</sup>, p = 1 N/mm<sup>2</sup>      b) A = 2400 mm<sup>2</sup>, p = 3,3 N/mm<sup>2</sup>      c) A = 90 mm<sup>2</sup>, p = 111 N/mm<sup>2</sup>

1



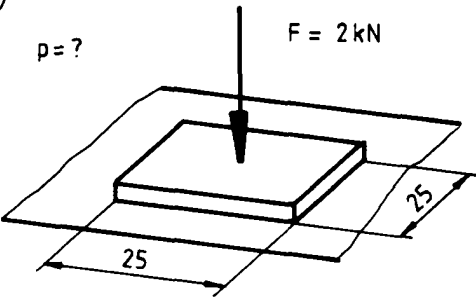
$p = \boxed{\phantom{000}} \frac{\text{N}}{\text{cm}^2}$

2



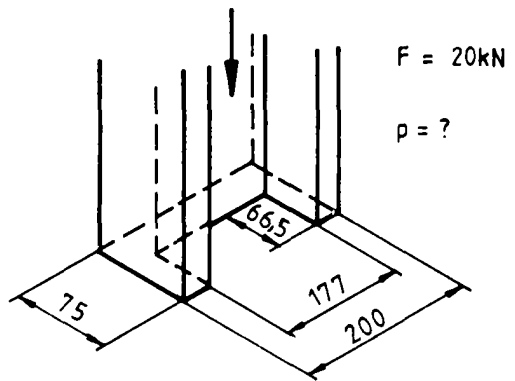
$F = \boxed{\phantom{000}} \text{ N}$      $p = \boxed{\phantom{000}} \frac{\text{N}}{\text{cm}^2}$

3



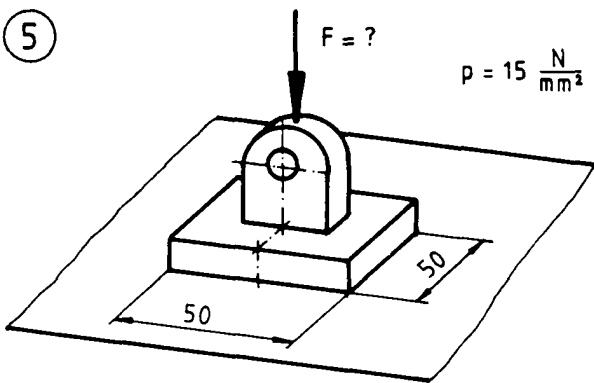
$p = \boxed{\phantom{000}} \frac{\text{N}}{\text{cm}^2}$

4



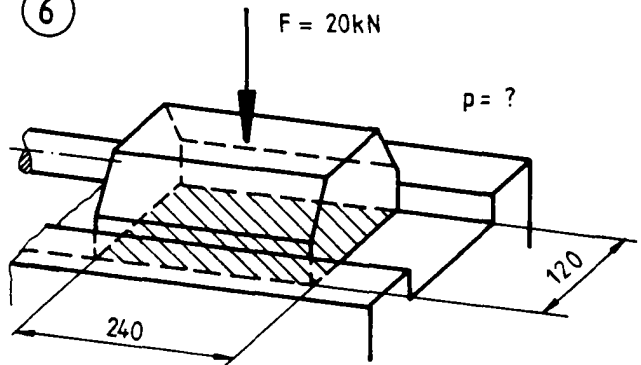
$p = \boxed{\phantom{000}} \frac{\text{N}}{\text{mm}^2}$

5



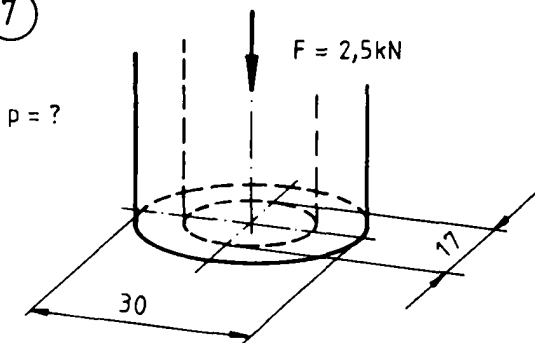
$F = \boxed{\phantom{000}} \text{ daN}$

6



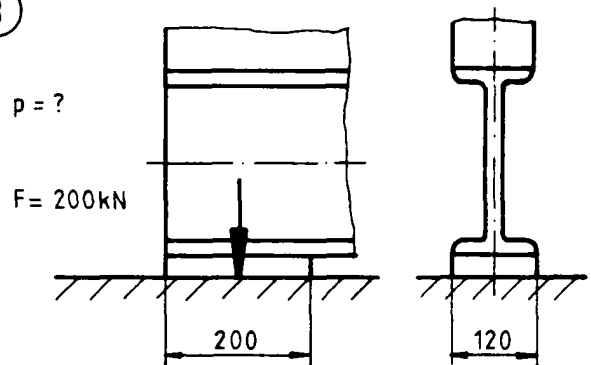
$p = \boxed{\phantom{000}} \frac{\text{N}}{\text{cm}^2}$

