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Lernen ohne Sprachbarrieren

Technische Mathematik Metall

Lösungsheft

L E R N E N   O H N E   S P R A C H B A R R I E R E N

TECHNISCHE MATHEMATIK METALL

Hermanns- Klemmstein

Besondere Merkmale:

Alle Aufgaben sind textfrei. Die vorhandenen Bilder, Symbole
und Zahlen erfordern keine Übersetzungen.
Während in der Lehrerfassung noch Überschriften und Fachwörter
erscheinen, tragen die Schüler die vorkommenden Begriffe hand-
schriftlich in die Leerzeilen der Schülerversion ein. Der Unter-
richt findet in der lokalen Umgangssprache statt.

Auf den **INFORMATIONSBLÄTTERN** zeigt ein Schlüsselbild das neue
Thema jeweils in einem typischen Anwendungsbeispiel. Daraus ist
eine Formel abzuleiten, die als Regel wörtlich festgehalten wird.
Darunter zeigen Rechenbeispiele die wichtigsten Anwendungsvarianten.
Abschließend ermöglichen leichte Testaufgaben eine erste Erfolgs-
kontrolle in kürzester Zeit.

Die **AUFGABENBLÄTTER** bieten Probleme mit unterschiedlichem Schwie-
rigkeitsgrad, wobei die Grundformel oft umgestellt werden muß.

Curriculare Anpassung:

Je nach Aufbau der lokalen Lehrpläne sollte die Themenwahl dem
lokalen Bedarf angepaßt werden. Diese projektadäquate Auswahl
ist vor Ort zu vervielfältigen.

Zur Erinnerung:
Beachten Sie möglichst folgende methodischen Hinweise!

- Fragen Sie die Schüler nach der möglichen Bedeutung
  des Schlüsselbildes und der darin verschlüsselten Regel!

- Beteiligen Sie möglichst viele Schüler am Lösungsprozeß
  bei den Aufgaben!

- Geben Sie den Schülern das Resultat der Hausaufgaben,
  aber kontrollieren Sie das Verständnis des Lösungsweges!

- Benutzen Sie die beiliegenden Modellösungen der Lehrer-
  fassung zum Vergleich!

LEARNING WITHOUT LANGUAGE BARRIERS
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TECHNICAL MATHEMATICS FOR METALWORKING

Hermanns - Klemmstein

Special features:

None of the exercises have written instructions. The
pictures, symbols and figures do not have to be translated.
Whereas the teacher's copy contains headings and subject
terminology, the pupils are required to enter terms by hand
as they occur, in blank spaces provided in their copies.
Teaching takes place in the local vernacular.

On the **INFORMATIONS SHEETS,** a key picture shows a typical
application of the new topic. From this, a formula is derived
and expressed in words as a generally valid rule. Underneath
this, specimen calculations illustrate the principal variations
of the application concerned. In conclusion, easy test exercises
permit a rapid initial check on success.

The **EXERCISE SHEETS** provide problems of varying degrees of
difficulty, often requiring the basic formula to be re-arranged.

Adapting to curriculum:
Depending on the structure of local curricula, the choice
of topics should be suited to local needs. The selection
deemed appropriate for the project must be duplicated locally
to produce the number of copies required.

Reminder:
Whenever possible, comply with the following instructions
concerning method:

- Ask pupils about the possible meaning of the key
  picture and the rule it symbolises!

- Obtain the participation of as many pupils as possible
  in the process of solving the exercises!

- Inform pupils of homework results, but check that
  they have understood the correct solution procedure!

- Use the accompanying specimen solutions in the
  teacher's copy as a means of comparison.

APPRENDRE SANS BARRIERE DE LANGUE
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MATHEMATIQUES TECHNIQUES - METAL

Hermanns - Klemmstein

Particularités:

Aucun exercice n'est accompagné de texte. Les figures, les symboles et les
chiffres ne nécessitent pas de traduction.
Alors que les exemplaires destiné aux enseignants comportent encore des titres
et des termes techniques, les élèves inscrivent eux-mêmes dans les espaces
prévus à effet les expressions qui se présentent. L'enseignement se fait dans
la langue du pays.
Sur les **FICHES D'INFORMATION**, le nouveau sujet abordé est annoncé par une
figure-clé, dans un example typique d'application. Il faut en déduire une
formule que l'on retient littéralement comme règle. Plus bas, des exemples de
calcul présentent les applications possibles les plus importantes. Ensuite, des
exercices faciles permettent d'effectuer très rapidement un premier control
de résultats.
Les **FICHES DE PROBLEMES** offrent des exercices de degrés de difficulté divers,
obligeant souvent à transformer la formule fondamentale.

Rappel:
Respectez dans la mesure du possible les indications suivantes concernant
la méthode d'enseignement:
- Demandez aux élèves la signification de la figure-clé et de la règle
  qu'elle représente.
- Faites participer le plus grand nombre possible d'élèves à la recherche
  des solutions de ces problèmes.
- Donnez aux étudiants la solution des exercices qu'ils font à la
  maison. mais vérifiez s'ils ont compris le raisonnement.
- Contrôlez en comparant avec les solutions types jointes à l'exemplaire
  pour enseignants.

APRENDER SIN OBSTACULOS DE IDIOMA

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MATEMATICAS EN LA TECNICA DEL METAL

Hermanns - Klemmstein

Características:

Todos los ejercicios se presentan sin texto. Los gráficos,
símbolos y números del ejercicio no necesitan traducción
alguna.
Mientras que en el ejemplar destinado al personal docente
aparecen títulos y denominaciones técnicas, los alumnos
escriben a mano las denominaciones que vayan apareciendo en
las líneas en blanco que se encuentran en al ejemplar destinado
al alumno. Las clases tienen lugar en el lenquaje corriente
local.
En las **HOJAS INFORMATIVAS** se muestra a través de un gráfico
clave el nuevo tema, en un ejemplo típico de aplicacion. De
allí habrá que deducir una fórmula, la cual se resumirá gene-
ralmente de modo verbal. Más abajo se presentan en ejemplos
de cálculo las variantes más importantes de aplicación. Por
fin, se consique en breve tiempo a través de problemas fáciles
la verificación de resultados.

Las **HOJAS DE TRABAJO** presentan problemas de dificultad diferente,
para los cuales habrá que adaptar frecuentemente la fórmula
básica.
Atencion:
Procuren atenerse a las siguientes observaciones de carácter
metódico:
  - Pregunten Uds. a los alumnos por el posible significado
    del gráfico clave y de la regla impolicada en el mismo.
  - Procuren que participe el mayor número posible de alumnos
    en la solución de los problemas.
  - Comuniquen a los alumnos los resultados de las tareas de
    casa pero controlen si han comprendido el proceso de cálculo
    hasta llegar a la solución.
  - Utilicen a título comparativo las soluciones modelo
    adjuntas del ejemplar para el personal docente.

Inhaltsverzeichnis

Contents

Sommaire

Indice

Informationsblätter Information sheets Fiches d'information Hojas informatives	Arbeitsblätter Work sheets Fiches de problémes Hojas de trabajo
1.1	1.2
2.1	2.2
3.1 .2	3.3
4.1	4.2
5.1	5.2
6.1	6.2
7.1	7.2 .3
8.1	8.2
9.1	9.2
10.1	10.2 .3
11.1 .2	11.3 .4
12.1	12.2
13.1	13.2
14.1 .2	14.3
15.1	15.2
16.1	16.2
17.1	17.2
18.1	18.2 .3
19.1	19.2
20.1	20.2
21.1 .2	21.3 .4
22.1	22.2 .3
23.1	23.2
24.1	24.2
25.1 .2	25.3 .4
26.1 .2	26.3 .4 .5
27.1	27.2
28.1	28.2
29.1	29.2 .3
30.1	30.2
31.1 .2 .3	31.4 .5
32.1 .2	32.3 .4
33.1 .2 .3	33.4 .5
34.1	34.2
35.1 .2 .3	35.4 .5
36.1	36.2 .3
37.1 .2	37.3 .4
38.1 .2	38.3
39.1 .2	39.3 .4
40.1 .2	40.3 .4
41.1 .2	41.3 .4
42.1 .2	42.3 .4
43.1	43.2

FACHBEGRIFFE - SUBJECT TERMINOLOGY
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Thema-Nr.:		topic-No.:	
8	Teilung	8	pitch
	Teilzahl		index number
11	Ankathete		adjacent side
	Gegenkathete		opposite side
	Hypothenuse		hypotenuse
14	Größtmaß	14	maximum dimension
	Kleinstmaß		minimum dimension
20	Länge	20	lenght
	Breite		width
21	Grundfläche	21	base
	Höhe		height
24	Dichte	24	density
	Gewichtskraft		weight
26	Hebelarm	26	lever
28	Reibzahl	28	friction coefficient
29	Weg	29	distance
30	Steigung	30	pitch
	Axialkraft		axial force
31	Zeit	31	time
	Drehzahl		rotational speed
32	Eingangsleistung	32	power input
	Ausgangsleistung		power output
34	Seilkraft	34	cable force
35	Modul	35	module
	Zähnezahl		number of teeth
	Teilkreisdurchmesser		pitch diameter
	Achsabstand		centre distance
	treibende Räder		driving gears
	getriebene Räder		driven gears
37	Teilkreisumfang	37	circumf. of pitch circle
	Zahnstangenweg		gear rack travel
	Schneckenrad		worm gear
	Gangzahl		number of starts
38	Kegellänge	38	length of taper
	Kegelwinkel		angle of taper
	Einstellwinkel		setting angle
	Durchmesserdifferenz		diameter difference
40	Höchstkraft	40	max. force
	Querschnittsfläche		cross section
42	Scherfläche	42	shearing section

TERMES TECHNIQUES - TERMINOLOGIA TECNICA

==

Sujet N°:		Tema Nr:

	Sujet N°:	Tema Nr:
8	Division	8 División
	Diviseur	Dividendo
11	Côté adjacent	11 Cateto
	Perpendiculaire opposé	Cateto opuesto
	Hypthênuse	Hipotenusa
14	Dimension maximale	14 Medida máxima
	Dimension minimale	Medida mínima
20	Longueur	20 Longitud
	Largeur	Anchura
21	Surface de base	21 Superficie del baso
	Hauteur	Altura
24	Epaisseur	24 Densidad
	Poids	Fuerza por peso
26	Levier	26 Palanca
29	Trajectoire	29 Trayectoria
30	Pas	30 Paso
	Force axiale	Fuerza axial
31	Temps	31 Tiempo
	Nombre de tours	Número de revoluc.
32	Puissance d'entrée	32 Potencia de entrada
	Puissance de sortie	Potencia de salida
34	Force exercée par la corde	34 Fuerza por cable
35	Module	35 Módulo
	Nombre de dents	Número de dientes
	Diamètre primitif de	Diámetro del círculo
	référence	primitivo
	Empattement	Distancia entre ejes
	Roues menantes	Ruedas de tracción
	Roues menées	Ruedas traccionadas
37	Circonférence primitive de	37 Perímetro del
	référence	círculo primitivo
	Trajectoire de la	Via de la
	crémaillère	cremallera
	Roue vis	Rueda helicoidal
	Nombre de spires	Número de filetes
39	Longueur de cône	39 Longitud del cono
	Angle de cône	Angulo del cono
	Angle de mise au point	Angulo de ajuste
	Différence de diamètre	Diferencia de diám.
40	Force maximale	40 Fuerza máxima
	Superficie de la coupe	Superficie de la
	transversale	sección transversal
43	Section de cisaillement	43 Superficie de corte

1) a) $48 - x = 19$

$x = 48 - 19$

$\underline{\underline{x = 29}}$

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

$x = 4,83 - 1,5$

$\underline{\underline{x = 3,33}}$

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

$x = 30,48 - 12,44 - 9,92$

$\underline{\underline{x = 8,12}}$

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

$x = 96,4 + 13,64 + 12,8$

$\underline{\underline{x = 122,84}}$

3) a) $4x + 12 = 32$

$4x = 32 - 12$

$4x = \dfrac{20}{4}$

$\underline{\underline{x = 5}}$

b) $80 - 2x = 68$

$2x = 80 - 68$

$x = \dfrac{12}{2}$

$\underline{\underline{x = 6}}$

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

$1 = 420 - 44,28 - 280,1$

$\underline{\underline{1 = 95,62}}$

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

$L = 100,2 - 88,6$

$\underline{\underline{L = 11,6}}$

5) a) $\dfrac{5"}{8} + x = \dfrac{9"}{12}$

$x = \dfrac{9"}{12} - \dfrac{5"}{8}$

$\underline{\underline{x = \dfrac{1"}{8}}}$

b) $42\dfrac{3}{4}\,ft - x = 39\dfrac{2}{3}\,ft$

$x = 42\dfrac{3}{4}\,ft - 39\dfrac{2}{3}\,ft$

$\underline{\underline{x = 3\dfrac{1}{12}\,ft}}$

6) a) $422,82\,mm - 2x = 311\,mm$

$2x = 422,82\,mm - 311\,mm$

$x = \dfrac{111,82\,mm}{2}$

$\underline{\underline{x = 55,91\,mm}}$

b) $x - 39,9\,mm = 60,21\,mm$

$x = 60,21\,mm + 39,9\,mm$

$\underline{\underline{x = 100,11\,mm}}$

7) a) $\dfrac{d_1}{2} + \dfrac{d_2}{2} = a$

$\dfrac{d_1}{2} = a - \dfrac{d_2}{2}$

$\underline{\underline{d_1 = 2a - d_2}}$

b) $V = V_1 - V_2 + V_3$

$\underline{\underline{V_3 = V - V_1 + V_2}}$

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

$\underline{\underline{d_2 = a - \dfrac{d_1}{2} - \dfrac{d_3}{2}}}$

b) $A = A_1 + A_2 - A_3$

$\underline{\underline{A_3 = A_1 + A_2 - A}}$

1) a) $\dfrac{5}{3}x = 12$

$x = \dfrac{12 \cdot 3}{5}$

$\underline{\underline{x = 7,2}}$

b) $9 = \dfrac{4x}{18}$

$x = \dfrac{9 \cdot 18}{4}$

$\underline{\underline{x = 40,5}}$

2) a) $120 = \dfrac{4 \cdot 12}{x}$

$x = \dfrac{4 \cdot 12}{120}$

$\underline{\underline{x = 0,4}}$

b) $\dfrac{5}{x} = \dfrac{12}{18}$

$x = \dfrac{5 \cdot 18}{12}$

$\underline{\underline{x = 7,5}}$

3) a) $100 = \dfrac{20 \cdot h}{3}$

$h = \dfrac{100 \cdot 3}{20}$

$\underline{\underline{h = 15}}$

b) $300 = \dfrac{A_m \cdot 50}{3}$

$A_m = \dfrac{300 \cdot 3}{50}$

$\underline{\underline{A_m = 18}}$

4) a) $628 = \dfrac{d \cdot 3,14}{2}$

$d = \dfrac{628 \cdot 2}{3,14}$

$\underline{\underline{d = 400}}$

b) $\dfrac{1}{v_1} = \dfrac{5}{36}$

$v_1 = \dfrac{36}{5}$

$\underline{\underline{v_1 = 7,2}}$

5) a) $v = d \cdot \pi \cdot n$

$\underline{\underline{n = \dfrac{v}{d \cdot \pi}}}$

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

$\underline{\underline{m = \dfrac{s}{z \cdot \pi}}}$

6) a) $F \cdot 2\pi\, r = F_{ax} \cdot P$

$\underline{\underline{r = \dfrac{F_{ax} \cdot P}{F \cdot 2\pi}}}$

b) $i = \dfrac{z_2 \cdot z_4}{z_1 \cdot z_3}$

$\underline{\underline{z_1 = \dfrac{z_2 \cdot z_4}{i \cdot z_3}}}$

7) a) $\dfrac{a}{b} = \dfrac{h}{l}$

$a \cdot l = h \cdot b$

$\underline{\underline{b = \dfrac{a \cdot l}{h}}}$

b) $W = \dfrac{F \cdot s}{t}$

$\underline{\underline{F = \dfrac{W \cdot t}{s}}}$

8) a) $a = \dfrac{m}{2}(z_1 + z_2)$

$\underline{\underline{m = \dfrac{2a}{z_1 + z_2}}}$

b) $A = \dfrac{a + b}{2}\,h$

$a + b = \dfrac{2A}{h}$

$\underline{\underline{a = \dfrac{2A}{h} - b}}$

(1)

$$5 \;---\; 200 \text{ kg}$$
$$3 \;---\; x \text{ kg}$$

$$5 \;---\; 200 \text{ kg}$$
$$1 \;---\; \frac{200}{5} \text{ kg} \qquad 40$$
$$3 \;---\; \frac{200 \cdot 3}{\cancel{5}_1} \text{ kg}$$

$$\underline{x = 120 \text{ kg}}$$

(2)

$$42 \text{ kg} \;---\; 4 \text{ m}$$
$$32 \text{ kg} \;---\; x \text{ m}$$

$$42 \text{ kg} \;---\; 4 \text{ m}$$
$$1 \text{ kg} \;---\; \frac{4}{42} \text{ m}$$
$$32 \text{ kg} \;---\; \frac{4 \cdot 32}{42} \text{ m}$$

$$\underline{x = 3{,}05 \text{ m}}$$

(3)

$$80 \text{ l} \;---\; 900 \text{ km}$$
$$50 \text{ l} \;---\; x \text{ km}$$

$$80 \text{ l} \;---\; 900 \text{ km}$$
$$1 \text{ l} \;---\; \frac{900}{80} \text{ km}$$
$$50 \text{ l} \;---\; \frac{900 \cdot 50}{80} \text{ km}$$

$$\underline{x = 562{,}5 \text{ km}}$$

(4)

$$3 \;---\; 4 \text{ h}$$
$$4 \;---\; x \text{ h}$$

$$3 \;---\; 4 \text{ h}$$
$$1 \;---\; \frac{4}{3} \text{ h}$$
$$4 \;---\; \frac{4 \cdot 3}{4} \text{ h}$$

$$\underline{x = 3 \text{ h}}$$

(5)

$$6 \;---\; 80 \text{ t}$$
$$9 \;---\; x \text{ t}$$

$$6 \;---\; 80 \text{ t}$$
$$1 \;---\; \frac{80}{6} \text{ t}$$
$$9 \;---\; \frac{80 \cdot 9}{6} \text{ t}$$

$$\underline{x = 120 \text{ t}}$$

(8)

$$24 \;---\; 42 \text{ h}$$
$$18 \;---\; x \text{ h}$$

$$24 \;---\; 42 \text{ h}$$
$$1 \;---\; 42 \cdot 24 \text{ h}$$
$$18 \;---\; \frac{42 \cdot 24}{18} \text{ h}$$

$$\underline{x = 56 \text{ h}}$$

(7)

$$32 \;---\; 48 \text{ mm}$$
$$36 \;---\; x \text{ mm}$$

$$32 \;---\; 48 \text{ mm}$$
$$1 \;---\; \frac{48}{32} \text{ mm}$$
$$36 \;---\; \frac{48 \cdot 36}{32} \text{ mm}$$

$$\underline{x = 54 \text{ mm}}$$

(6)

$$3 \;---\; 2000 \text{ h}$$
$$2 \;---\; x \text{ h}$$

$$3 \;---\; 2000 \text{ h}$$
$$1 \;---\; 2000 \cdot 3 \text{ h}$$
$$2 \;---\; \frac{\cancel{2000}^1 \cdot 3}{\cancel{2}_1} \text{ h}$$

$$\underline{x = 3000 \text{ h}}$$

(1)

$$\frac{x}{8m} = \frac{1\cancel{m}}{3\cancel{m}}$$
$$x = \frac{8}{3} \text{ m}$$
$$\underline{x = 2{,}67 \text{ m}}$$

(2)

$$\frac{x}{4,5m} = \frac{4\cancel{m}}{2\cancel{m}}$$
$$x = 2 \cdot 4{,}5m$$
$$\underline{x = 9 \text{ m}}$$

(3)

$$y = \frac{0{,}68m}{4}$$
$$\underline{y = 0{,}17 \text{ m}}$$

$$\frac{x}{0,17mm} = \frac{1,2\cancel{m}}{0,68\cancel{m}}$$
$$x = \frac{1,2 \cdot 0,17m}{0,68}$$
$$\underline{x = 0{,}30 \text{ m}}$$

(4)

$$\frac{x}{100mm} = \frac{120\cancel{mm}}{200\cancel{mm}}$$
$$x = \frac{12 \cdot 100mm}{20}$$
$$\underline{x = 60 \text{ mm}}$$

(5)

$$\frac{1}{36mm} = \frac{120\cancel{mm}}{48\cancel{mm}}$$
$$1 = \frac{120 \cdot 36mm}{48}$$
$$1 = = 90 \text{ mm}$$
$$x = = 120mm - 90mm$$
$$\underline{x = 30 \text{ mm}}$$

(6)

$$\frac{x}{(250-120)mm} = \frac{160\cancel{mm}}{250\cancel{mm}}$$
$$x = \frac{16 \cdot 130mm}{25}$$
$$\underline{x = 83{,}2 \text{ mm}}$$

⑦ $\dfrac{1}{180\text{mm}} = \dfrac{420\text{mm}}{280\text{mm}}$

$1 = \dfrac{42 \cdot 180\text{mm}}{28}$

$1 = 270 \text{ mm}$

$x = 420\text{mm} - 270\text{mm}$

$x = 150 \text{ mm}$

⑧ $\dfrac{x}{200} = \dfrac{1}{2}$

$x = \dfrac{200}{2}$

$x = 100 \text{ mm}$

$\dfrac{y}{120\text{mm}} = \dfrac{100\text{mm}}{200\text{mm}}$

$y = \dfrac{120\text{mm}}{2}$

$y = 60\text{mm}$

5.2

① $8 \$ \; \hat{=} \; 100\%$
$2 \$ \; \hat{=} \; x\%$

$\dfrac{x}{100} \; \hat{=} \; \dfrac{2}{8}$

$x \; \hat{=} \; \dfrac{2 \cdot 100}{8}$

$x \; \hat{=} \; 25\%$

② $100\% \; \hat{=} \; 12 \$$
$30\% \; \hat{=} \; x \$$

$\dfrac{x}{12} \; \hat{=} \; \dfrac{30}{100}$

$x \; \hat{=} \; \dfrac{30 \cdot 12}{100}$

$x \; \hat{=} \; 3,6 \$$

③ $56\text{mm} \; \hat{=} \; 100\%$
$24\text{mm} \; \hat{=} \; x\%$

$\dfrac{x}{100} \; \hat{=} \; \dfrac{24}{56}$

$x \; \hat{=} \; \dfrac{24 \cdot 100}{56}$

$x \; \hat{=} \; 43\%$

④ $100\% \; \hat{=} \; 8$
$25\% \; \hat{=} \; x$

$\dfrac{x}{8} \; \hat{=} \; \dfrac{25}{100}$

$x \; \hat{=} \; \dfrac{25 \cdot 8}{100}$

$x \; \hat{=} \; 2$

⑥ a) $112\% \; \hat{=} \; 896 \$$
$100\% \; \hat{=} \; x \$$

$\dfrac{x}{896} \; \hat{=} \; \dfrac{100}{112}$

$x \; \hat{=} \; \dfrac{100 \cdot 896}{112}$

$x \; \hat{=} \; 800 \$$

b) $100\% \; \hat{=} \; 800 \$$
$12\% \; \hat{=} \; Y \$$

$\dfrac{Y}{800} \; \hat{=} \; \dfrac{12}{100}$

$Y \; \hat{=} \; \dfrac{12 \cdot 800}{100}$

$Y \; \hat{=} \; 96 \$$

⑤ $9000 \$ \; \hat{=} \; 100\%$
$8000 \$ \; \hat{=} \; x\%$

$\dfrac{x}{100} \; \hat{=} \; \dfrac{8000}{9000}$

$x \; \hat{=} \; \dfrac{8000 \cdot 100}{9000}$

$x \; \hat{=} \; 89\%$

⑦ a) $6000\text{g} \; \hat{=} \; 100\%$
$5700\text{g} \; \hat{=} \; Al\%$

$\dfrac{Al}{100} \; \hat{=} \; \dfrac{5700}{6000}$

$Al \; \hat{=} \; \dfrac{5700 \cdot 100}{6000}$

$Al \; \hat{=} \; 95\%$

b) $Cu \; \hat{=} \; 100\% - 95\%$
$Cu \; \hat{=} \; 5\%$

⑧ $122\% \; \hat{=} \; 160\frac{\text{km}}{\text{h}}$
$100\% \; \hat{=} \; x\frac{\text{km}}{\text{h}}$

$\dfrac{x}{160} \; \hat{=} \; \dfrac{100}{122}$

$x \; \hat{=} \; \dfrac{100 \cdot 16}{122}$

$x \; \hat{=} \; 131\frac{\text{km}}{\text{h}}$

(1)
$$\alpha = 90° - 52°$$
$$\alpha = 38°$$
==========

(2)
$$\beta = 90° - 40°15'$$
$$\beta = 49°45' = 49,75°$$
=====================

$$\alpha = 90° + 49°45'$$
$$\alpha = 139°45' = 139,75°$$
=========================

(3)
$$\alpha = 72° - 65°$$
$$\alpha = 7°$$
=========

$$\gamma = 90° - 72°$$
$$\gamma = 18°$$
=========

(4)
$$\alpha = 18°$$
$$\beta = 108°$$
$$\gamma = 132°$$
=========

(5)
$$\alpha = \frac{42°}{2}$$
$$\alpha = 21°$$
=========

$$\beta = 90° - 21°$$
$$\beta = 69°$$
=========

$$\gamma = 180° - 69°$$
$$\gamma = 111°$$
============

(6)
$$\alpha = 360° - 120°$$
$$\alpha = 240°$$
==========

$$\beta = 180° - 60°$$
$$\beta = 120°$$
==========

(7)
$$\beta = 90° - 38° - 8°$$
$$\beta = 44°$$
============

(8)
$$\alpha = 180° - 70° - 50°$$
$$\alpha = 60°$$
=========

$$\beta = 180° - 60° - 70°$$
$$\beta = 50°$$
==========

$$\gamma = \alpha$$
$$\gamma = 60°$$
==========

7.2

(1)

	mm	cm	dm	m
a)	800	80	8	0,8
b)	4000	400	40	4
c)	120	12	1,2	0,12
d)	200	20	2	0,2

(2)

	in	ft	mm
a)	24	2	609,6
b)	3/8	1/32	9,525
c)	18	$1\frac{1}{2}$	457,2
d)	3/4	1/16	19,05
e)	4	1/3	101,6

(3)
$$95mm + x + 120mm = 972mm$$
$$x = 972mm - 95mm - 120mm$$
$$x = 757mm$$
=========

(4)
$$d + 2 \cdot 4mm = 128,2mm$$
$$d = 128,2mm - 8mm$$
$$d = 120,2mm$$
==========

(5)
$$a = \frac{240mm}{2} + 160mm + \frac{200mm}{2}$$
$$a = 380mm$$
=========

(6)
$$x + \frac{2"}{2} = 14,641mm + \frac{1"}{2}$$
$$x = 14,641mm + \frac{25,4mm}{2} - \frac{2 \cdot 25,4mm}{2}$$
$$x = 1,941mm$$
==========

(7)
$$200mm + x = \frac{182mm}{2} + \frac{264mm}{2}$$
$$x = 91mm + 132mm - 200mm$$
$$x = 23mm$$
=========

(8)
$$x + \frac{220mm}{2} = 130,8mm$$
$$x = 130,8mm - 110mm$$
$$x = 20,8mm$$
============

$$y + 355,7mm = 376,25mm$$
$$y = 376,25mm - 355,7mm$$
$$y = 20,55mm$$
============

⑨ $R = \dfrac{63,08mm}{2}$

$\underline{\underline{R = 31,54mm}}$

$x = 240,545mm - 2R$

$x = 240,545mm - 63,08mm$

$\underline{\underline{x = 177,465mm}}$

⑩ $x = 244,2mm + \dfrac{72mm}{2} - \dfrac{412,4mm}{2}$

$\underline{\underline{x = 73,8mm}}$

⑪ $x = 186mm + 28mm$

$\underline{\underline{x = 214mm}}$

$y = \dfrac{234,6mm - x}{2}$

$y = \dfrac{234,6mm - 214mm}{2}$

$\underline{\underline{y = 10,3mm}}$

⑫ $x = \dfrac{56,7mm - 42,8mm}{2}$

$\underline{\underline{x = 6,95mm}}$

⑬ $x = \dfrac{160,1mm - 40,2mm}{2}$

$\underline{\underline{x = 59,95mm}}$

⑭

$384mm + (412mm - x) = 672mm$

$384mm + 412mm - 672mm = x$

$\underline{\underline{x = 124mm}}$

⑮ $420mm = 56mm + 104mm + 8,2mm + x$

$x = 420mm - 56mm - 104mm - 8,2mm$

$\underline{\underline{x = 251,8mm}}$

⑯ $12,56mm + x + 21,624mm = 52,482mm$

$x = 52,482mm - 12,56mm - 21,624mm$

$\underline{\underline{x = 18,298mm}}$

① $\underline{\underline{n = 8}}$

$L = p \cdot n$

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

$p = \dfrac{480mm}{8}$

$\underline{\underline{p = 60mm}}$

② $\underline{\underline{n = 10}}$

$L = p \cdot n$

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

$p = \dfrac{9mm}{10}$

$\underline{\underline{p = 0,9mm}}$

③ $L = 24000mm$

$L = p \cdot n$

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

$n = \dfrac{24000mm}{200mm}$

$\underline{\underline{n = 120}}$

④ $L = p \cdot n$

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

$p = \dfrac{25,4mm}{4}$

$\underline{\underline{p = 6,35mm}}$

⑤ $L = 6400mm - 150mm - 250mm$

$L = 6000mm$

$\underline{\underline{n = 30}}$

$L = p \cdot n$

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

$p = \dfrac{6000mm}{30}$

$\underline{\underline{p = 200mm}}$

⑥ $l = L + 12mm$

$l = 7 \cdot 20mm + 12mm$

$\underline{\underline{l = 152mm}}$

⑦ $L = 2 \cdot 328mm + 2 \cdot 164m$

$L = 984mm$

$L = p \cdot n \qquad ; \quad \underline{\underline{n = 12}}$

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

$p = \dfrac{984mm}{12}$

$\underline{\underline{p = 82mm}}$

⑧ $L = p \cdot n$

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

$p = \dfrac{63,5mm}{5}$

$\underline{\underline{p = 12,7mm = 1/2"}}$

(1) $L = d \cdot \pi$

$L = 450mm \cdot 3,14$

$\underline{L = 1413\ mm}$

(2) $a = \dfrac{d \cdot \pi \cdot \alpha}{360°}$

$a = \dfrac{400mm \cdot 3,14 \cdot 120°}{360°}$

$\underline{a = 418,7\ mm}$

(3) $L = d \cdot \pi + 1$

$L = 320mm \cdot 3,14 + 400mm$

$\underline{L = 1404,8\ mm}$

(4) $L = \dfrac{D \cdot \pi}{2} + \dfrac{d \cdot \pi}{2} + 1$

$L = \dfrac{360mm \cdot 3,14}{2} + \dfrac{200mm \cdot 3,14}{2}$

$+\ 860mm$

$\underline{L = 1739,2\ mm}$

(5) $L = d \cdot \pi + 1$

$L = 160mm \cdot 3,14 + 2 \cdot 440mm + 2 \cdot 240mm$

$\underline{L = 1862,4\ mm}$

(6) $L = \dfrac{D \cdot \pi}{2} + \dfrac{d \cdot \pi}{2} + 1$

$L = \dfrac{440mm \cdot 3,14}{2} + \dfrac{200mm \cdot 3,14}{2}$

$+\ 2 \cdot 150mm + 240mm$

$\underline{L = 1544,8\ mm}$

(7) $L = \dfrac{D \cdot \pi}{2} + \dfrac{d \cdot \pi}{2} + 1$

$L = \dfrac{500mm \cdot 3,14}{2} + \dfrac{300mm \cdot 3,14}{2} + 200mm$

$\underline{L = 1456\ mm}$

(8) $L = d \cdot \pi + 1_1 + 1_2$

$L = 160mm \cdot 3,14 + 2 \cdot 400mm + 2 \cdot 240mm$

$\underline{L = 1782,4\ mm}$

(1) $x^2 = a^2 + a^2$

$x^2 = 2a^2$

$x = a\sqrt{2}$

$x = 50\sqrt{2}$

$\underline{x = 70,7mm}$

(3) $r^2 = \left(\dfrac{s}{2}\right)^2 + \left(\dfrac{r}{2}\right)^2$

$\left(\dfrac{s}{2}\right)^2 = \dfrac{3}{4}r^2$

$s = r\sqrt{3}$

$s = 30\sqrt{3}$

$\underline{s = 52mm}$

(2) $a^2 = h^2 + \left(\dfrac{a}{2}\right)^2$

$h^2 = a^2 - \dfrac{a^2}{4}$

$h^2 = \dfrac{3}{4}a^2$

$h = \dfrac{a}{2}\sqrt{3}$

$h = \dfrac{40}{2}\sqrt{3}$

$\underline{h = 34,6mm}$

(4) a) $x^2 = a^2 + a^2$

$x^2 = 2a^2$

$x = a\sqrt{2}$

$x = 20\sqrt{2}$

$\underline{x = 28,3mm}$

b) $y = \dfrac{x}{2}$

$y = \dfrac{28,2}{2}$

$\underline{y = 14,15mm}$

⑤ $x^2 = 30^2 + 40^2$

$x = \sqrt{30^2 + 40^2}$

$x = \sqrt{2500}$

$\underline{x = 50mm}$

⑥   a) $\underline{\underline{x = 50mm}}$

b) $y = 50 - 43,3$

$\underline{\underline{y = 6,7mm}}$

⑦ $s^2 = (2d)^2 + (\frac{d}{2})^2$

$s^2 = 4d^2 + \frac{d^2}{4}$

$s = \frac{d}{2}\sqrt{17}$

$s = \frac{120}{2}\sqrt{17}$

$\underline{\underline{s = 247mm}}$

$\boxed{10.3}$

⑧ $r^2 = l^2 + (r - a)^2$

$l^2 = r^2 - (r - a)^2$

$l^2 = 30^2 - (30 - 6)^2$

$l^2 = 30^2 - 24^2$

$l = \sqrt{900 - 576}$

$l = \sqrt{324}$

$\underline{\underline{l = 18mm}}$

⑨ $x^2 = 400^2 + 250^2$

$x = \sqrt{400^2 + 250^2}$

$x = \sqrt{160000 + 62500}$

$x = \sqrt{222500}$

$\boxed{222500 \;\sqrt{x}\; 471,699}$

$\underline{\underline{x = 471,7mm}}$

$\sqrt{222500} = 471,6$
   16
8 7   625
   609
94 1   1600
   941
942 6   65900
   56556
   9344