7



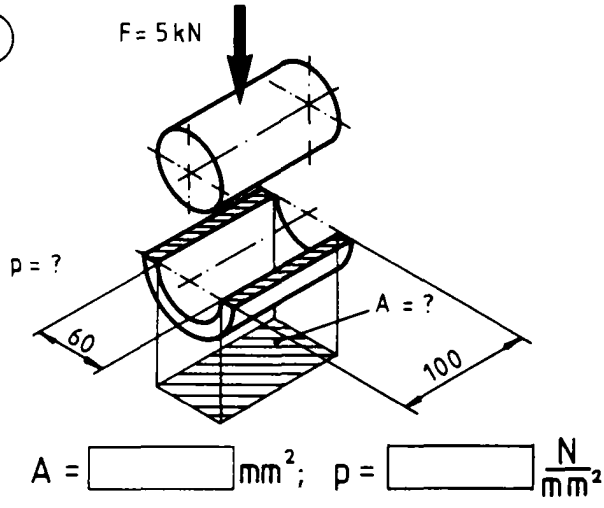
$p = \boxed{\phantom{000}} \frac{\text{N}}{\text{mm}^2}$

8

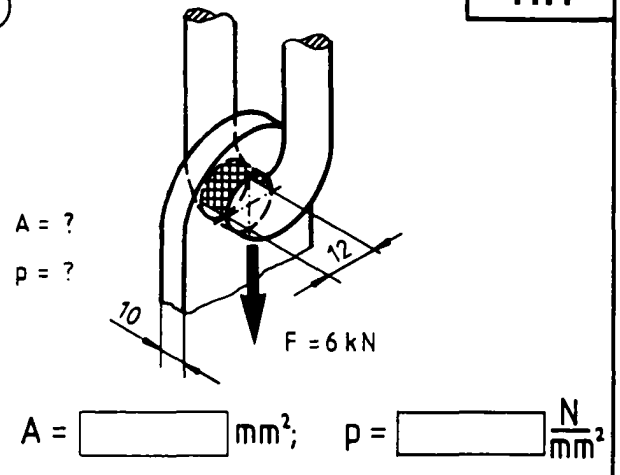


$p = \boxed{\phantom{000}} \frac{\text{daN}}{\text{cm}^2}$

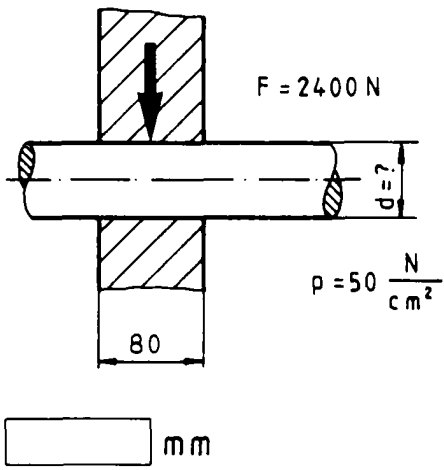
1



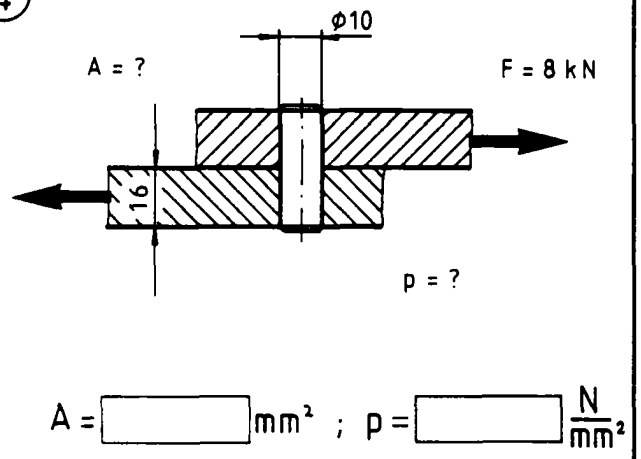
2



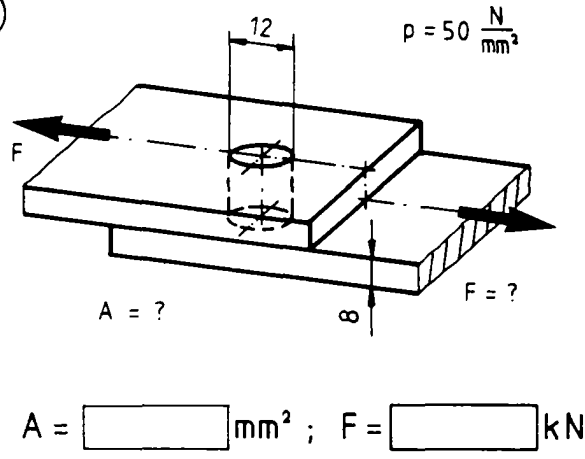
3



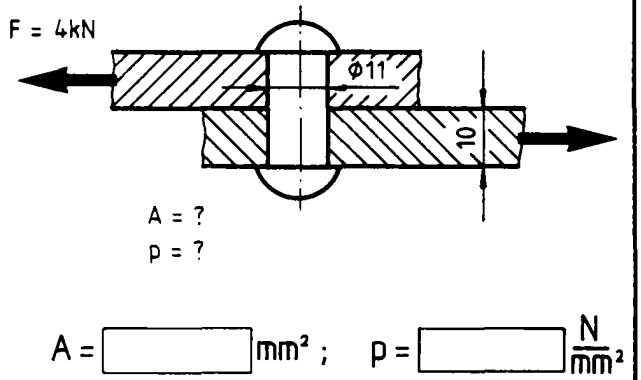
4



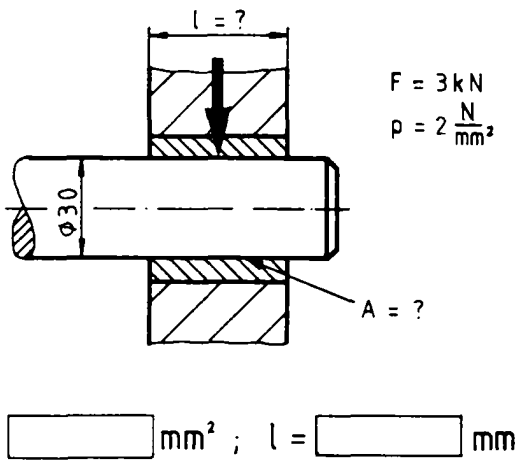
5



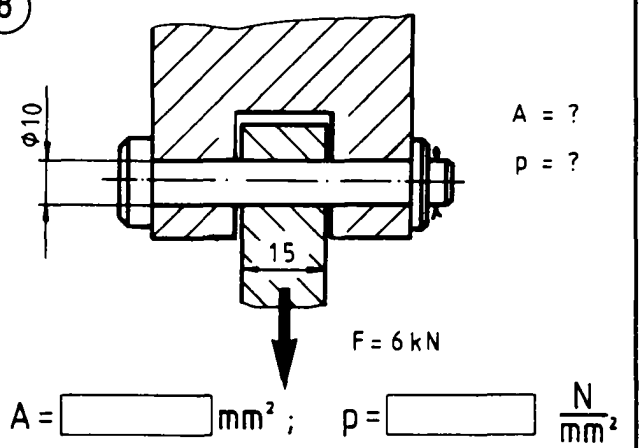
6

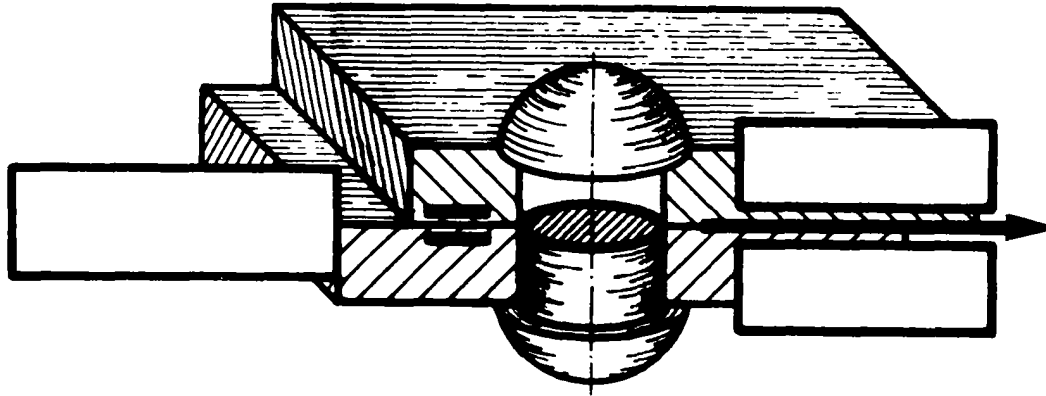


7



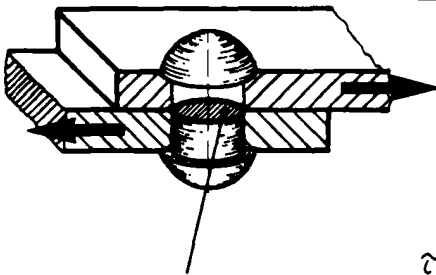
8





$$= \text{—————}$$

$$\tau = \text{—————}$$



F = 10000 N

$\tau = ?$

A = 63,6 mm<sup>2</sup>

$$\tau = \frac{F}{A}$$

$$\tau = \frac{10000\text{N}}{63,6\text{mm}^2}$$

$$\tau = 157 \frac{\text{N}}{\text{mm}^2}$$

Test:

a)

F = 12000 N  
A = 133 mm<sup>2</sup>  
 $\tau = ?$

b)

$\tau = 157,5 \frac{\text{N}}{\text{mm}^2}$   
F = 10 kN  
A = ?

c)

F = 16 kN  
A = ?     $\tau = ?$

A =  mm<sup>2</sup>  
 $\tau =$    $\frac{\text{N}}{\text{mm}^2}$

$\tau =$    $\frac{\text{N}}{\text{mm}^2}$

A =  mm<sup>2</sup>

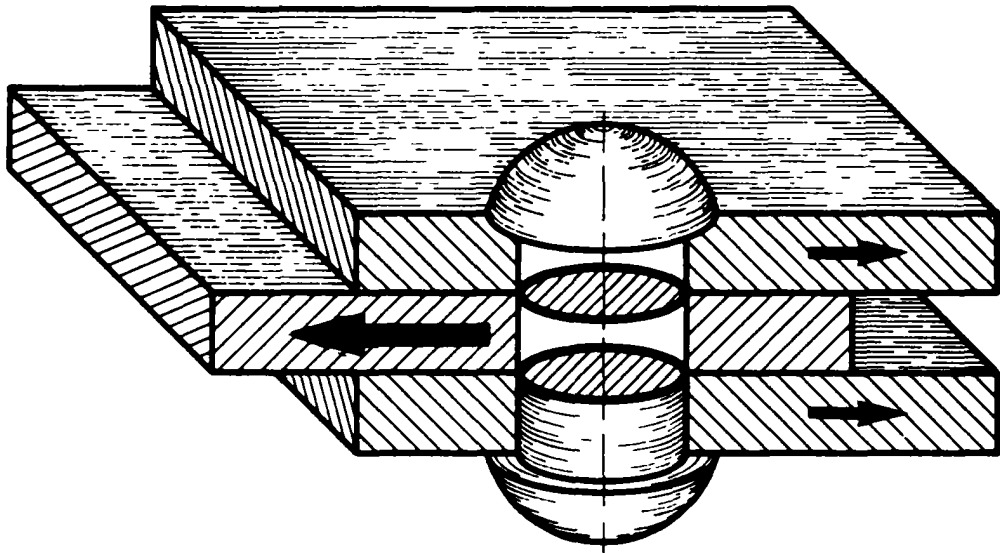
$\tau =$    $\frac{\text{N}}{\text{mm}^2}$