⑩ $460^2 = 350^2 + x^2$

$x^2 = 460^2 - 350^2$

$x = \sqrt{460^2 - 350^2}$

$x = \sqrt{211600 - 122500}$

$x = \sqrt{89100}$

$\boxed{89100 \;\sqrt{x}\; 298,496}$

$x = 298mm$

$\sqrt{89100} = 298,4$
   4
4 9   491
   441
58 8   5000
   4704
596 4   29600
   23856
   5744

⑪ $620^2 = (\frac{b}{2})^2 + 300^2$

$(\frac{b}{2})^2 = 620^2 - 300^2$

$\frac{b}{2} = \sqrt{620^2 - 300^2}$

$\frac{b}{2} = \sqrt{384400 - 90000}$

$\frac{b}{2} = \sqrt{294400}$

$\boxed{294400 \;\sqrt{x}\; 542,586}$

$\frac{b}{2} = 542,6$

$\underline{\underline{b = 1085,2mm}}$

$\sqrt{294400} = 542,5$
   25
10 4   444
   416
108 2   2800
   2164
1084 5   63600
   54225
   9375

(12)

$$x^2 = (60 + 50)^2 + (50 + 40)^2$$

$$x^2 = 110^2 + 90^2$$

$$x = \sqrt{110^2 + 90^2}$$

$$x = \sqrt{20200}$$

20200	x	142,13

$$\underline{\underline{x = 142,13mm}}$$

(13)

$$55^2 = x^2 + 25^2$$

$$x^2 = 55^2 - 25^2$$

$$x = \sqrt{55^2 - 25^2}$$

$$x = \sqrt{2400}$$

2400	$\sqrt{x}$	48,989

$$\underline{\underline{x = 49mm}}$$

$$\sqrt{2400} \quad = 48,9$$

```
          2400
           16
8 8        800
           704
96 9       9600
           8721
            879
```

$$\sqrt{20200} \qquad = 142,1$$

```
          20200
           1
2 4        102
            96
28 2        600
            564
284 1      3600
           2841
            759
```

(14)

$$400^2 = 320^2 + x^2$$

$$x^2 = 400^2 - 320^2$$

$$x = \sqrt{400^2 - 320^2}$$

$$x = \sqrt{57600}$$

57600	$\sqrt{x}$	240

$$\underline{\underline{x = 240 \ mm}}$$

$$\sqrt{57600} \quad = 240$$

```
          57600
           4
4 4        176
           176
             0
```

(15)

$$F^2 = 80^2 + 120^2$$

$$F = \sqrt{80^2 + 120^2}$$

$$F = \sqrt{6400 + 14400}$$

$$F = \sqrt{20800}$$

20800	$\sqrt{x}$	144,22

$$\underline{\underline{F = 144N}}$$

$$\sqrt{20800} \qquad = 144,$$

```
          20800
           1
2 4        108
            96
28 4       1200
           1136
288 2      6400
           5764
            636
```

(16)

$$x^2 = 800^2 + 1200^2$$

$$x = \sqrt{800^2 + 1200^2}$$

$$x = \sqrt{640000 + 1440000}$$

$$x = \sqrt{2080000} \quad (\text{wie } (15) \ )$$

2080000	$\sqrt{x}$	1442,2

$$\underline{\underline{x = 1442mm}}$$

(1) $\sin\alpha = \dfrac{2,5m}{12m}$

$\sin\alpha = 0,208333$

$\alpha = 12°$
========

(2) $\sin 42° = \dfrac{x}{8m}$

$x = 8m \cdot \sin 42°$ $\cos 42° = \dfrac{y}{8m}$

$x = 5,353\ m$
============

$y = 8m \cdot \cos 42°$

$\underline{y = 5,95m}$

(3) $\cos\alpha = \dfrac{280mm}{420mm}$

$\cos\alpha = 0,666667$

$\alpha = 48,19°$
============

(4) $\sin 21° = \dfrac{x}{2 \cdot 100mm}$

$x = 200mm \cdot \sin 21°$

$x = 71,67\ mm$
===============

(5) $\sin 40° = \dfrac{G}{2 \cdot F_2}$

$F_1 = F_2 = \dfrac{G}{2 \cdot \sin 40°}$

$F_1 = F_2 = \dfrac{10kN}{2 \cdot \sin 40°}$

$F_1 = F_2 = 7,78\ kN$
===================

(6) $\sin 5° = \dfrac{x}{100mm}$

$x = 100mm \cdot \sin 5°$

$x = 8,72\ mm$

$D = 80mm + 2 \cdot 8,72mm$

$D = 97,44\ mm$
============

(7) $\cos 48° = \dfrac{800mm - 240mm}{x}$

$x = \dfrac{560mm}{\cos 48°}$

$x = 836,9\ mm$
==============

$\sin 48° = \dfrac{y}{x}$

$y = x \cdot \sin 48°$

$y = 836,9mm \cdot \sin 48°$

$y = 621,9\ mm$
============

(8) $\sin 59° = \dfrac{10mm}{x}$

$x = \dfrac{10mm}{\sin 59°}$

$x = 11,7\ mm$
============

(9) $\cos\alpha = \dfrac{280mm}{340mm}$

$\underline{\alpha = 34,6°}$

$\sin = \dfrac{x}{340mm}$

$x = 340mm \cdot \sin 34,6°$

$\underline{x = 193mm}$

(12) $\cos 16° = \dfrac{F_n}{G}$

$F_n = G \cdot \cos 16°$

$F_n = 800N \cdot \cos 16°$

$\underline{F_n = 769N}$

(10) $\cos 24° = \dfrac{600N}{F}$

$F = \dfrac{600N}{\cos 24°}$

$\underline{F = 657N}$

(13) $\sin 18° = \dfrac{F}{8000N}$

$F = 8000N \cdot \sin 18°$

$\underline{F = 2472N}$

(11) $\cos 16° = \dfrac{18mm}{x}$

$x = \dfrac{18mm}{\cos 16°}$

$\underline{x = 18,7mm}$

(14) $F = G \cdot \sin\alpha$

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

$G = \dfrac{1200N}{\sin 20°}$

$\underline{G = 3509N}$

(15) $\sin 48° = \dfrac{x}{280mm}$

$x = 280mm \cdot \sin 48°$

$\underline{x = 208mm}$

(16) $\sin 30° = \dfrac{x}{R}$

$x = R \cdot \sin 30°$

$x = 30mm \cdot \dfrac{1}{2}$

$\underline{x = 15mm}$

(1) $\tan\alpha = \dfrac{2m}{3,6m}$

$\tan\alpha = 0,55555$

$\alpha = 29,1^\circ$
==========

(2) $\tan 48^\circ = \dfrac{x}{3,6m}$

$x = 3,6m \cdot \tan 48^\circ$

$x = 4\ m$
=========

(3) $\tan 16^\circ = \dfrac{D}{2 \cdot 400mm}$

$D = 800mm \cdot \tan 16^\circ$

$D = 229\ mm$
=============

(4) $\tan\alpha = \dfrac{100mm}{160mm}$

$\tan\alpha = 0,625$

$\alpha = 32^\circ$
==========

(5) $\tan\dfrac{\alpha}{2} = \dfrac{30mm}{160mm}$

$\tan\dfrac{\alpha}{2} = 0,1875$

$\dfrac{\alpha}{2} = 10,62^\circ$
===========

$\alpha = 21,24^\circ$
===========

(6) $\tan 30^\circ = \dfrac{200mm}{x}$

$x = \dfrac{200mm}{\tan 30^\circ}$

$x = 346,4\ mm$
================

(7) $\tan 32^\circ = \dfrac{F_2}{F_1}$

$F_1 = \dfrac{F_2}{\tan 32^\circ}$

$F_1 = \dfrac{8kN}{\tan 30^\circ}$

$F_1 = 12,8\ kN$
===============

(8) $\tan 59^\circ = \dfrac{12mm}{x}$

$x = \dfrac{12mm}{\tan 59^\circ}$

$x = 7,21\ mm$
=============

(1) $L = d \cdot \pi$

$L = 42mm \cdot \pi$

$L = 132\ mm$
==========

(2) $L = \dfrac{d \cdot \pi \cdot 340^\circ}{360^\circ}$

$L = \dfrac{47mm \cdot \pi \cdot 34}{36}$

$L = 139\ mm$
===========

(3) $L = \dfrac{d \cdot \pi}{2} + 1$

$L = \dfrac{36mm \cdot \pi}{2} + 70mm$

$L = 127\ mm$
==========

(4) $L = d \cdot \pi$

$L = 136mm \cdot \pi$

$L = 427\ mm$
==========

(5) $L = \dfrac{d \cdot \pi \cdot 3}{4} + l_1 + l_2$

$L = \dfrac{30mm \cdot \pi \cdot 3}{4} + 80mm + 50mm$

$L = 201\ mm$
============

(6) $L = d \cdot \pi + 1$

$L = 180mm \cdot 3,14 + 100mm$

$L = 665,2\ mm$
=============

(7) $L = \dfrac{d \cdot \pi \cdot 2}{3} + 1$

$L = \dfrac{48mm \cdot \pi \cdot 2}{3} + 400mm$

$L = 500\ mm$
==========

(8) $L = \dfrac{d \cdot \pi \cdot 3}{4} + l_1 + l_2$

$L = \dfrac{140mm \cdot \pi \cdot 3}{4} + 130mm$

$+ 210mm$

$L = 670\ mm$
==========

(1) $ei = -0,2mm$
$==========$
$T = es - ei$

$T = +0,1mm -(-0,2)mm$

$\underline{\underline{T = 0,3mm}}$

(2) $D_{max} = 49,98mm$
$============$

$D_{min} = 49,94mm$
$============$

(3) $D_{max} = 12,027mm$
$============$
$T = ES - EI$

$T = 0,027mm - 0$

$\underline{\underline{T = 0,027mm}}$

(4) $T = es - ei$

$T = -0,009mm -(-0,025)mm$

$\underline{\underline{T = 0,016mm}}$

$d_{max} = 49,991mm$
$============$

(5) $T = d_{max} - d_{min}$

$T = 41,85mm - 40,9mm$

$\underline{\underline{T = 0,95mm}}$

$d_{min} = 40,9mm$
$============$

(6) $T = ES - EI$

$T = +0,05mm -(-0,05)mm$

$\underline{\underline{T = 0,1mm}}$

$D_{min} = 39,95mm$
$============$

(7) $l_{max} = 18,1mm + 20,025mm + 18,1mm$

$\underline{\underline{l_{max} = 56,225mm}}$

$l_{min} = 17,8mm + 20,000mm + 17,8mm$

$\underline{\underline{l_{min} = 55,6mm}}$

(8) $L_{max} = 100,0mm - 19,8mm - 19,8mm$

$\underline{\underline{L_{max} = 60,4mm}}$

$L_{min} = 99,08mm - 20,2mm - 20,2mm$

$\underline{\underline{L_{min} = 59,58\ mm}}$

(1) $\Delta t = t_2 - t_1$

$\Delta t = 60°C -(-15)°C$

$\underline{\underline{\Delta t = 75K}}$

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

$\Delta l = 16m \cdot 0,000012\frac{1}{K} \cdot 75K$

$\underline{\underline{\Delta l = 0,0144m = 14,4mm}}$

(2) $\Delta t = t_2 - t_1$

$\Delta t = 50°C -(-20)°C$

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

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

$\Delta l = 20mm \cdot 0,000012\frac{1}{K} \cdot 70K$

$\underline{\underline{\Delta l = 0,0168m = 16,8mm}}$

(3) $\Delta t = t_2 - t_1$

$\Delta t = 50°C -(-20)°C$

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

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

$\Delta l = 60m \cdot 0,000012\frac{1}{K} \cdot 70K$

$\underline{\underline{\Delta l = 0,0504m = 50,4mm}}$

(4) $\Delta l = l_0 \cdot \alpha \cdot \Delta t$

$\Delta t = \frac{\Delta l}{l_0 \cdot \alpha}$

$\Delta t = \frac{3,2mm \cdot K}{4000mm \cdot 0,000012}$

$\underline{\underline{\Delta t = 66,7K}}$

$\Delta t = t_2 - t_1$

$t_2 = \Delta t + t_1$

$t_2 = 66,7K + 20°C$

$t_2 = 86,7°C$
$=========$

(5) $\Delta l = l_0 \cdot \alpha \cdot \Delta t$

$\Delta l = 82m \cdot 0,000012\frac{1}{K} \cdot 200K$

$\underline{\underline{\Delta l = 0,197m = 197mm}}$

(6) $\Delta t = t_2 - t_1$

$\Delta t = 80°C - 20°C$

$\underline{\underline{\Delta t = 60K}}$

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

$\Delta l = 420mm \cdot 0,000012\frac{1}{K} \cdot 60K$

$\underline{\underline{\Delta l = 0,302mm}}$

(7) $\Delta t = t_2 - t_1$ $\Delta l = l_0 \cdot \alpha \cdot \Delta t$ $d = 100mm + - \Delta l$

$\Delta t = 20^\circ C - 180^\circ C$ $\Delta l = 100mm \cdot 0,000012\frac{1}{K} \cdot (-160)K$ $d = 100mm - 0,192mm$

$\Delta t = -160K$ $\Delta l = -0,192mm$ $\underline{d = 99,808\,mm}$

(8) $\Delta l = l_0 \cdot \alpha \cdot \Delta t$ $\Delta t = t_2 - t_1$

$\Delta t = \frac{\Delta l}{l_0 \cdot \alpha}$ $t_2 = \Delta t + t_1$

$\Delta t = \frac{0,080mm\,K}{40,025mm \cdot 0,000012}$ $t_2 = 167^\circ C + 20^\circ C$

$\underline{\Delta t = 167K}$ $t_2 = 187^\circ C$

(1) $A = a \cdot b$

$A = 40cm \cdot 30cm$

$A = 1200\ cm^2$

(2) $A = m \cdot h$

$m = \frac{a+b}{2}$

$m = \frac{500mm + 200mm}{2}$

$m = 350\ mm$

$A = 350mm \cdot 250mm$

$A = 87500\ mm^2 = 875cm^2$

(3) $A = a \cdot h$

$A = 0,5m \cdot 0,25m$

$A = 0,125\ m^2$

(4) $A = \frac{a \cdot h}{2}$

$A = \frac{4dm \cdot 3dm}{2}$

$A = 6\ dm^2$

(5) $a \cdot b = 300^2\ mm^2$

$a = \frac{300^2\ mm^2}{b}$

$a = \frac{300^2\ mm^2}{250mm}$

$a = 360\ mm$

(6) $A = \frac{a \cdot h}{2}$

$h = \frac{2 \cdot A}{a}$

$h = \frac{2 \cdot 787,5\ cm^2}{45cm}$

$h = 35\ cm = 350\ mm$

(7) $a \cdot 400mm = \frac{800mm \cdot 900mm}{2}$

$a = \frac{800mm \cdot 900mm}{2 \cdot 400mm}$

$a = 900\ mm$

(8) $A = m \cdot h$

$m = \frac{A}{h}$

$m = \frac{1710cm^2}{36cm}$

$m = 47,5\ cm = 475\ mm$

$m = \frac{a+b}{2}$

$2m = a + b$

$b = 2m - a$

$b = 2 \cdot 475mm - 600mm$

$b = 350\ mm$

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

$A = \frac{420^2 mm^2 \cdot 3,14}{4}$

$A = 138474\ mm^2$

(2) $A = \frac{d^2 \cdot \pi}{4} \cdot \frac{60^\circ}{360^\circ}$

$A = \frac{380^2 mm^2 \cdot 3,14}{4 \cdot 60}$

$A = 18892mm^2 = 18\ 892cm^2$

(3) $A = \frac{D^2 \cdot \pi}{4} - \frac{d^2 \cdot \pi}{4}$

$A = \frac{44^2 cm^2 \cdot 3,14}{4}$

$- \frac{30^2 cm^2 \cdot 3,14}{4}$

$A = 813,26\ cm^2$

(4) $a^2 = \frac{d^2 \cdot \pi}{4}$

$\frac{4a^2}{\pi} = d^2$

$d = \sqrt{\frac{4a^2}{\pi}}$

$d = \frac{2a}{\sqrt{\pi}}$

$\underline{d = 451,5mm}$

(5) $A = \frac{d^2 \pi}{4}$

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

$d = \sqrt{\frac{4A}{\pi}}$

$d = \sqrt{\frac{4 \cdot 803,84cm^2}{\pi}}$

$\underline{d = 32cm = 320mm}$

(6) $\frac{d^2 \pi}{4} = \frac{D^2 \pi}{4} - \frac{x^2 \pi}{4}$

$x^2 = D^2 - d^2$

$x = \sqrt{D^2 - d^2}$

$x = \sqrt{500mm^2 - 400mm^2}$

$\underline{x = 300mm}$

(7)
$$A = \frac{D^2 \cdot \pi}{4} - \frac{d^2 \cdot \pi}{4}$$

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

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

$$D = \sqrt{\frac{4A}{\pi} + d^2}$$

$$D = \sqrt{\frac{4 \cdot 1275,63 cm^2}{3,14} + 20^2 cm^2}$$

$$\underline{D = 45cm = 450mm}$$

(8)
$$A = \left(\frac{D^2 \cdot \pi}{4} - \frac{d^2 \cdot \pi}{4} \right) \frac{260^\circ}{360^\circ}$$