c) A = 190 mm<sup>2</sup>,  $\tau = 84 \frac{\text{N}}{\text{mm}^2}$

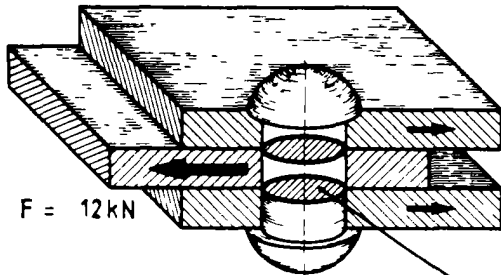
42.1 b) A = 63,5 mm<sup>2</sup>

a)  $\tau = 90 \frac{\text{N}}{\text{mm}^2}$





$$A = \text{circle} + \text{circle}$$



$$A = 2 \cdot 95 \text{ mm}^2$$

$$\tau = \frac{F}{A}$$

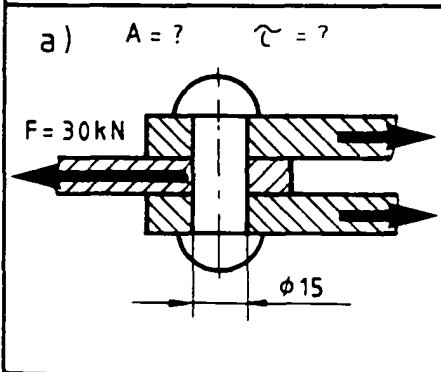
$$A = 190 \text{ mm}^2$$

$$\tau = \frac{12000 \text{ N}}{190 \text{ mm}^2}$$

$$\tau = 63 \frac{\text{N}}{\text{mm}^2}$$

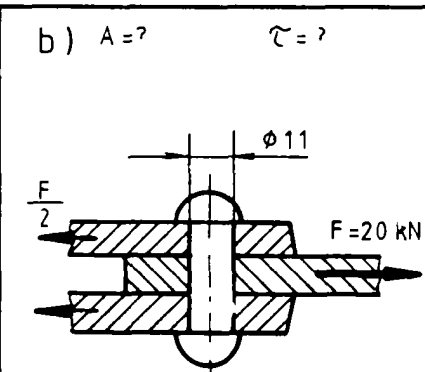
$A = ?$        $\tau = ?$        $95 \text{ mm}^2$

Test.



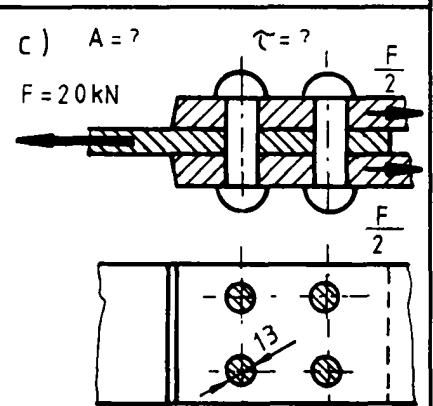
$A = \text{[ ]} \text{ mm}^2$

$\tau = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$



$A = \text{[ ]} \text{ mm}^2$

$\tau = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$



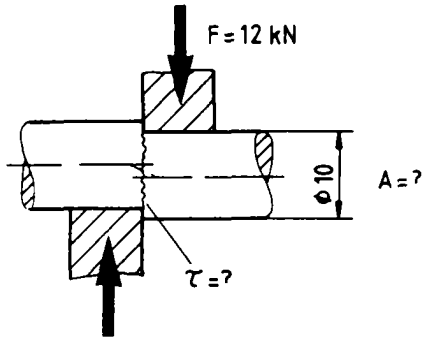
$A = \text{[ ]} \text{ mm}^2; \tau = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

c)  $A = 1061 \text{ mm}^2, \tau = 18,8 \frac{\text{N}}{\text{mm}^2}$

b)  $A = 190 \text{ mm}^2, \tau = 105 \frac{\text{N}}{\text{mm}^2}$

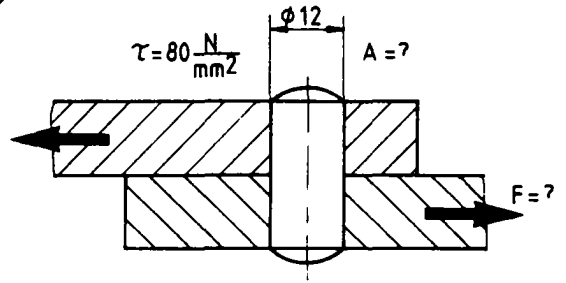
a)  $A = 353 \text{ mm}^2, \tau = 85 \frac{\text{N}}{\text{mm}^2}$

1



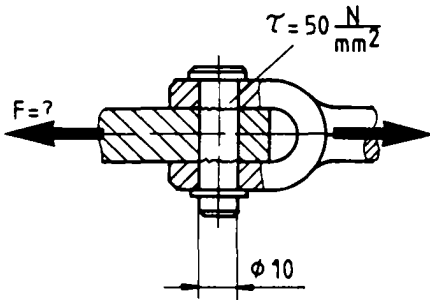
$A = \text{[ ] mm}^2; \tau = \text{[ ] } \frac{\text{N}}{\text{mm}^2}$

2



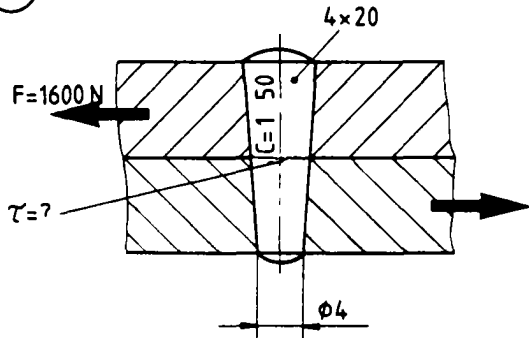
$A = \text{[ ] mm}^2; F = \text{[ ] kN}$

3



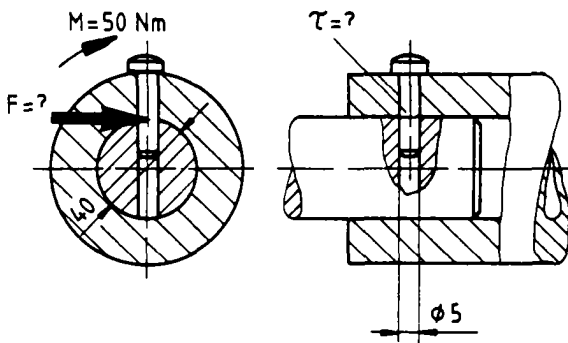
$F = \text{[ ] kN}$

4



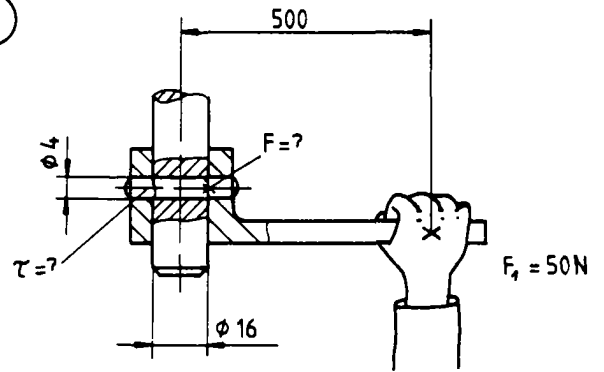
$\tau = \text{[ ] } \frac{\text{N}}{\text{mm}^2}$

5



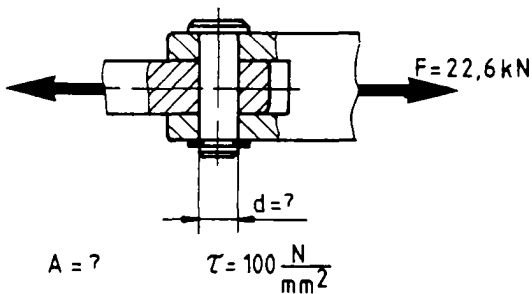
$F = \text{[ ] N; } \tau = \text{[ ] } \frac{\text{N}}{\text{mm}^2}$

6



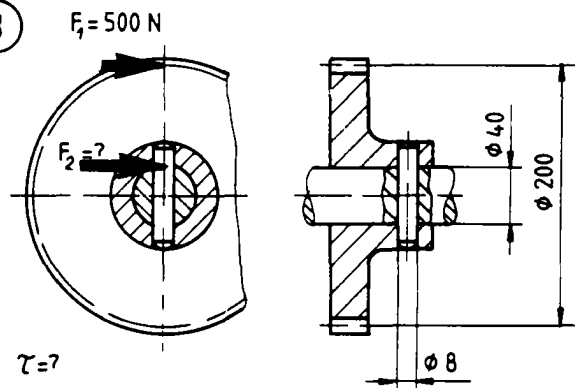
$F = \text{[ ] N; } \tau = \text{[ ] } \frac{\text{N}}{\text{mm}^2}$

7



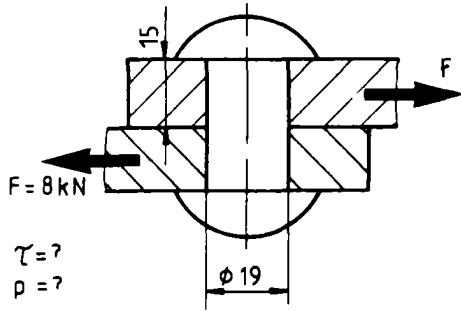
$A = \text{[ ] mm}^2; d = \text{[ ] mm}$