$$A = \left(\frac{50^2 cm^2 \cdot 3,14}{4} - \frac{29^2 cm^2 \cdot 3,14}{4} \right) \cdot \frac{260}{360}$$

$$\underline{A = 941 cm^2}$$

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(1) $A = A_1 + A_2 + A_3$

$A_1 = 15cm \cdot 30cm$

$A_1 = 450cm^2$

$A_2 = 15cm \cdot 15cm$

$A_2 = 225cm^2$

$A_3 = 10cm \cdot 20cm$

$A_3 = 200cm^2$

$A = 450cm^2 + 225cm^2 + 200cm^2$

$\underline{A = 875cm^2}$

(2) $A = A_1 - A_2$

$A_1 = m \cdot h$

$A_1 = 45cm \cdot 30cm$

$A_1 = 1350cm^2$

$A_2 = 20cm \cdot 15cm$

$A_2 = 300cm^2$

$A = 1350cm^2 - 300cm^2$

$\underline{A = 1050cm^2}$

(3) $A = A_1 - A_2$

$A_1 = m \cdot h$

$A_1 = 48cm \cdot 30cm$

$A_1 = 1440cm^2$

$A_2 = 5cm \cdot 30cm$

$A_2 = 150cm^2$

$A = 1440cm^2 - 150cm^2$

$\underline{A = 1290cm^2}$

(4) $A = A_1 - A_2$

$A_1 = 5,4dm \cdot 3,2dm$

$A_1 = 17,28dm^2$

$$A_2 = \frac{1,4^2 dm^2 \cdot 3,14}{4}$$

$A_2 = 1,54dm^2$

$A = 17,28dm^2 - 1,54dm^2$

$\underline{A = 15,74dm^2}$

(5) $A = A_1 - A_2 - A_3$

$A_1 = 36cm \cdot 42cm$

$A_1 = 1512cm^2$

$A_2 = 24cm \cdot 24cm$

$A_2 = 576cm^2$

$A_3 = 10cm \cdot 5cm$

$A_3 = 50cm^2$

$A = 1512cm^2 - 576cm^2 - 50cm^2$

$\underline{A = 886cm^2}$

(6) $A = A_1 - A_2 - A_3$

$A_1 = 50cm \cdot 30cm$

$A_1 = 1500cm^2$

$A_2 = 20cm \cdot 10cm$

$A_2 = 200cm^2$

$A_3 = 10cm \cdot 8cm$

$A_3 = 80cm^2$

$A = 1500cm^2 - 200cm^2 - 80cm^2$

$\underline{A = 1220cm^2}$

(7) $A = A_1 - A_2$

$A_1 = 40cm \cdot 20cm$

$A_1 = 800cm^2$

$A_2 = 10^2 cm^2 \cdot 0,215 \cdot \left(0,215 = 1 - \frac{\pi}{4}\right)$

$A_2 = 21,5cm^2$

$A = 800cm^2 - 21,5cm^2$

$\underline{A = 778,5cm^2}$

(8) $A = A_1 + A_2$

$A_1 = 40cm \cdot 16cm$

$A_1 = 640cm^2$

$$A_2 = \left(\frac{D^2 \pi}{4} - \frac{d^2 \pi}{4} \right) \cdot \frac{1}{2}$$

$$A_2 = (D^2 - d^2) \frac{\pi}{8}$$

$$A_2 = (36^2 - 20^2)cm^2 \cdot \frac{3,14}{8}$$

$A_2 = 351,68cm^2$

$A = 640cm^2 + 351,68cm^2$

$\underline{A = 991,68cm^2}$

(9) $A = A_1 - A_2 - A_3$

$A_1 = 5dm \cdot 4dm$

$A_1 = 20dm^2$

$A_2 = 1,1dm \cdot 2dm$

$A_2 = 2,2dm^2$

$A_3 = 2^2dm^2 \cdot \frac{\pi}{4}$

$A_3 = 3,14dm^2$

$A = 20dm^2 - 2,2dm^2 - 3,14dm^2$

$\underline{A = 14,66dm^2}$

(10) $A = A_1 - A_2 - A_3$

$A_1 = 0,37m \cdot 0,57m$

$A_1 = 0,2109m^2$

$A_2 = 0,23m \cdot 0,42m \cdot \frac{1}{2}$

$A_2 = 0,0483m^2$

$A_3 = 0,3^2m^2 \cdot \frac{\pi}{4 \cdot 2}$

$A_3 = 0,03533m^2$

$A = 0,2109m^2 - 0,0483m^2 - 0,03533m^2$

$\underline{A = 0,12725m^2}$

(11) $A = A_1 + A_2 - A_3$

$A_1 = 4,5dm \cdot 3,2dm$

$A_1 = 14,4dm^2$

$A_2 = \frac{4,5^2dm^2 \cdot 3,14}{4 \cdot 2}$

$A_2 = 7,95dm^2$

$A_3 = \frac{2,5^2dm^2 \cdot 3,14}{4}$

$A_3 = 4,9006dm^2$

$A = 14,4dm^2 + 7,95dm^2$

$\qquad - 4,9006dm^2$

$\underline{A = 17,45dm^2}$

(12) $A = A_1 - A_2 - A_3$

$A_1 = 3,8dm \cdot 5,5dm$

$A_1 = 20,9dm^2$

$A_2 = 1,3dm \cdot 1,3dm \cdot 2$

$A_2 = 3,38dm^2$

$A_3 = 1dm \cdot 1dm + 1,2^2dm^2 \cdot \frac{3,14}{4}$

$A_3 = 2,33dm^2$

$A = 20,9dm^2 - 3,38dm^2 - 2,33dm^2$

$\underline{A = 15,19dm^2}$

(13) $A = A_1 - A_2 + A_3$

$A_1 = 2dm \cdot 4dm$

$A_1 = 8dm^2$

$A_2 = 1,8dm \cdot 0,8dm$

$A_2 = 1,44dm^2$

$A_3 = 0,8^2dm^2 \cdot 0,215 \cdot \frac{1}{2}$

$A_3 = 0,0688dm^2$

$A = 8dm^2 - 1,44dm^2 + 0,0688dm^2$

$\underline{A = 6,63dm^2}$

(14) $A = A_1 - A_2$

$A_1 = 1,6dm \cdot 1dm$

$A_1 = 1,6dm^2$

$A_2 = \frac{1dm^2 \cdot 3,14}{4 \cdot 2}$

$A_2 = 0,3925dm^2$

$A = 0,3925dm^2 - 0,3925dm^2$

$\underline{A = 1,2075dm^2}$

(15) $A = A_1 - A_2 - A_3$

$A_1 = 4dm \cdot 3dm$

$A_1 = 12dm^2$

$A_2 = \frac{0,4^2dm^2 \cdot 3,14}{4} \cdot 4$

$A_2 = 0,5024dm^2$

$A_3 = 0,2^2dm^2 \cdot 2$

$A_3 = 0,08dm^2$

$A = 12dm^2 - 0,5024dm^2 - 0,08dm^2$

$\underline{A = 11,42dm^2}$

(16) $A = A_1 - A_2$

$A_1 = \frac{1,8dm + 1,2dm}{2} \cdot 1,4dm$

$A_1 = 2,1 \ dm^2$

$A_2 = 0,6dm \cdot 1dm$

$A_2 = 0,6dm^2$

$A = 2,1 \ dm^2 - 0,6dm^2$

$\underline{A = 1,5 \ dm^2}$

1
$$A = \frac{d^2 \pi}{4}$$
$$A = \frac{40^2 cm^2 \cdot 3,14}{4}$$
$$\underline{\underline{A = 1256 cm^2}}$$

$$A_1 = 40cm \cdot 40cm$$
$$\underline{\underline{A_1 = 1600 cm^2}}$$

$$A_{2\%} = \frac{A_2 \cdot 100}{A_1}$$
$$A_{2\%} = \frac{344 cm^2 \cdot 100}{1600 cm^2}$$
$$\underline{\underline{A_{2\%} = 21,5\%}}$$

$$A_2 = A_1 - A$$
$$A_2 = 1600 cm^2 - 1256 cm^2$$
$$\underline{\underline{A_2 = 344 cm^2}}$$

2
$$A_2 = \frac{15cm \cdot 20cm}{2} + \frac{30cm \cdot 20cm}{2}$$
$$\underline{\underline{A_2 = 450 cm^2}}$$

$$A_{2\%} = \frac{A_2 \cdot 100}{A_1}$$
$$A_{2\%} = \frac{450 cm^2 \cdot 100}{1500 cm^2}$$
$$\underline{\underline{A_{2\%} = 30\%}}$$

$$A_1 = 30cm \cdot 50cm$$
$$\underline{\underline{A_1 = 1500 cm^2}}$$

$$A = A_1 - A_2$$
$$A = 1500 cm^2 - 450 cm^2$$
$$\underline{\underline{A = 1050 cm^2}}$$

3
$$A_2 = \frac{40cm + 50cm}{2} \cdot 10cm$$
$$\underline{\underline{A_2 = 450 cm^2}}$$

$$A_{2\%} = \frac{A_2 \cdot 100}{A_1}$$
$$A_{2\%} = \frac{450 cm^2 \cdot 100}{1800 cm^2}$$
$$\underline{\underline{A_{2\%} = 25\%}}$$

$$A_1 = 30cm \cdot 60cm$$
$$\underline{\underline{A_1 = 1800 cm^2}}$$

$$A = A_1 - A_2$$
$$A = 1800 cm^2 - 450 cm^2$$
$$\underline{\underline{A = 1350 cm^2}}$$

4
$$A_2 = \frac{20cm \cdot 35cm}{2} + \frac{36^2 cm^2 \cdot 3,14}{4 \cdot 4}$$
$$A_2 = 350 cm^2 + 254,34 cm^2$$
$$\underline{\underline{A_2 = 604,34 cm^2}}$$
$$\underline{\underline{A_{2\%} = 34,5\%}}$$

$$A_1 = 50cm \cdot 35cm$$
$$\underline{\underline{A_1 = 1750 cm^2}}$$

$$A = A_1 - A_2$$
$$A = 1750 cm^2 - 604,34 cm^2$$
$$\underline{\underline{A = 1146,6 cm^2}}$$

5
$$A_1 = 60cm \cdot 35cm$$
$$\underline{\underline{A_1 = 2100 cm^2}}$$

$$A_2 = d^2 \cdot 0,215$$
$$A_2 = 28^2 cm^2 \cdot 0,215$$
$$\underline{\underline{A_2 = 169 cm^2}}$$

$$A = A_1 - A_2$$
$$A = 2100 cm^2 - 169 cm^2$$
$$\underline{\underline{A = 1931 cm^2}}$$

$$A_{2\%} = \frac{A_2 \cdot 100}{A_1}$$
$$A_{2\%} = \frac{169 cm^2 \cdot 100}{2100 cm^2}$$
$$\underline{\underline{A_{2\%} = 8\%}}$$

6
$$A_1 = 42cm \cdot 41cm$$
$$\underline{\underline{A_1 = 1722 cm^2}}$$

$$A_{2\%} = \frac{A_2 \cdot 100}{A_1}$$
$$A_{2\%} = \frac{720 cm^2 \cdot 100}{1722 cm^2}$$
$$\underline{\underline{A_{2\%} = 42\%}}$$

$$A = 42cm \cdot 20cm + \frac{42^2 cm^2 \cdot 3,14}{2 \cdot 4} - \frac{26^2 cm^2 \cdot 3,14}{4}$$
$$\underline{\underline{A = 1002 cm^2}}$$

$$A_2 = A_1 - A$$
$$A_2 = 1722 cm^2 - 1002 cm^2$$
$$\underline{\underline{A_2 = 720 cm^2}}$$

7
$$A_2 = \frac{26^2 cm^2 \cdot 3,14}{2 \cdot 4} + 22cm \cdot 16cm \cdot \frac{1}{2}$$
$$\underline{\underline{A_2 = 441 cm^2}}$$

$$A_1 = 38cm \cdot 56cm$$
$$\underline{\underline{A_1 = 2128 cm^2}}$$

$A = A_1 - A_2$

$A = 2128cm^2 - 441cm^2$

$\underline{A = 1687cm^2}$

$A_{2\%} = \dfrac{A_2 \cdot 100}{A_1}$

$A_{2\%} = \dfrac{441cm^2 \cdot 100}{2128cm^2}$

$\underline{A_{2\%} = 20,7\%}$

(8)

$A_1 = 32cm \cdot 52cm$

$\underline{A_1 = 1664cm^2}$

$A = 31cm \cdot 26cm + \dfrac{26^2cm^2 \cdot 3,14}{2 \cdot 4}$

$\underline{A = 1071cm^2}$

$A_2 = A_1 - A$

$A_2 = 1664cm^2 - 1071cm^2$

$\underline{A_2 = 593cm^2}$

$A_{2\%} = \dfrac{A_2 \cdot 100}{A_1}$

$A_{2\%} = \dfrac{593cm^2 \cdot 100}{1664cm^2}$

$\underline{A_{2\%} = 36\%}$

(1) $V = a \cdot b \cdot c$

$V = 1m \cdot 2m \cdot 1,2m$

$\underline{V = 2,4m^3}$

(2) $V = a \cdot b \cdot c$

$V = 20cm \cdot 12cm \cdot 32cm$

$\underline{V = 7680cm^3}$

(3) $V = A \cdot h$

$V = (6cm \cdot 4,5cm - 4cm \cdot 2,5cm - 2cm \cdot 1cm) \cdot 12cm$

$\underline{V = 180cm^3}$

(4) $V = \dfrac{a \cdot b}{2} \cdot h$

$V = \dfrac{20cm \cdot 5cm}{2} \cdot 30cm$

$\underline{V = 1500cm^3}$

(5) $V = \dfrac{d^2 \cdot \pi}{4} \cdot h$

$V = \dfrac{1^2m^2 \cdot 3,14}{4} \cdot 1,5m$

$\underline{V = 1,18m^3}$

(6) $V = \dfrac{d^2 \cdot \pi}{4} \cdot h$

$V = \dfrac{20^2cm^2 \cdot 3,14}{4} \cdot 24cm$

$\underline{V = 7536cm^3}$

(7) $V = A \cdot h$

$V = 12dm \cdot 24dm \cdot 0,04dm$

$\underline{V = 11,52dm^3}$

(8) $V = A \cdot h$

$V = \dfrac{6dm + 4dm}{2} \cdot 2dm \cdot 0,05dm$

$\underline{V = 0,5dm^3}$

(1) $V = \dfrac{A \cdot h}{3}$

$V = \dfrac{4m \cdot 4m}{3} \cdot 6m$

$\underline{V = 32m^3}$

(2) $V = \dfrac{A \cdot h}{3}$

$V = \dfrac{4^2m^2 \cdot 3,14 \cdot 6m}{4 \cdot 3}$

$\underline{V = 25,12m^3}$

(3) $V_1 = V_2$

$300mm \cdot 300mm \cdot h = \dfrac{400mm \cdot 300mm \cdot 200mm}{3}$

$h = \dfrac{400mm \cdot 100mm \cdot 200mm}{300mm \cdot 300mm}$

$\underline{h = 88,89mm}$

(4) $V = \dfrac{A \cdot h}{3}$

$V = \dfrac{1,2^2dm^2 \cdot 3,14 \cdot 1,5dm}{4 \cdot 3}$

$\underline{V = 0,565dm^3}$

(5) $V = \dfrac{A \cdot l}{3}$

$l = \dfrac{3V}{A}$

$l = \dfrac{3 \cdot 100cm^3}{5cm \cdot 5cm}$

$\underline{l = 12cm = 120mm}$

(6) $V = \dfrac{A \cdot h}{3}$

$V = \dfrac{0,4^2dm^2 \cdot 3,14 \cdot 1,2dm}{4 \cdot 3}$

$\underline{V = 0,05dm^3}$

(7) $V = \dfrac{A \cdot h}{3}$

$V = \dfrac{2m \cdot 2m \cdot 3m}{3}$

$\underline{\underline{V = 4m^3}}$

(8) $h \cdot 3m \cdot 3m = \dfrac{4^2 m^2 \cdot \pi \cdot 3m}{4 \cdot 3}$

$h = \dfrac{4^2 m^2 \cdot 3,14 \cdot m}{4 \cdot 3m \cdot 3m}$

$\underline{\underline{h = 1,396m}}$

(9) $V \approx A_m \cdot h$

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

$A_m = \dfrac{4m \cdot 4m + 2m \cdot 2m}{2}$

$A_m = 10m^2$

$V \approx 10 \ m^2 \cdot 1m$

$\underline{\underline{V \approx 10 \ m^3}}$

(10) $V \approx A_m \cdot h$

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

$A_m = \dfrac{3^2 dm^2 \cdot 3,14 + 1,8^2 dm^2 \cdot 3,14}{4 \cdot 2}$

$A_m = 4,804dm^2$

$V \approx 4,804dm^2 \cdot 2dm$

$\underline{\underline{V \approx 9,61dm^3}}$

(11) $V \approx A_m \cdot h$

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

$A_m = \dfrac{10cm \cdot 10cm + 5cm \cdot 5}{2}$

$A_m = 62,5cm^2$

$V \approx 62,5cm^2 \cdot 12cm$

$\underline{\underline{V \approx 750cm^3}}$

(12) $V \approx A_m \cdot h$

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

$A_m = \dfrac{4dm \cdot 8dm + 6dm \cdot 3dm}{2}$

$A_m = 25dm^2$

$V \approx 25dm^2 \cdot 0,5dm$

$\underline{\underline{V \approx 12,5dm^3}}$

(13) $V \approx A_m \cdot h$

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

$A_m = \dfrac{2^2 dm^2 \cdot 3,14 + 1^2 dm^2 \cdot 3,14}{4 \cdot 2}$

$A_m = 1,96dm^2$

$V \approx 1,96dm^2 \cdot 1,5dm$

$\underline{\underline{V \approx 2,94dm^3}}$

(14) $V \approx A_m \cdot h$

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

$A_m = \dfrac{1,6^2 dm^2 + 1^2 dm^2}{2}$

$A_m = 1,78dm^2$

$V \approx 1,78dm^2 \cdot 1,2dm$

$\underline{\underline{V \approx 2,136dm^3}}$

(15) $V \approx A_m \cdot h$

$A_m = \dfrac{1,6^2 dm^2 \cdot 3,14 + 1^2 dm^2 \cdot 3,14}{4 \cdot 2}$

$A_m = 1,4dm^2$

$V \approx 1,4dm^2 \cdot 1,2dm$

$\underline{\underline{V \approx 1,68dm^3}}$

(16) $V \approx A_m \cdot h$

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

$A_m = \dfrac{1,8^2 dm^2 \cdot 3,14 + 1^2 dm^2 \cdot 3,14}{4 \cdot 2}$

$A_m = 1,66dm^2$

$V \approx 1,66dm^2 \cdot 2dm$

$\underline{\underline{V \approx 3,32dm^3}}$

(1) $V = V_1 + V_2$

$V_1 = a \cdot b \cdot c$

$V_1 = 3cm \cdot 8cm \cdot 8cm$

$V_1 = 192cm^3$

$V_2 = \dfrac{d^2 \cdot \pi}{4} \cdot h$

$V_2 = \dfrac{5^2 cm^2 \cdot \pi}{4} \cdot 7cm$

$V_2 = 137cm^3$

$V = 192cm^3 + 137cm^3$

$\underline{\underline{V = 329cm^3}}$

② $V = V_1 - V_2$

  $V_1 = \dfrac{D^2 \cdot \pi}{4} \cdot h$

  $V_1 = \dfrac{15^2 cm^2 \cdot 3,14}{4} \cdot 20cm$

  $V_1 = 3533 cm^3$

$V_2 = \dfrac{d^2 \cdot \pi}{4} \cdot h$

$V_2 = \dfrac{10^2 cm^2 \cdot 3,14}{4} \cdot 20cm$

$V_2 = 1570 cm^3$

$V = 3533 cm^3 - 1570 cm^3$

$\underline{\underline{V = 1963 cm^3}}$

③ $V = V_1 + V_2$

  $V_1 = a \cdot b \cdot c$

  $V_1 = 12cm \cdot 20cm \cdot 3cm$

  $V_1 = 720 cm^3$

$V_2 = \dfrac{a + b}{2} \cdot h \cdot c$

$V_2 = \dfrac{10cm + 6cm}{2} \cdot 3cm \cdot 6cm$

$V_2 = 144 cm^2$

$V = 720 cm^3 + 144 cm^3$

$\underline{\underline{V = 864 cm^3}}$

④ $V = V_1 + V_2 - V_3$

  $V_1 = a \cdot b \cdot c$

  $V_1 = 8cm \cdot 5cm \cdot 2cm$

  $V_1 = 80 cm^3$

$V_2 = \dfrac{4cm + 3cm}{2} \cdot 4cm \cdot 3cm$

$V_2 = 42 cm^3$

$V_3 = \dfrac{2^2 cm^2 \cdot 3,14}{4} \cdot 3cm$

$V_3 = 9,42 cm^3$

$V = 80 cm^3 + 42 cm^3 - 9,42 cm^3$

$\underline{\underline{V = 112,58 cm^3}}$

⑤ $V = V_1 + V_2 - V_3$

  $V_1 = 12cm \cdot 8cm \cdot 3cm$

  $V_1 = 288 cm^3$

$V_2 = 8cm \cdot 4cm \cdot 2cm$

$V_2 = 64 cm^3$

$V_3 = 4cm \cdot 2cm \cdot 2cm$

$V_3 = 16 cm^3$

$V = 288 cm^3 + 64 cm^3 - 16 cm^3$

$\underline{\underline{V = 336 cm^3}}$

⑥ $V = V_1 + V_2$

$V_1 = 5dm \cdot 5dm \cdot 5dm$

$V_1 = 125 dm^3$

$V_2 = \dfrac{5dm \cdot 5dm}{3} \cdot 3dm$

$V_2 = 25 dm^3$

$V = 125 dm^3 + 25 dm^3$

$\underline{\underline{V = 150 dm^3}}$

⑦ $V = V_1 - V_2 - V_3$

  $V_1 = \dfrac{16^2 cm^2 \cdot 3,14}{4} \cdot 6cm$

  $V_1 = 1206 cm^3$

$V_2 = \dfrac{10^2 cm^2 \cdot 3,14}{4} \cdot 3cm$

$V_2 = 236 cm^3$

$V_3 = \dfrac{5^2 cm^2 \cdot 3,14}{4} \cdot 3cm$

$V_3 = 59 cm^3$

$V = 1206 cm^3 - 236 cm^3 - 59 cm^3$

$\underline{\underline{V = 911 cm^3 = 0,911 dm^3}}$

⑧ $V = V_1 + V_2 - V_3$

  $V_1 = 10cm \cdot 20cm \cdot 3cm$

  $V_1 = 600 cm^3$

$V_2 = 20cm \cdot 12cm \cdot 4cm$

$V_2 = 960 cm^3$

$V_3 = 10^2 cm^2 \cdot 0,215 \cdot \dfrac{1}{2} \cdot 4cm$

$V_3 = 43 cm^3$

$V = 600 cm^3 + 960 cm^3 - 43 cm^3$

$\underline{\underline{V = 1517 cm^3}}$

$$V = a^2 \cdot x$$

(9)
$$x = \frac{V}{a^2}$$

$$x = \frac{3,2m^3}{2m \cdot 2m}$$

$$\underline{x = 0,8m}$$

(10) $V = V_1 - V_2$ 　　　 $V_1 = (\frac{12^2cm^2 \cdot 3,14}{4} + \frac{18^2cm^2 \cdot 3,14}{4}) \cdot \frac{1}{2} \cdot 10cm$ 　　 $V_2 = \frac{8^2 \cdot cm^2 \cdot 3,14}{4} \cdot 10cm$

　　　　　　　　　　　$V_1 = 1837cm^3$ 　　　　　　　　　　　　　　　　　　$V_2 = 502cm^3$

$$V = 1837cm^3 - 502cm^3$$

$$\underline{V = 1335cm^3 = 1,335dm^3}$$

(11) $V = A \cdot h$ 　　　　　　$\sin 60^o = \frac{10mm}{R}$ 　　　 (12) $V = V_1 + V_2 + V_3$

　　　$A = \frac{R^2 \cdot \pi}{6}$ 　　　　　　$R = \frac{10mm}{\sin 60^o}$ 　　　　　　　$V_1 = 12cm \cdot 10cm \cdot 4cm$

　　　　　　　　　　　　　　　　　　　　　　　　　　　$V_1 = 480cm^3$

　　　$A = \frac{1,15^2cm^2 \cdot 3,14}{6}$ 　　$R = 11,5mm$

　　　$A = 0,692cm^2$ 　　　　　　　　　　　　　　　　　$V_2 = 2 \cdot 10cm \cdot 3cm \cdot 5cm$

　　　　　　　　　　　　　　　　　　　　　　　　　　　$V_2 = 300cm^3$

$$V = 0,692cm^2 \cdot 8cm$$ 　　　　　　　　　　　　　　　$V_3 = \frac{10^2cm^2 \cdot 3,14}{4} \cdot 3cm$

$$\underline{V = 5,5cm^3}$$ 　　　　　　　　　　　　　　　　　$V_3 = 235,5cm^3$

(13) $V = V_1 + V_2 - V_3$

　　　$V_1 = \frac{8^2cm^2 \cdot 3,14}{4} \cdot 8cm$ 　　　　　　　　$V = 480cm^3 + 300cm^3 + 235,5cm^3$

　　　$V_1 = 402cm^3$ 　　　　　　　　　　　　　　$\underline{V = 1016cm^3 = 1,016dm^3}$

　　　$V_2 = \frac{10^2cm^2 \cdot 3,14}{4} \cdot 4cm$ 　　 (14)

　　　$V_2 = 314cm^3$ 　　　　　　　$V = V_1 - V_2$ 　　　　　　$V_2 = \frac{4cm \cdot 8cm}{2} \cdot 6cm$

　　　　　　　　　　　　　　　　　　　$V_1 = 12cm \cdot 8cm \cdot 12cm$ 　　　$V_2 = 96cm^3$

　　　$V_3 = \frac{6^2cm^2 \cdot 3,14}{4} \cdot 12cm$ 　　　$V_1 = 1152cm^3$

　　　$V_3 = 339cm^3$ 　　　　　　　　$V = 1152cm^3 - 96cm^3$

　　　　　　　　　　　　　　　　$\underline{V = 1056cm^3}$

$$V = 402cm^3 + 314cm^3 - 339cm^3$$

$$\underline{V = 377cm^3}$$

(15) $V = V_1 - V_2 - V_3$ 　　　　　　　　 (16) $V = V_1 + V_2$

　　　$V_1 = 10cm \cdot 10cm \cdot 2cm$ 　　　　　　　　$V_1 = \frac{10cm \cdot 10cm}{2} \cdot 10cm$

　　　$V_1 = 200cm^3$ 　　　　　　　　　　　　$V_1 = 500cm^3$

　　　$V_2 = 6cm \cdot 10cm \cdot 1cm$ 　　　　　　　　$V_2 = \frac{10^2cm^2 \cdot 3,14}{4} \cdot 10cm$

　　　$V_2 = 60cm^3$ 　　　　　　　　　　　　$V_2 = 785cm^3$

　　　$V_3 = \frac{5^2cm^2 \cdot 3,14}{4} \cdot 1cm$

　　　$V_3 = 19,63cm^3$ 　　　　　　　　　　$V = 500cm^3 + 785cm^3$

　　　　　　　　　　　　　　　　$\underline{V = 1285cm^3}$

$$V = 200cm^3 - 60cm^3 - 19,63cm^3$$

$$\underline{V = 120cm^3}$$

(1)

$$V_1 = V_2$$

$l_1 \cdot 60mm \cdot 120mm = 200mm \cdot 40mm \cdot 120mm$

$$l_1 = \frac{200mm \cdot 40mm}{60mm}$$

$$l_1 = 133,3mm$$

(2)

$$V_1 = V_2$$

$l_1 \cdot 40mm \cdot 10mm = 50mm \cdot 5 \cdot 40mm$

$$l_1 = \frac{50mm \cdot 5mm}{10mm}$$

$$l_1 = 25mm$$

(3)

$$V_1 = V_2$$

$l_1 \cdot 40mm \cdot 40mm = 50mm \cdot \frac{25^2 mm^2 \cdot 3,14}{4}$

$$l_1 = \frac{50mm \cdot 25^2 mm^2 \cdot 3,14}{40mm \cdot 40mm \cdot 4}$$

$$l_1 = 15,3mm$$

(4)

$$V_1 = V_2$$

$80mm \cdot 800mm \cdot 600mm = l_2 \cdot 4mm \cdot 800mm$

$$l_2 = \frac{80mm \cdot 600mm}{4mm}$$

$$l_2 = 12000mm = 12m$$

(5)

$$V_1 = V_2$$

$l_1 \cdot 50mm \cdot 50mm = 50mm \cdot 50mm \cdot 300mm \cdot \frac{1}{3}$

$$l_1 = 100mm$$

(6)

$$V_1 = V_2$$

$40mm \cdot 40mm \cdot 100mm = 40mm \cdot 40mm \cdot l_2 \cdot \frac{1}{3}$

$$l_2 = 100mm \cdot 3$$

$$l_2 = 300mm$$

(7)

$$V_1 = V_2$$

$l_1 \cdot 40mm \cdot 100mm = 40mm \cdot 100mm \cdot 120mm \cdot \frac{1}{2}$

$$l_1 = 60mm$$

(8)

$$V_1 = V_2$$

$60mm \cdot 60mm \cdot 80mm = 100mm \cdot 100mm \cdot l_2$

$$l_2 = \frac{60mm \cdot 60mm \cdot 80mm}{100mm \cdot 100mm}$$

$$l_2 = 28,8mm$$

$$x = 120mm + l_2$$

$$x = 120mm + 28,8mm$$

$$x = 148,8mm$$

(1)

$m = V \cdot \rho$

$m = 1,2m \cdot 1m \cdot 0,8m \cdot 2,2 \frac{t}{m^3}$

$$m = 2,112t = 2112kg$$

(2)

$m = V \cdot \rho$

$m = \frac{8^2 dm^2 \cdot 3,14}{4} \cdot 8dm \cdot 0,95 \frac{kg}{dm^3}$

$$m = 382kg = 0,382t$$

(3)

$m = V \cdot \rho$

$V = A \cdot l$

$V = (2dm \cdot 1dm - 1,5dm \cdot 0,75dm) \cdot 8dm$

$V = 7dm^3$

$m = 7dm^3 \cdot 7,85 \frac{kg}{dm^3}$

$$m = 54,95kg$$

(4.)

$2,5t = 1,2m \cdot 1,2m \cdot x \cdot \rho$

$$x = \frac{2,5t}{1,2m \cdot 1,2m \cdot \rho}$$

$$x = \frac{2,5t \cdot m^3}{1,2m \cdot 1,2m \cdot 2,5t}$$

$$x = 0,69m$$

(5)

$m = V \cdot \rho$

$m = 20dm \cdot 10dm \cdot 0,008dm \cdot 8,96 \frac{kg}{dm^3}$

$$m = 14,336kg$$

⑥ $m = V \cdot \rho$

$V = \dfrac{3^2 dm^2 \cdot 3,14 + 4^2 dm^2 \cdot 3,14}{4} \cdot \dfrac{}{2} \cdot 2dm$

$V = 19,6 dm^3$

$m = 19,6 dm^3 \cdot 1\dfrac{kg}{dm^3}$

$\underline{\underline{m = 19,6 kg}}$

⑦ $m = V \cdot \rho$

$V = \dfrac{0,02^2 dm^2 \cdot 3,14}{4} \cdot 200 dm$

$\underline{\underline{V = 0,0628 dm^3}}$

$m = 0,0628 dm^3 \cdot 7,8\dfrac{kg}{dm^3}$

$\underline{\underline{m = 0,490 kg}}$

⑧ $m = V \cdot \rho$

$V = (8dm \cdot 7dm - 5dm \cdot 1dm - 3dm \cdot 3dm) \cdot 0,05dm$

$V = 2,1 dm^3$

$m = 2,1 dm^3 \cdot 7,8\dfrac{kg}{dm^3}$

$\underline{\underline{m = 16,38 kg}}$

$\boxed{25.3}$

①
	N	daN	kN
a)	2000	200	2
b)	8400	840	8,4
c)	5200	520	5,2
d)	2250	225	2,25
e)	4500	450	4,5

② $1 kg \mathrel{\widehat{=}} 10N$

$\underline{\underline{G = 800N}}$

$\underline{\underline{F = 800N}}$

③ $m = m_1 + m_2 + m_3$

$m = 1000kg + 2000kg + 800kg$

$m = 3800kg$

$\underline{\underline{F = 38000N}}$

④ $\underline{\underline{F_1 = 70N}}$

$\underline{\underline{F_2 = 100N}}$

⑤ $\underline{\underline{F_1 = 100N}}$

$\underline{\underline{F_2 = 37,5N}}$

$\underline{\underline{F_3 = 62,5N}}$

⑥ $m = m_1 + m_2$

$m = 100kg + 250kg$

$m = 350kg \mathrel{\widehat{=}} 3500N$

$F = 3500N - 3350N$

$\underline{\underline{F = 150N}}$

⑦ $F = F_1 + F_2$

$F = 250N + 400N$

$\underline{\underline{F = 650N}}$

⑧ $m = m_1 + m_2 + m_3 + m_4$

$m = 80kg + 60kg + 120kg + 250kg$

$\underline{\underline{m = 510kg}}$

$\underline{\underline{F = 5100N = 5,1kN}}$

$\boxed{25.4}$

① $G^2 = 2F_1^2$

$F_1^2 = \dfrac{G^2}{2}$

$F_1 = \sqrt{\dfrac{G^2}{2}}$

$F_1 = \sqrt{\dfrac{700^2}{2}}$

$\underline{\underline{F_1 = 495\ N = F_2}}$

② $F_1 = F_2$

$F_1 = \sqrt{\dfrac{G}{2}}$

$F_1 = \sqrt{\dfrac{10^2}{2}}$

$F_1 = 7,1kN = F_2$

$\underline{\underline{F_1 = 7100N = F_2}}$

③ $F^2 = F_1{}^2 + F_2{}^2$

$F_1 = F_2$

$F^2 = 2 \cdot F_1{}^2$

$F = \sqrt{2 \cdot F_1{}^2}$

$F = \sqrt{2 \cdot 500^2}$

$\underline{F = 707N}$

④ a) $F_1 = \frac{G}{2}$ b) $F_1{}^2 + F_1{}^2 = 10^2$ c)