8



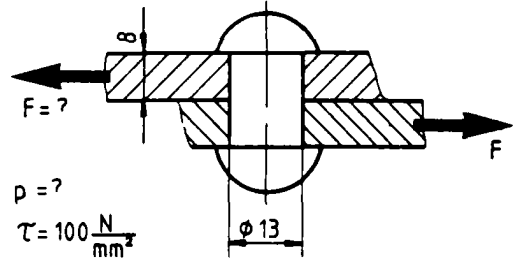
$F_2 = \text{[ ] N; } \tau = \text{[ ] } \frac{\text{N}}{\text{mm}^2}$

1



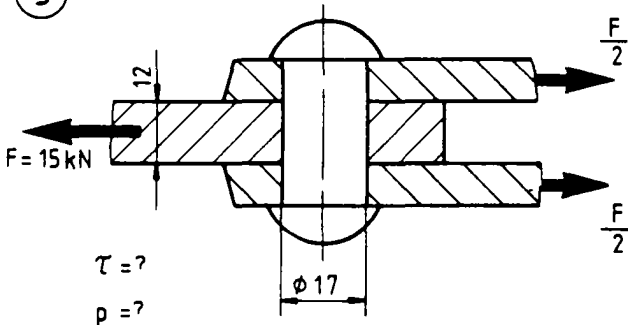
$\tau = \text{[ ]} \frac{\text{N}}{\text{mm}^2}; p = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

2



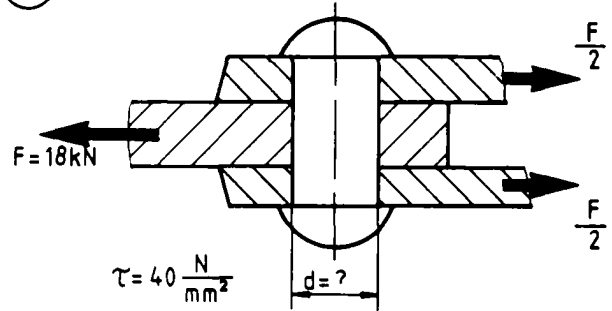
$F = \text{[ ]} \text{ N}; p = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

3



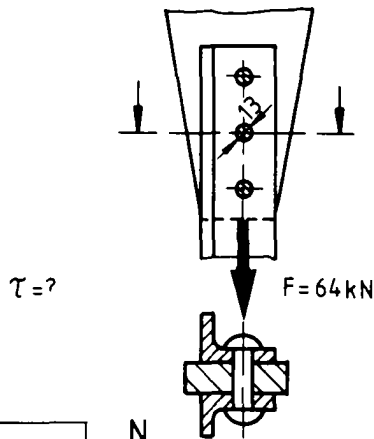
$\tau = \text{[ ]} \frac{\text{N}}{\text{mm}^2}; p = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

4



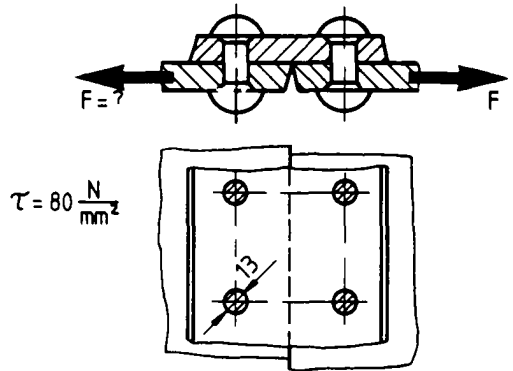
$d = \text{[ ]} \text{ mm}$

5



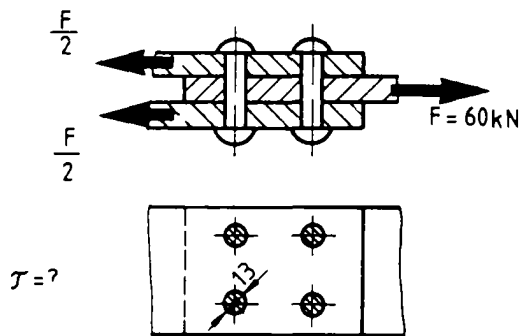
$\tau = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