$F_1 = \frac{10kN}{2}$

$2F_1{}^2 = 10^2$ $F_1 = G$

$F_1 = 7,1kN$ $F_1 = 10kN$

$F_1 = 5kN$

⑤ $F_1{}^2 + F_2{}^2 = 1,5^2$

$F_1 = F_2$

$2F_1{}^2 = 1,5^2$

$F_1{}^2 = \frac{1,5^2}{2}$

$F_1 = \sqrt{\frac{1,5^2}{2}}$

$F_1 = 1,06kN$

$F_2 = 1,06kN$

⑥ $F^2 = 600^2 + 400^2$

$F = \sqrt{600^2 + 400^2}$

$\underline{F = 721N}$

⑦

$\sin17^o = \frac{F}{2 \cdot F_1}$

$F_1 = \frac{F}{2 \cdot \sin17^o}$

$F_1 = \frac{120N}{2 \cdot \sin17^o}$

$F_1 = 205N = F_2$

⑧ a) $F = 2 \cdot 10kN$ b) $\cos30^o = \frac{F}{2 \cdot 10kN}$ c) $F^2 = 10^2 + 10^2$

$\underline{F = 20kN}$

$F = 20kN \cdot \cos30^o$ $F = \sqrt{10^2 + 10^2}$

$\underline{F = 17,3kN}$ $\underline{F = 14,14kN}$

① $M = F \cdot r$

$M = 300N \cdot 240mm$

$M = 72000Nmm$

$\underline{M = 72Nm}$

② $M = F_1 \cdot r + F_2 \cdot r$

$M = 50N \cdot 0,21m + 50N \cdot 0,21m$

$\underline{M = 21Nm}$

③ $M = F \cdot r$

$M = 200N \cdot 0,2m$

$\underline{M = 40Nm}$

④ $M = F \cdot r$

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

$F = \frac{80Nm}{0,22m}$

$\underline{F = 364N}$

⑤ $M = F \cdot r$

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

$F = \frac{8Nm}{0,2m}$

$\underline{F = 40N}$

⑥ $M = F \cdot r$

$M = 8000N \cdot 0,12m$

$\underline{M = 960Nm}$

⑦ $M = F \cdot r$

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

$F = \frac{40Nm}{0,34m}$

$\underline{F = 118N}$

⑧ $M = F \cdot r$

$M = 50N \cdot 0,24m$

$\underline{M = 12Nm}$

① $F_1 \cdot l_1 = F_2 \cdot l_2$

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

$$F_2 = \frac{12 daN \cdot 120mm}{450mm}$$

$$F_2 = 3,2daN$$
============

② $F_2 \cdot l_2 = F_1 \cdot l_1$

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

$$F_2 = \frac{8kN \cdot 280mm}{480mm}$$

$$F_2 = 4,7kN$$
=========

③ $1kg \mathrel{\hat{=}} 10N$

$G = 1500N$

$F \cdot 1300mm = G \cdot 400mm$

$$F = \frac{G \cdot 400mm}{1300mm}$$

$$F = 462N$$

④ $F_2 \cdot l_2 = F_1 \cdot l_1$

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

$$F_2 = \frac{12 daN \cdot 320mm}{10mm}$$

$$F_2 = 384daN$$
=========

⑤ $F_1 \cdot l_1 = F_2 \cdot l_2$

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

$$F_1 = \frac{8kN \cdot 260mm}{124mm}$$

$$F_1 = 16,8kN$$
==========

⑥ $F_1 \cdot l_1 = F_2 \cdot l_2$

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

$$F_1 = \frac{25 daN \cdot 30mm}{240mm}$$

$$F_1 = 3,125daN$$
=============

⑦ $F_1 \cdot l_1 = F_2 \cdot l_2$

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

$$F_1 = \frac{7kN \cdot 320mm}{180mm}$$

$$F_1 = 12,4kN$$
=========

⑧ $F_1 \cdot l_1 = F_2 \cdot l_2$

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

$$F_1 = \frac{2kN \cdot 800mm}{600mm}$$

$$F_1 = 2,7kN$$
=========

① $F_1 \cdot 5,5m = G \cdot 2m$

$$F_1 = \frac{G \cdot 2m}{5,5m}$$

$$F_1 = \frac{120daN \cdot 2}{5,5}$$

$$F_1 = 43,6daN$$
=============

$F_1 + F_2 = G$

$$F_2 = G - F_1$$

$$F_2 = 120daN - 43,6daN$$

$$F_2 = 76,4daN$$
=============

② $F_1 \cdot 70m = G \cdot 40m$

$$F_1 = \frac{G \cdot 40m}{70m}$$

$$F_1 = \frac{200kN \cdot 40}{70}$$

$$F_1 = 114kN$$
===========

$F_1 + F_2 = G$

$$F_2 = G - F_1$$

$$F_2 = 200kN - 114kN$$

$$F_2 = 86kN$$
=========

③ $F_1 \cdot 850mm = F \cdot 250mm$

$$F_1 = \frac{F \cdot 250mm}{850mm}$$

$$F_1 = \frac{5000N \cdot 25}{85}$$

$$F_1 = 1471N$$
==========

$F_1 + F_2 = F$

$$F_2 = F - F_1$$

$$F_2 = 5000N - 1471N$$

$$F_2 = 3529N$$
=========

④ $F_2 \cdot 380mm = F \cdot 300mm$

$$F_2 = \frac{F \cdot 300mm}{380mm}$$

$$F_2 = \frac{8000N \cdot 300}{380}$$

$$F_2 = 6316N$$
=========

⑤ $F_1 \cdot 3600mm = F \cdot 2100mm$

$$F_1 = \frac{F \cdot 2100mm}{3600mm}$$

$$F_1 = \frac{12000N \cdot 2100}{360}$$

$$F_1 = 7000N$$
=========

$F_1 + F_2 = F$

$$F_2 = F - F_1$$

$$F_2 = 12000N - 7000N$$

$$F_2 = 5000N$$
==========

⑥ $F_1 \cdot 3m = G \cdot 1m$

$F_1 = \frac{G \cdot 1m}{3m}$

$F_1 = \frac{12000N}{3}$

$F_1 = 4000N$
==========

$F_1 + F_2 = G$

$F_2 = G - F_1$

$F_2 = 12000N - 4000N$

$F_2 = 8000N$
==========

⑦ $F_1 \cdot 480mm = F \cdot 250mm$

$F_1 = \frac{F \cdot 250mm}{480mm}$

$F_1 = \frac{14000N \cdot 250}{480}$

$F_1 = 7292N$
==========

$F_1 + F_2 = F$

$F_2 = F - F_1$

$F_2 = 14000N - 7292N$

$F_2 = 6708N$
==========

⑧ $F_1 \cdot 12500mm = G_1 \cdot 8000mm + G_2 \cdot 12500mm \cdot 0,5$

$F_1 = \frac{G_1 \cdot 8000mm + G_2 \cdot 12500mm \cdot 0,5}{12500mm}$

$F_1 = \frac{40kN \cdot 8000 + 12kN \cdot 12500 \cdot 0,5}{12500}$

$F_1 = 31,6kN$
==========

$F_1 + F_2 = G_1 + G_2$

$F_2 = 40kN + 12kN - 31,6kN$

$F_2 = 20,4kN$
==========

① $F_1 \cdot l_1 = F_2 \cdot l_2$

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

$F_1 = \frac{400N \cdot 50mm}{220mm}$

$F_1 = 91N$
========

② $F_1 \cdot l_1 = G \cdot l_2$

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

$F_1 = \frac{750N \cdot 420mm}{1200mm}$

$F_1 = 263N$
========

③ $F_2 \cdot l_2 = F_1 \cdot l_1$

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

$F_2 = \frac{5kN \cdot 500mm}{400mm}$

$F_2 = 6,25kN$
==========

④ $1kg \; \hat{=} \; 10N$

$G = 4000N$
========

$F_1 \cdot 300mm = G \cdot 80mm$

$F_1 = \frac{G \cdot 80mm}{300mm}$

$F_1 = \frac{4000N \cdot 80}{300}$

$F_1 = 1067N$
==========

⑤ $F_1 \cdot l_1 = F_2 \cdot l_2$

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

$F_1 = \frac{8kN \cdot 300mm}{200mm}$

$F_1 = 12kN$
========

⑥ $F_1 \cdot l_1 = F_2 \cdot l_2$

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

$F_1 = \frac{12kN \cdot 180mm}{240mm}$

$F_1 = 9kN$
========

⑦ $F_2 \cdot l_2 = F_1 \cdot l_1$

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

$F_2 = \frac{25daN \cdot 400mm}{120mm}$

$F_2 = 83daN$
==========

⑧ $F_2 \cdot l_2 = F_1 \cdot l_1$

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

$F_2 = \frac{2kN \cdot 300mm}{198mm}$

$F_2 = 3kN$
========

$\cos45° = \frac{l_2}{280mm}$

$l_2 = 280mm \cdot \cos45°$

$l_2 = 198mm$

1 $F = \mu \cdot G$

$F = 0,3 \cdot 2000N$

$\underline{F = 600N}$

2 $m = m_1 + m_2$

$m = 200kg + 200kg$

$m = 400kg$

$\underline{G = 4000N}$

$F = \mu \cdot G$

$F = 0,08 \cdot 4000N$

$\underline{F = 320N}$

3 $m = m_1 + m_2 + m_3$

$m = 50kg + 100kg + 70kg$

$m = 220kg$

$\underline{G = 2200N}$

$F = \mu \cdot G$

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

$\mu = \frac{100\cancel{N}}{2200\cancel{N}}$

$\underline{\mu = 0,045}$

4 $F = \mu \cdot G$

$F = 0,08 \cdot 1,8kN$

$\underline{F = 0,144kN}$

5 $G = \mu \cdot 2F_n$

$F_n = \frac{G}{2 \cdot \mu}$

$F_n = \frac{200N}{2 \cdot 0,4}$

$\underline{F_n = 250N}$

6 $F = \mu \cdot F_n$

$F = 0,25 \cdot 15kN$

$\underline{F = 3,75kN}$

7 a) $F_n \cdot 800mm = F_1 \cdot 1600mm$

$F_n = \frac{F_1 \cdot 1600\cancel{mm}}{800\cancel{mm}}$

$F_n = \frac{80N \cdot 1600}{800}$

$\underline{F_n = 160N}$

b) $F = \mu \cdot F_n$

$F = 0,25 \cdot 160N$

$\underline{F = 40N}$

c) $M = F \cdot r$

$M = 40N \cdot 0,075m$

$\underline{M = 3Nm}$

8 $F = \mu \cdot F_n$

$F = 0,04 \cdot 5kN$

$\underline{F = 0,2kN}$

$M = F \cdot r$

$M = 200N \cdot 0,03m$

$\underline{M = 6Nm}$

29.2

1 $W = G \cdot s$

$W = 9000N \cdot 2m$

$\underline{W = 18000Nm = 18000J}$

2 $W = G \cdot s$

$W = 45N \cdot 3m$

$\underline{W = 135Nm = 135J}$

3 $W = G \cdot s$

$W = 30000N \cdot 3m$

$\underline{W = 90000Nm = 90000J = 90\ kJ}$

4 $W = G \cdot s$

$W = 2000N \cdot 2m$

$\underline{W = 4000Nm = 4000J}$

5 $W = G \cdot s$

$G = \frac{W}{s}$

$G = \frac{200000N\cancel{m}}{8\cancel{m}}$

$G = 25000N$

$10N \triangleq 1kg$

$\underline{m = 2500kg = 2,5t}$

6 $m = m_1 + m_2$

$m = 25kg + 70kg$

$m = 95kg$

$W = G \cdot s$

$W = 950N \cdot 2000m$

$\underline{W = 1900000Nm = 1900000J = 1900}$

29,2

(7) a) $m = V \cdot \rho$

$V = 2dm \cdot 4dm \cdot 10dm$

$V = 80dm^3$

$m = 80dm^3 \cdot 7,8\dfrac{kg}{dm^3}$

$\underline{\underline{m = 624kg}}$

b) $W = G \cdot s$

$W = 6240N \cdot 6m$

$W = 37440Nm$

$\underline{\underline{W = 37440J = 37,44kJ}}$

(8) a) $m = V \cdot \rho$

$V = \dfrac{1^2dm^2 \cdot 3,14}{4} \cdot 40dm$

$V = 31,4dm^3$

$m = 31,4dm^3 \cdot 7,8\dfrac{kg}{dm^3}$

$\underline{\underline{m = 245kg = 0,245t}}$

b) $W = G \cdot s$

$s = \dfrac{W}{G}$

$s = \dfrac{4900Nm}{2450N}$

$\underline{\underline{s = 2m}}$

---

(9) $W = G \cdot s$

$s = \dfrac{W}{G}$

$s = \dfrac{5000000Nm}{500000N}$

$\underline{\underline{s = 10m}}$

(10) $W = G \cdot s$

$W = 1000000kN \cdot 20m$

$\underline{\underline{W = 20Mio kJ}}$

(11) $W = F \cdot s$

$W = 2kN \cdot 1,2m$

$\underline{\underline{W = 2,4kJ}}$

(12) $F \cdot 400mm = G \cdot r$

$F = \dfrac{G \cdot r}{400mm}$

$F = \dfrac{120N \cdot 200mm}{400mm}$

$\underline{\underline{F = 60N}}$

$W = G \cdot s$

$W = 120N \cdot 6m$

$\underline{\underline{W = 720Nm = 720J}}$

(13) $W = G \cdot s$

$W = 80N \cdot 12m$

$\underline{\underline{W = 960Nm = 960J}}$

(14) $W = F \cdot s$

$F = \mu \cdot G$

$F = 0,3 \cdot 1000N$

$F = 300N$

$W = 300N \cdot 8m$

$\underline{\underline{W = 2400Nm = 2400J = 2,4kJ}}$

(15) $W = G \cdot s$

$W = 1000N \cdot 18m$

$\underline{\underline{W = 18000Nm = 18000J = 18kJ}}$

(16) $W = F \cdot s$

$W = 1500N \cdot 10000m$

$\underline{\underline{W = 15000000Nm = 15000kJ}}$

---

(1) $F_{ax} \cdot P = F \cdot 2\pi r$

$F_{ax} = \dfrac{F \cdot 2\pi \cdot r}{P}$

$F_{ax} = \dfrac{160N \cdot 2\pi \cdot 200mm}{5mm}$

$\underline{\underline{F_{ax} = 40192N}}$

(2) $F \cdot 2\pi r = F_{ax} \cdot P$

$F = \dfrac{F_{ax} \cdot P}{2 \cdot \pi r}$

$F = \dfrac{4000N \cdot 1,5mm}{2 \cdot 3,14 \cdot 240mm}$

$\underline{\underline{F = 4N}}$

(3) $F_{ax} \cdot P = F \cdot 2\pi r$

$P = \dfrac{F \cdot 2\pi r}{F_{ax}}$

$P = \dfrac{100N \cdot 2\pi \cdot 300mm}{37680N}$

$\underline{\underline{P = 5mm}}$

(4) $F \cdot 2\pi r = F_{ax} \cdot P$

$F = \dfrac{F_{ax} \cdot P}{2 \cdot \pi r}$

$F = \dfrac{5000N \cdot 3mm}{2 \cdot 3,14 \cdot 320mm}$

$\underline{\underline{F = 7,46N}}$

(5) a) $F_{ax} \cdot 240mm = 9000N \cdot 360mm$

$F_{ax} = \dfrac{9000N \cdot 360mm}{240mm}$

$\underline{\underline{F_{ax} = 13500N}}$

b) $F \cdot 2\pi r = F_{ax} \cdot P$

$F = \dfrac{F_{ax} \cdot P}{2 \cdot \pi r}$

$F = \dfrac{13500N \cdot 6mm}{2 \cdot 3,14 \cdot 230mm}$

$\underline{\underline{F = 56N}}$

⑥ $F_{ax} \cdot P = F \cdot 2 \pi r$

$F_{ax} = \dfrac{F \cdot 2 \pi r}{P}$

$F_{ax} = \dfrac{80N \cdot 2 \pi \cdot 140mm}{1,25mm}$

$\underline{F_{ax} = 56269N}$

⑦ $F_{ax} \cdot P = F \cdot 2 \pi r$

$F_{ax} = \dfrac{F \cdot 2 \pi r}{P}$

$F_{ax} = \dfrac{120N \cdot 2 \cdot 3,14 \cdot 270mm}{5mm}$

$\underline{F_{ax} = 40694N}$

⑧ $2 F_{ax} \cdot P = F \cdot 2 \pi r$

$F_{ax} = \dfrac{F \cdot 2 \pi r}{2 \cdot P}$

$F_{ax} = \dfrac{80N \cdot 2 \cdot \pi \cdot 400mm}{2 \cdot 2mm}$

$\underline{F_{ax} = 50240N}$

---

① $v = \dfrac{s}{t}$

$s = v \cdot t$

$s = 120\dfrac{km}{h} \cdot \dfrac{1}{4} h$

$\underline{s = 30km}$

② $v = \dfrac{s}{t}$

$v = \dfrac{12km \cdot 4}{3 \cdot h}$

$\underline{v = 16\dfrac{km}{h} = \dfrac{16000m}{3600s} = 4,4\dfrac{m}{s}}$

③ $v_m = \dfrac{s}{t}$

$v_m = \dfrac{200mm}{0,8 \cdot 60min}$

$\underline{v_m = 4,17\dfrac{mm}{min} = 0,25\dfrac{m}{s}}$

$\underline{v_m = 15\dfrac{m}{min}}$

④ $v = \dfrac{s}{t}$

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

$t = \dfrac{800mm \cdot min}{60mm}$

$\underline{t = 13,3min}$

⑤ $v = \dfrac{s}{t}$

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

$t = \dfrac{20m \cdot s}{0,15m}$

$\underline{t = 133s}$

⑥ $v = \dfrac{s}{t}$

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

$t = \dfrac{0,160m \cdot min}{8m}$

$\underline{t = 0,02min = 1,2s}$

⑦ $v = \dfrac{s}{t}$

$s = v \cdot t$

$s = 16\dfrac{m}{min} \cdot \dfrac{16}{60} min$

$\underline{s = 4,267m}$

⑧ $v = \dfrac{s}{t}$

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

$t = \dfrac{20m \cdot s}{4m}$

$\underline{t = 5s}$

---

① $v = d \cdot \pi \cdot n$

$v = \dfrac{0,6m \cdot 3,14 \cdot 1061}{60 \cdot s}$

$v = 33,3\dfrac{m}{s} = \dfrac{33,3km \cdot 3600}{1000 \, h}$

$\underline{v = 120\dfrac{km}{h}}$

② $v = d \cdot \pi \cdot n$

$v = \dfrac{0,12m \cdot 3,14 \cdot 160}{min}$

$v = 60,3\dfrac{m}{min} = \dfrac{60,3m}{60 \, s}$

$\underline{v = 1\dfrac{m}{s}}$

③ $v = D \cdot \pi \cdot n$

$D = \dfrac{v}{\pi \cdot n}$

$D = \dfrac{25m \cdot 60 \cdot s}{s \cdot 3,14 \cdot 2000}$

$\underline{D = 0,239m = 239mm}$

④ $v = d \cdot \pi \cdot n$

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

$n = \dfrac{25m}{min \cdot 0,016m \cdot 3,14}$

$\underline{n = 498\dfrac{1}{min} \Longrightarrow 438\dfrac{1}{min}}$

⑤ $v = d \cdot \pi \cdot n$

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

$n = \dfrac{40m}{min \cdot 0,012m \cdot 3,14}$

$\underline{n = 1062\dfrac{1}{min}}$

⑥ $v = d \cdot \pi \cdot n$

$v = 0,08m \cdot 3,14 \cdot 90\dfrac{1}{min}$

$\underline{v = 22,6\dfrac{m}{min}}$

⑧ $v = d \cdot \pi \cdot n$

$v = 0,15m \cdot 3,14 \cdot 2400\dfrac{1}{min}$

$v = 1130 \dfrac{m}{min} = \dfrac{1130m}{60s}$

$\underline{v = 18,8\dfrac{m}{s}}$

⑦ $v = d \cdot \pi \cdot n$

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

$n = \dfrac{40m}{min \cdot 0,4m \cdot 3,14}$

$\underline{n = 31,8 \dfrac{1}{min}}$

(1) $1 kg \; \hat{=} \; 10N$

$G = 600N + 400N$

$\underline{\underline{G = 1000N}}$

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

$P = \dfrac{1000N \cdot 5m}{15s}$

$P = 333\dfrac{Nm}{s} \quad (1\dfrac{Nm}{s} = 1W)$

$\underline{\underline{P = 333W}}$

(2) $P = F \cdot v$

$v = 20\dfrac{m}{min} = 0,33\dfrac{m}{s}$

$P = 28000N \cdot 0,333\dfrac{m}{s}$

$P = 9324\dfrac{Nm}{s}$

$\underline{\underline{P = 9,324kW}}$

(3) $m = 1t = 1000kg$

$\underline{\underline{G = 10000N}}$

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

$P = \dfrac{10000N \cdot 4m}{5s}$

$P = 8000\dfrac{Nm}{s} = 8000W$

$\underline{\underline{P = 8kW}}$

(4) $v = d \cdot \pi \cdot n$

$v = 0,1m \cdot 3,14 \cdot 420 \cdot \dfrac{1}{60s}$

$\underline{v = 2,2\dfrac{m}{s}}$

$P = F \cdot v$

$P = 1455N \cdot 2,2\dfrac{m}{s}$

$\underline{\underline{P = 3201W = 3,201kW}}$

(5) $P = \dfrac{F \cdot s}{t}$

$P = \dfrac{200N \cdot 6m}{12s}$

$P = 100\dfrac{Nm}{s}$

$\underline{\underline{P = 100W}}$

(6) $P = \dfrac{F \cdot s}{t}$

$P = \dfrac{20000N \cdot 20m}{40s}$

$P = 10000\dfrac{Nm}{s} = 10000W$

$\underline{\underline{P = 10kW}}$

(7) $v = 24\dfrac{m}{min} = 0,4\dfrac{m}{s}$

$P = F \cdot v$

$F = \dfrac{P}{v}$

$F = \dfrac{3000W \cdot s}{0,4m}(1W = 1\dfrac{Nm}{s})$

$F = \dfrac{3000Nm \cdot s}{0,4m \cdot s}$

$\underline{\underline{F = 7500N}}$

(8) $700\dfrac{m^3}{h} = 700\,000\dfrac{dm^3}{h} \implies \begin{array}{l} F = 7000\,000N \\ t = 3600s \end{array}$

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

$P = \dfrac{7000\,000N \cdot 200m}{3600s}$

$P = 388888\dfrac{Nm}{s} = 388888W$

$\underline{\underline{P = 389kW}}$

(1) $\eta = \dfrac{P_2}{P_1}$

$\eta = \dfrac{5,1kW}{6kW}$

$\underline{\underline{\eta = 0,85 \; ; \; \eta_{\%} = 85\%}}$

(2) $\eta = \dfrac{P_2}{P_1}$

$P_2 = \eta \cdot P_1$

$P_2 = 0,88 \cdot 5kW$

$\underline{\underline{P_2 = 4,4kW}}$

(3) $\eta = \dfrac{P_2}{P_1}$

$P_2 = \eta \cdot P_1$

$P_2 = 0,7 \cdot 4kW$

$\underline{\underline{P_2 = 2,8kW}}$

(4) $P_2 = F \cdot v$

$P_2 = 120N \cdot 0,2\dfrac{m}{s}$

$P_2 = 24\dfrac{Nm}{s} \quad (1\dfrac{Nm}{s} = 1W)$

$\underline{\underline{P_2 = 24W}}$

$\underline{\underline{P_1 = 30W}}$

(5) $P_2 = \dfrac{G \cdot h}{t}$

$P_2 = \dfrac{4000N \cdot 4m}{15s}$

$P_2 = 1067W = \underline{\underline{1,067kW}}$

$\eta = \dfrac{P_2}{P_1}$

$P_1 = \dfrac{P_2}{\eta}$

$P_1 = \dfrac{1,067kW}{0,75}$

$\underline{\underline{P_1 = 1,422kW}}$

(6) $P_2 = G \cdot v$

$P_2 = \dfrac{15000N \cdot 2m}{s}$

$P_2 = 30000\dfrac{Nm}{s} = 30000W$

$\underline{\underline{P_2 = 30kW}}$

$\eta = \dfrac{P_2}{P_1}$

$P_1 = \dfrac{P_2}{\eta}$

$P_1 = \dfrac{30kW}{0,8}$

$\underline{\underline{P_1 = 37,5kW}}$

⑦ $\eta = \dfrac{P_2}{P_1}$

$\eta = \dfrac{8000N \cdot 4m}{s \cdot 42700W}$ (1 W = 1$\dfrac{Nm}{s}$)

$\eta = 0,75$; $\eta_{\%} = 75\%$
================================

⑧ $P_2 = \dfrac{G \cdot h}{t}$

$P_2 = \dfrac{200N \cdot 4m}{10s}$

$P_2 = 80\dfrac{Nm}{s} = 80W$
================

$P_1 = \dfrac{F \cdot s_1}{t}$

$F = \dfrac{P_1 \cdot t}{s_1}$

$F = \dfrac{100Nm \cdot 10s}{s \cdot 8m}$

$F = 125N$
========

$\eta = \dfrac{P_2}{P_1}$

$P_1 = \dfrac{P_2}{\eta}$

$P_1 = \dfrac{80W}{0,8}$

$P_1 = 100W$
=========

① $F \cdot 3,2m = G \cdot 1,3m$

$F = \dfrac{G \cdot 1,3m}{3,2m}$

$F = \dfrac{450N \cdot 1,3}{3,2}$

$F = 183N$
========

② $F \cdot 4,8m = G \cdot 3,2m$

$F = \dfrac{G \cdot 3,2}{4,8}$

$F = \dfrac{450N \cdot 3,2}{4,8}$

$F = 300N$
========

③ $F \cdot 120m = G \cdot 72m$

$F = \dfrac{G \cdot 72}{120}$

$850kg \hat{=} 8500N$

$F = \dfrac{8500N \cdot 72}{120}$

$F = 5100N$
=========

$G = 800N$
========

④ $F \cdot 12m = G \cdot 4m$

$F = \dfrac{G \cdot 4}{12}$

$F = \dfrac{800N}{3}$

$F = 267N$
========

⑤ $F = G \cdot \sin\alpha$

$F = 80kN \cdot \sin 30°$

$F = 40kN$
========

⑥ $F = G \cdot \sin\alpha$

$G = 9500N$
========

$F = 9500N \cdot \sin 19°$

$F = 3093N$
=========

⑦ $F = G \cdot \sin\alpha$

$F = 50kN \cdot \sin 58°$

$F = 42,4kN$
==========

⑧ $F = G \cdot \sin\alpha$

$F = 5kN \cdot \sin 32°$

$F = 2,65kN$
==========

① $F_2 \cdot 5mm = F_1 \cdot 25mm$

$F_2 = \dfrac{F_1 \cdot 25}{5}$

$F_2 = 50N \cdot 5$

$F_2 = 250N$
=========

② $F_2 \cdot 5mm = F_1 \cdot 100mm$

$F_2 = \dfrac{F_1 \cdot 100}{5}$

$F_2 = 160N \cdot 20$

$F_2 = 3200N$
=========

③ $\dfrac{F_1}{F_2} = \dfrac{1}{100}$

$100F_1 = F_2$

$F_2 = 100F_1$

$F_2 = 100 \cdot 120N$

$F_2 = 12000N$
===========

④ $\dfrac{F_1}{F_2} = \dfrac{1}{100}$

$F_1 = \dfrac{F_2}{100}$

$F_1 = \dfrac{5000N}{100}$

$\underline{\underline{F_1 = 50N}}$

⑤ $\dfrac{F_1}{G} = \dfrac{1}{100}$

$F_1 = \dfrac{G}{100}$

$F_1 \cdot 100 = G$

$G = F_1 \cdot 100$

$G = 20N \cdot 100$

$\underline{\underline{G = 2000N}}$

⑥ $\underline{\underline{G = 8000N}}$

$\dfrac{F_1}{G} = \tan 10^\circ$

$F_1 = G \cdot \tan 10^\circ$

$F_1 = 8000N \cdot \tan 10^\circ$

$\underline{\underline{F_1 = 1411N}}$

⑦ $F_1 \cdot 200mm = F_2 \cdot 4mm$

$F_1 = \dfrac{F_2 \cdot 4}{200}$

$F_1 = \dfrac{70kN}{50}$

$\underline{\underline{F_1 = 1,4kN}} \; \underline{\underline{= 1400N}}$

⑧ $\dfrac{F_1}{F_2} = \dfrac{1}{50}$

$F_1 \cdot 50 = F_2$

$F_2 = 50 \cdot 150N$

$\underline{\underline{F_2 = 7500N}}$

① $F = \dfrac{G}{n}$

$F = \dfrac{800N}{2}$

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

② $F = \dfrac{G}{n}$

$F = \dfrac{450N}{1}$

$\underline{\underline{F = 450N}}$

③ $F = \dfrac{G}{n}$

$F = \dfrac{1200N}{2}$

$\underline{\underline{F = 600N}}$

$s_1 = s_2$

$\underline{\underline{s_1 = 2m}}$

④ $s_1 = s_2$ $F = \dfrac{G}{n}$

$\underline{\underline{s_1 = 3m}}$ $G = F \cdot n$

$G = 400N \cdot 1$

$G = 400N$

$10N \mathrel{\hat{=}} 1kg$

$\underline{\underline{m = 40kg}}$

$W = G \cdot s_2$

$W = 400N \cdot 3m$

$\underline{\underline{W = 1200Nm = 1200J}}$

⑤ $s_1 = 2 \cdot s_2$

$s_2 = \dfrac{s_1}{2}$

$s_2 = \dfrac{4,8m}{2}$

$\underline{\underline{s_2 = 2,4m}}$

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

$G = F \cdot n$

$G = 84N \cdot 2$

$G = 168N$ $10N \mathrel{\hat{=}} 1kg$

$\underline{\underline{m = 16,8kg}}$

$W = G \cdot s_2$

$W = 168N \cdot 2,4m$

$\underline{\underline{W = 403,2Nm = 403J}}$

⑥ $F = \dfrac{G}{n}$

$F = \dfrac{8000N}{4}$

$\underline{\underline{F = 2000N}}$

(7)

$F_1 \cdot 320mm = G \cdot 400mm$

$F_1 = \dfrac{G \cdot 400mm}{320mm}$

$F_1 = \dfrac{400N \cdot 400}{320}$

$F_1 = 500N$
=========

$F_2 = \dfrac{F_1}{2}$

$F_2 = \dfrac{500N}{2}$

$F_2 = 250N$
=========

(8)

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

$G = F \cdot n$

$G = 120N \cdot 6$

$G = 720N$

$\underline{m = 72kg}$

$10N \,\hat{=}\, 1kg$

$m = 72kg$

$s_1 = 6s_2$

$s_1 = 6 \cdot 4m$

$s_1 = 24m$
=========

$W = G \cdot s_2$

$W = 720N \cdot 4m$

$\underline{W = 2880Nm = 2880J}$

(1)

$d = m \cdot z$

$d = 4mm \cdot 28$

$\underline{d = 112mm}$

$h = \dfrac{13}{6} m$

$h = \dfrac{13 \cdot 4mm}{6}$

$\underline{h = 8,67mm}$

$h_a = m$

$h_a = 4mm$
=========

(2)

$\underline{z = 24}$

$d = m \cdot z$

$d = 5mm \cdot 24$

$\underline{d = 120mm}$

$d_a = d + 2m$

$d_a = 120mm + 2 \cdot 5mm$

$d_a = 130mm$
=========

$d_f = 120mm - \dfrac{14}{6} \cdot 5mm$

$d_f = 108,33mm$
=========

(3)

$\underline{z = 16}$

$h_a = m$

$h_a = 1,75mm$
=========

$h_f = \dfrac{7}{6} m$

$h_f = \dfrac{7 \cdot 1,75mm}{6}$

$h_f = 2,04mm$
=========

(4)

$d_a = d + 2m$

$d_a = z \cdot m + 2m$

$d_a = m(z + 2)$

$m = \dfrac{d_a}{z + 2}$

$m = \dfrac{85mm}{32 + 2}$

$\underline{m = 2,5mm}$

$d = m \cdot z$

$d = 2,5mm \; 32$

$\underline{d = 80mm}$

$d_f = d - \dfrac{14}{6} \cdot m$

$d_f = 80mm - \dfrac{14}{6} \cdot 2,5mm$

$d_f = 74,17mm$
=========

(5)

$d_1 = m \cdot z_1$

$z_1 = \dfrac{d_1}{m}$

$z_1 = \dfrac{75mm}{3mm}$

$z_1 = 25$
=========

$d_2 = m \cdot z_2$

$z_2 = \dfrac{d_2}{m}$

$z_2 = \dfrac{159mm}{3mm}$

$z_2 = 53$
=========

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

$a = \dfrac{75mm}{2} + \dfrac{159mm}{2}$

$\underline{a = 117mm}$

(6)

$d_1 = m \cdot z_1$

$d_1 = 2,5mm \cdot 31$

$d_1 = 77,5mm$
=========

$d_2 = m \cdot z_2$

$d_2 = 2,5mm \cdot 59$

$d_2 = 147,5mm$
=========

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

$a = \dfrac{77,5mm}{2} + \dfrac{147,5mm}{2}$

$\underline{a = 112,5mm}$

(7)　$d_1 = m \cdot z_1$　　　$a = \dfrac{d_1}{2} + \dfrac{d_2}{2}$　　　$d_2 = m \cdot z_2$

$d_1 = 4mm \cdot 31$　　　$2a = d_1 + d_2$　　　$z_2 = \dfrac{d_2}{m}$

$\underline{\underline{d_1 = 124mm}}$　　　$d_2 = 2a - d_1$　　　$z_2 = \dfrac{192mm}{4mm}$

　　　　　　　　　$d_2 = 2 \cdot 158mm - 124mm$　　　$\underline{\underline{z_2 = 48}}$

　　　　　　　　　$\underline{\underline{d_2 = 192mm}}$

(8)　$d_1 = m \cdot z_1$　　　$d_2 = m \cdot z_2$　　　$a = \dfrac{d_2}{2} - \dfrac{d_1}{2}$

$d_1 = 2,5mm \cdot 31$　　$d_2 = 2,5mm \cdot 92$　　$a = \dfrac{230mm}{2} - \dfrac{77,5mm}{2}$