6



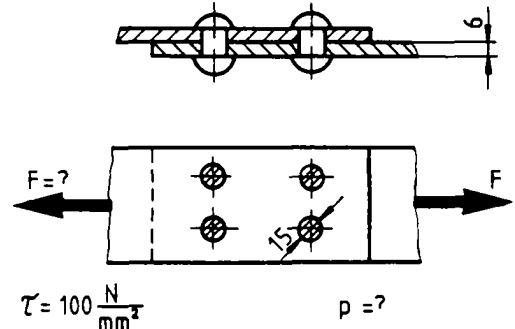
$F = \text{[ ]} \text{ kN}$

7

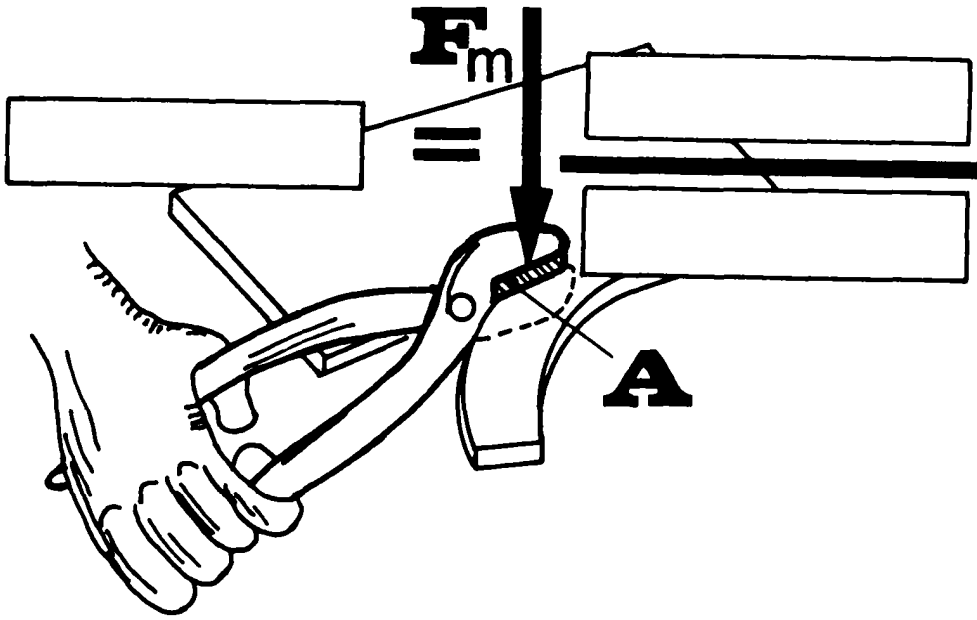


$\tau = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$

8



$F = \text{[ ]} \text{ kN}; p = \text{[ ]} \frac{\text{N}}{\text{mm}^2}$



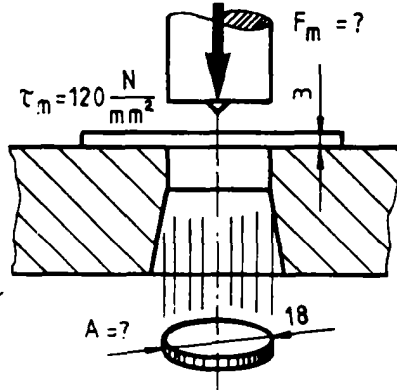
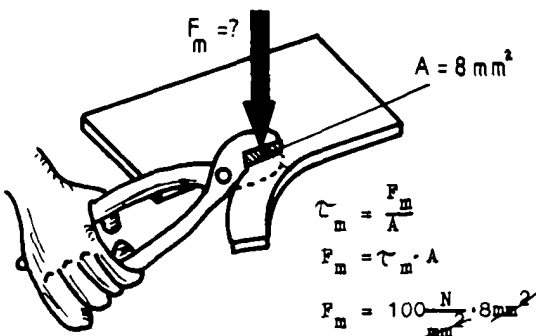
= \_\_\_\_\_

**$\tau_m$**  = \_\_\_\_\_

1.

$\tau_m = 100 \frac{N}{mm^2}$

2.



$\tau_m = \frac{F_m}{A}$

$F_m = \tau_m \cdot A$

$A = 18 \text{ mm} \cdot 3,14 \cdot 3 \text{ mm}$

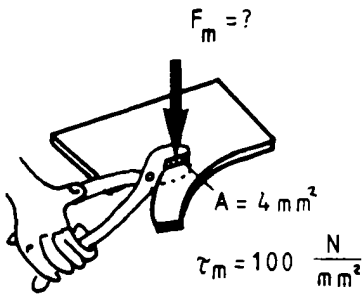
$A = 170 \text{ mm}^2$

$F_m = 120 \frac{N}{mm^2} \cdot 170 \text{ mm}^2$

$F_m = 20347 \text{ N} = 20,347 \text{ kN}$

Test:

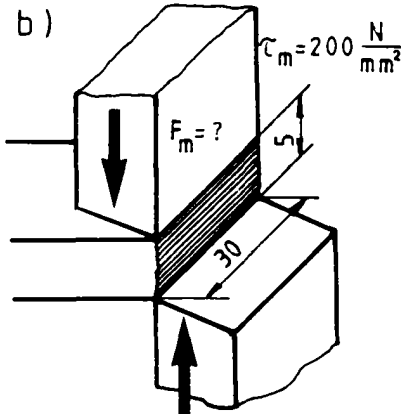
a)



$F_m = \text{ } \text{ N}$

$F_m = 400 \text{ N}$

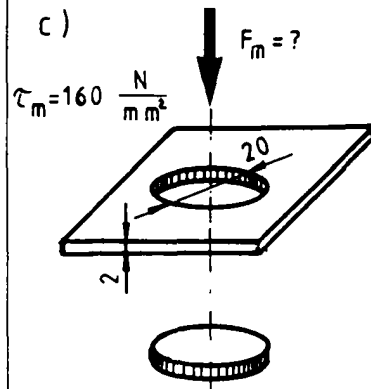
b)



$F_m = \text{ } \text{ kN}$

$F_m = 30 \text{ kN}$

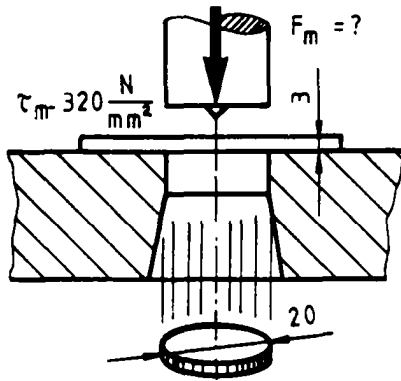
c)



$F_m = \text{ } \text{ kN}$

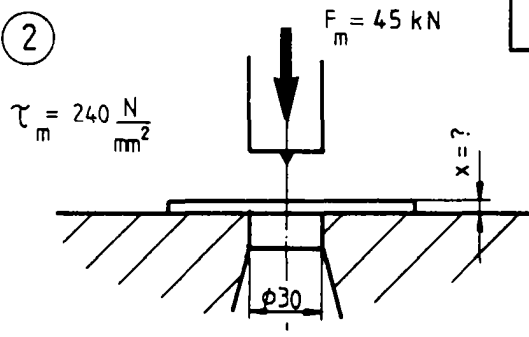
$F_m = 400 \text{ N}$

1



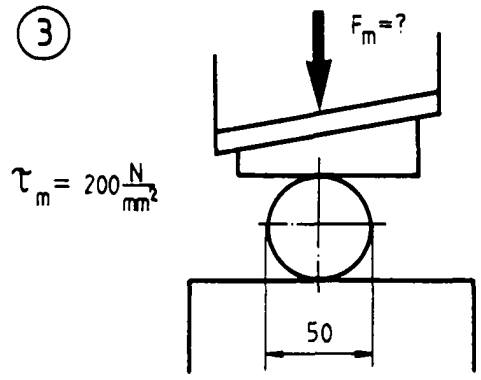
$F_m = \text{[ ] kN}$

2



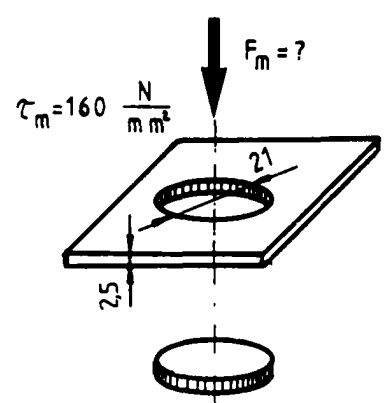
$x = \text{[ ] mm}$

3



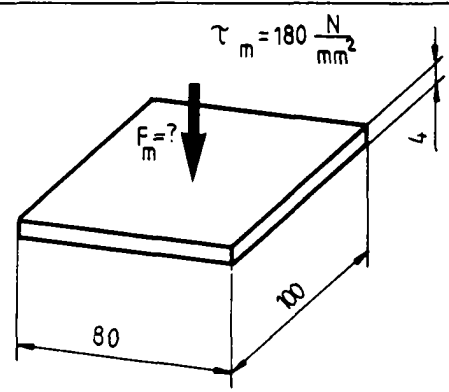
$F_m = \text{[ ] kN}$

4



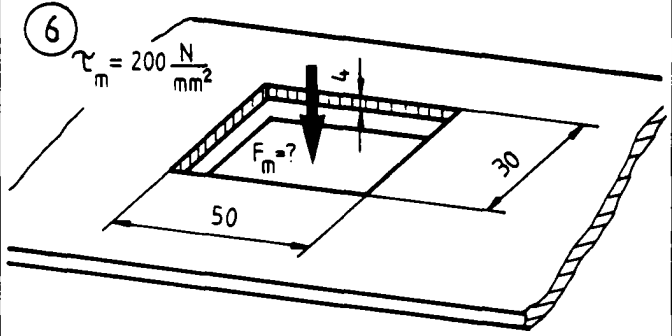
$F_m = \text{[ ] kN}$

5



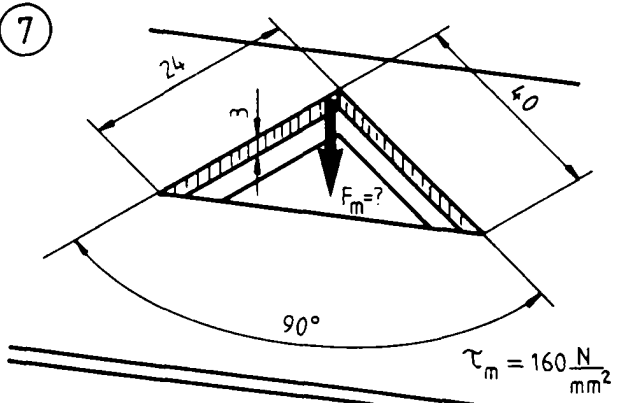
$F_m = \text{[ ] kN}$

6



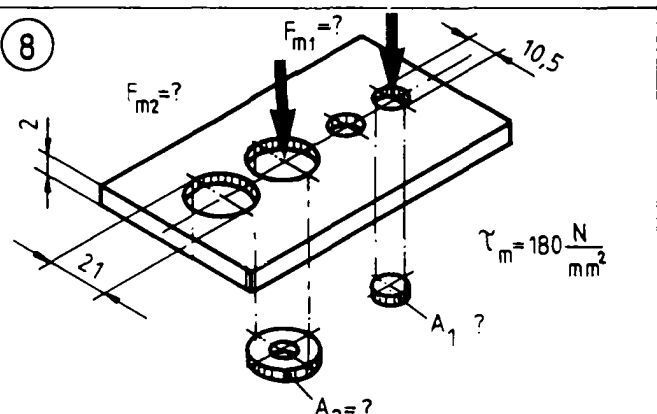
$F_m = \text{[ ] kN}$

7



$F_m = \text{[ ] kN}$

8



$A_1 = \text{[ ] mm}^2$        $A_2 = \text{[ ] mm}^2$   
 $F_{m1} = \text{[ ] kN}$        $F_{m2} = \text{[ ] kN}$