$\underline{\underline{d_1 = 77,5mm}}$　　$\underline{\underline{d_2 = 230mm}}$

　　　　　　　　　　　　　　　$\underline{\underline{a = 76,25mm}}$

(1)　$a = \dfrac{m \cdot z_1}{2} + \dfrac{m \cdot z_2}{2}$

$a = \dfrac{5mm \cdot 5}{2} + \dfrac{5mm \cdot 15}{2}$

$\underline{\underline{a = 50mm}}$

(2)　$a = \dfrac{m \cdot z_1}{2} + \dfrac{m \cdot z_2}{2}$

$a = \dfrac{8mm \cdot 16}{2} + \dfrac{8mm \cdot 12}{2}$

$\underline{\underline{a = 112mm}}$

$\dfrac{n_1}{n_2} = \dfrac{z_2}{z_1}$

$n_2 = \dfrac{n_1 \cdot z_1}{z_2}$

$n_2 = \dfrac{700 \cdot 16}{min \cdot 12}$

$\underline{\underline{n_2 = 933\dfrac{1}{min}}}$

(3)　$i = \dfrac{M_2}{M_1}$

$M_2 = i \cdot M_1$

$M_2 = 2 \cdot 10Nm$

$\underline{\underline{M_2 = 20Nm}}$

(4)　$a = \dfrac{d_1}{2} + \dfrac{d_2}{2}$　　　$i = \dfrac{z_2}{z_1}$

$a = \dfrac{m \cdot z_1}{2} + \dfrac{m \cdot z_2}{2}$　　$i = \dfrac{49}{17}$

$a = \dfrac{4mm \cdot 17}{2} + \dfrac{4mm \cdot 49}{2}$　　$\underline{\underline{i = 2,88}}$

$\underline{\underline{a = 132mm}}$

(5)　$i = \dfrac{n_1}{n_2} = \dfrac{z_2}{z_1} = \dfrac{z_2 \cdot m}{z_1 \cdot m} = \dfrac{d_2}{d_1}$

$\dfrac{n_1}{n_2} = \dfrac{d_2}{d_1}$

$n_2 = \dfrac{n_1 \cdot d_1}{d_2}$

$n_2 = \dfrac{240 \cdot 108mm}{min \ 200mm}$

$\underline{\underline{n_2 = 129,6 \dfrac{1}{min}}}$

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

$v = 0,2m \cdot 3,14 \cdot \dfrac{129,6}{60s}$

$\underline{\underline{v = 1,36\dfrac{m}{s}}}$

(6)　$i = \dfrac{z_2}{z_1}$　　　$i = \dfrac{n_1}{n_2}$

$i = \dfrac{108}{54}$　　　$n_2 = \dfrac{n_1}{i}$

$\underline{\underline{i = 2}}$　　　$n_2 = \dfrac{1400}{min \cdot 2}$

　　　　　　$\underline{\underline{n_2 = 700\dfrac{1}{min}}}$

$\text{(7)} \quad a = \dfrac{d_2}{2} - \dfrac{d_1}{2}$

$2a = d_2 - d_1$

$d_1 = d_2 - 2a$

$d_1 = m \cdot z_3 - 2a$

$d_1 = 3mm \cdot 64 - 2 \cdot 58,5mm$

$d_1 = 75mm$

$d_1 = m \cdot z_1$

$z_1 = \dfrac{d_1}{m}$

$z_1 = \dfrac{75mm}{3mm}$

$z_1 = 25$

$i = \dfrac{z_2}{z_1}$

$i = \dfrac{64}{25}$

$\underline{i = 2,56}$

$\text{(8)} \quad i = \dfrac{z_2}{z_1}$

$i = \dfrac{56}{14}$

$\underline{i = 4}$

$i = \dfrac{M_2}{M_1}$

$M_1 = \dfrac{M_2}{i}$

$M_1 = \dfrac{500N \cdot 0,2m}{4}$

$M_1 = 25Nm$

$M_1 = F \cdot r$

$F = \dfrac{M_1}{r}$

$F = \dfrac{25Nm}{0,3m}$

$\underline{F = 83,3N}$

$\text{(1)} \quad i_1 = \dfrac{z_2}{z_1} \qquad i_2 = \dfrac{z_4}{z_3}$

$i_1 = \dfrac{24}{16} \qquad i_2 = \dfrac{24}{12}$

$\underline{i_1 = 1,5} \qquad \underline{i_2 = 2}$

$i = i_1 \cdot i_2$

$i = 1,5 \cdot 2$

$\underline{i = 3}$

$\text{(2)} \quad \dfrac{n_1}{n_4} = \dfrac{z_2 \cdot z_4}{z_1 \cdot z_3}$

$n_4 = \dfrac{n_1 \cdot z_1 \cdot z_3}{z_2 \cdot z_4}$

$n_4 = \dfrac{1400 \cdot 51 \cdot 41}{min \cdot 17 \cdot 25}$

$\underline{n_4 = 6888\dfrac{1}{min}}$

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

$i = \dfrac{1400 \cdot min}{6888 \cdot min}$

$\underline{i = 0,2}$

$\text{(3)} \quad i = \dfrac{z_2 \cdot z_4}{z_1 \cdot z_3}$

$i = \dfrac{40 \cdot 45}{25 \cdot 21}$

$\underline{i = 3,43}$

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

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

$n_4 = \dfrac{1400}{min \cdot 3,43}$

$\underline{n_4 = 408\dfrac{1}{min}}$

$\text{(4)} \quad i = \dfrac{z_2 \cdot z_4}{z_1 \cdot z_3}$

$i = \dfrac{45 \cdot 50}{15 \cdot 25}$

$\underline{i = 6}$

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

$n_1 = n_4 \cdot i$

$n_1 = n_4 \cdot i$

$n_1 = 124\dfrac{1}{min} \cdot 6$

$\underline{n_1 = 744\dfrac{1}{min}}$

$\text{(5)} \quad i = \dfrac{d_2 \cdot z_3}{d_1 \cdot z_1}$

$i = \dfrac{240mm \cdot 42}{120mm \cdot 17}$

$\underline{i = 4,94}$

$i = \dfrac{n_1}{n}$

$n = \dfrac{n_1}{i}$

$n = \dfrac{1400}{min \cdot 4,94}$

$\underline{n = 283\dfrac{1}{min}}$

$\text{(6)} \quad i = \dfrac{z_2}{z_1}$

$i = \dfrac{34}{17}$

$\underline{i = 2}$

$i = \dfrac{n_1}{n}$

$n = \dfrac{n_1}{i}$

$n = \dfrac{900}{min \cdot 2}$

$\underline{n = 450\dfrac{1}{min}}$

$\text{(7)} \quad i = \dfrac{z_2 \cdot z_4}{z_1 \cdot z_3}$

$i = \dfrac{35 \cdot 41}{17 \cdot 19}$

$\underline{i = 4,44}$

$i = \dfrac{n_1}{n}$

$n = \dfrac{n_1}{i}$

$n = \dfrac{1400}{min \cdot 4,44}$

$\underline{n = 315\dfrac{1}{min}}$

$i = \dfrac{1400 \cdot min}{8400 \cdot min}$

$\underline{i = 1 : 6}$

$\text{(8)} \quad i = \dfrac{z_2 \cdot z_4 \cdot z_6}{z_1 \cdot z_3 \cdot z_5}$

$z_2 = \dfrac{z_1 \cdot z_3 \cdot z_5 \cdot i}{z_4 \cdot z_6}$

$z_2 = \dfrac{48 \cdot 30 \cdot 50}{20 \cdot 25 \cdot 6}$

$\underline{z_2 = 24}$

(9) $\dfrac{n}{n_{min}} = \dfrac{21\cdot 28}{7\cdot 7}$ $\dfrac{n}{n_{max}} = \dfrac{21\cdot 15}{7\cdot 15}$ (10) $\dfrac{1400}{n\cdot min} = \dfrac{120mm}{80mm}\cdot\dfrac{25}{15}$

$n_{min} = \dfrac{n}{12}$ $n_{max} = \dfrac{n}{3}$ $n = \dfrac{1400\cdot 80\cdot 15}{min\cdot 120\cdot 25}$

$n_{min} = \dfrac{3000}{min\cdot 12}$ $n_{max} = \dfrac{3000}{min\cdot 3}$ $n = 560\dfrac{1}{min}$

$\underline{\underline{n_{min} = 250\dfrac{1}{min}}}$ $\underline{\underline{n_{max} = 1000\dfrac{1}{min}}}$

(11) $\dfrac{1000}{min\cdot n_{min}} = \dfrac{35\cdot 15}{15\cdot 15}$ $\dfrac{1000}{min\cdot n_{max}} = \dfrac{35\cdot 30}{15\cdot 30}$ (12) $\dfrac{700}{min\cdot n} = \dfrac{34\cdot 39}{17\cdot 13}$ $i = \dfrac{700\cdot min}{min\cdot 117}$

$n_{min} = \dfrac{1000\cdot 15}{min\cdot 35}$ $n_{max} = \dfrac{1000\cdot 30}{min\cdot 35}$ $n = \dfrac{700}{min\cdot 6}$ $\underline{\underline{i = 6}}$

$\underline{\underline{n_{min} = 429\dfrac{1}{min}}}$ $\underline{\underline{n_{max} = 857\dfrac{1}{min}}}$ $\underline{\underline{n = 117\dfrac{1}{min}}}$

(13) $\dfrac{1400}{min\cdot n_{min}} = \dfrac{31\cdot 50}{19\cdot 13}$ $\longrightarrow 1400\dfrac{1}{min} \longrightarrow n_{max}$ (14) $n = \dfrac{1400\cdot 60\cdot mm\cdot 15}{180mm\cdot min\cdot 30}$

$n_{min} = \dfrac{1400\cdot 19\cdot 13}{min\cdot 31\cdot 50}$ $n_{max} = 1400\dfrac{1}{min}$ $\underline{\underline{n = 233\dfrac{1}{min}}}$

$\underline{\underline{n_{min} = 223\dfrac{1}{min}}}$

(15) $\dfrac{n\cdot min}{350} = \dfrac{34\cdot 30}{17\cdot 15}$ (16) $\dfrac{1400}{min\cdot n_{min}} = \dfrac{120mm\cdot 31}{80mm\cdot 15}$ $\dfrac{1400}{min\cdot n_{max}} = \dfrac{80mm\cdot 31}{120mm\cdot 15}$

$n = \dfrac{350\cdot 34\cdot 30}{min\cdot 17\cdot 15}$ $n_{min} = \dfrac{1400\cdot 80\cdot 15}{min\cdot 120\cdot 31}$ $n_{max} = \dfrac{1400\cdot 120\cdot 1}{80\cdot 31}$

$\underline{\underline{n = 1400\dfrac{1}{min}}}$ $\underline{\underline{n_{min} = 452\dfrac{1}{min}}}$ $n_{max} = 1016\dfrac{1}{min}$

$\underline{\underline{n_{max} = 1016\dfrac{1}{min}}}$

(1) $s = m\cdot z\cdot \pi\cdot\dfrac{108^{o}}{360^{o}}$ (2) $s = m\cdot z\cdot \pi$ $d = m\cdot z$ (3) $d = m\cdot z$

$s = 3mm\cdot 10\cdot 3,14\cdot\dfrac{108}{360}$ $z = \dfrac{s}{m\cdot \pi}$ $d = 3mm\cdot 15$ $d = 4mm\cdot 10$

$\underline{\underline{s = 28,26mm}}$ $z = \dfrac{141,3mm}{3mm\cdot 3,14}$ $\underline{\underline{d = 45mm}}$ $d = 40mm$

$\underline{\underline{z = 15}}$ $v = d\cdot \pi\cdot n$

$v = 0,04m\cdot 3,14\cdot 90\dfrac{1}{min}$

$\underline{\underline{v = 11,3\dfrac{m}{min}}}$

(4) $d = m\cdot z$ (5) $i = \dfrac{1200\ min}{40\ min}$ (6) $i = \dfrac{z_2}{z_1}$ $i = \dfrac{n_1}{n_2}$

$d = 4mm\cdot 30$ $\underline{\underline{i = 30}}$ $i = \dfrac{50}{2}$ $n_2 = \dfrac{n_1}{i}$

$d = 120mm$ $i = \dfrac{z_2}{z_1}$ $\underline{\underline{i = 25}}$ $n_2 = \dfrac{1400}{min\cdot 25}$

$v = d\cdot \pi\cdot n$ $z_2 = i\cdot z_1$ $\underline{\underline{n_2 = 56\dfrac{1}{min}}}$

$n = \dfrac{v}{d\cdot \pi}$ $z_2 = 30\cdot 1$

$n = \dfrac{6,28m}{min\cdot 0,12m\cdot 3,14}$ $z_2 = 30$

$\underline{\underline{n = 16,7\dfrac{1}{min}}}$

(7) $i = \dfrac{n_1}{n_2}$

$i = \dfrac{1400 \text{min}^{-1}}{70 \text{min}}$

$\underline{\underline{i = 20}}$

(8) $\dfrac{n_1}{n_2} = \dfrac{z_2}{z_1}$

$n_2 = \dfrac{n_1 \cdot z_1}{z_2}$

$n_2 = \dfrac{1500 \cdot 3}{\text{min} \cdot 30}$

$\underline{\underline{n_2 = 150\dfrac{1}{\text{min}}}}$

(9) $d = m \cdot z$ $\alpha = 360° \cdot \dfrac{10}{40}$

$d = 5\text{mm} \cdot 40$ $\underline{\underline{\alpha = 90°}}$

$d = 200\text{mm}$

$\sin 45° = \dfrac{1}{2 \cdot 120\text{mm}}$

$1 = 2 \cdot 120\text{mm} \cdot \sin 45°$

$\underline{\underline{1 = 169{,}7\text{mm}}}$

(10) $\dfrac{n_1}{n_4} = \dfrac{z_2 \cdot z_4}{z_1 \cdot z_2}$

$n_4 = \dfrac{n_1 \cdot z_1 \cdot z_3}{z_2 \cdot z_4}$

$n_4 = \dfrac{1400 \cdot 1 \cdot 20}{\text{min} \cdot 40 \cdot 60}$

$\underline{\underline{n_4 = 11{,}7\dfrac{1}{\text{min}}}}$

(11) $s = m \cdot z \cdot \pi$

$s = 4\text{mm} \cdot 6 \cdot 3{,}14$

$s = 75{,}36\text{mm}$

$\bigcirc = \dfrac{1000\text{mm}}{75{,}36\text{mm}}$

$\underline{\underline{\bigcirc \approx 14}}$

(12) $s = m \cdot z \cdot \pi \cdot \dfrac{90°}{360°}$

$s = 4\text{mm} \cdot 24 \cdot 3{,}14 \cdot \dfrac{1}{4}$

$\underline{\underline{s = 75{,}36\text{mm}}}$

(13) $\dfrac{n_1}{n_2} = \dfrac{z_2}{z_1}$

$n_2 = \dfrac{n_1 \cdot z_1}{z_2}$

$n_2 = \dfrac{1400 \cdot 1}{\text{min} \cdot 40}$

$n_2 = 35\dfrac{1}{\text{min}}$

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

$v = 0{,}2\text{m} \cdot 3{,}14 \cdot 35\dfrac{1}{\text{min}}$

$\underline{\underline{v = 0{,}37\dfrac{\text{m}}{\text{s}}}}$

(14) $s = m \cdot z_3 \cdot \pi \cdot \dfrac{1}{i}$

$s = 5\text{mm} \cdot 12 \cdot 3{,}14 \cdot \dfrac{15}{45}$

$\underline{\underline{s = 62{,}8\text{mm}}}$

(15) $\dfrac{n_1}{n_4} = \dfrac{z_2 \cdot z_4}{z_1 \cdot z_3}$

$n_4 = \dfrac{n_1 \cdot z_1 \cdot z_3}{z_2 \cdot z_4}$

$n_4 = \dfrac{1400 \cdot 15 \cdot 1}{\text{min} \cdot 30 \cdot 40}$

$\underline{\underline{n_4 = 17{,}5\dfrac{1}{\text{min}}}}$

(16) $\dfrac{n_1}{n_2} = \dfrac{z_2}{z_1}$

$n_2 = \dfrac{n_1 \cdot z_1}{z_2}$

$n_2 = \dfrac{240 \cdot 40}{\text{min} \cdot 4}$

$\underline{\underline{n_2 = 2400\dfrac{1}{\text{min}}}}$

(1) $\tan\dfrac{\alpha}{2} = \dfrac{D}{2L}$ ▷ 1 : 2

$\tan\dfrac{\alpha}{2} = \dfrac{40\text{mm}}{2 \cdot 80\text{mm}}$

$\underline{\underline{\dfrac{\alpha}{2} = 14°}}$

(2) $C = \dfrac{D}{L}$

$L = \dfrac{D}{C}$

$L = \dfrac{36\text{mm}}{0{,}2}$

$\underline{\underline{L = 180\text{mm}}}$ $\underline{\underline{\dfrac{\alpha}{2} = 5{,}7°}}$

(3) $C = \dfrac{D - d}{L}$

$D = C \cdot L + d$

$D = \dfrac{40\text{mm}}{50} + 4\text{mm}$

$\underline{\underline{D = 4{,}8\text{mm}}}$

$\underline{\underline{\dfrac{\alpha}{2} = 0{,}57°}}$

(4)
$$\tan \frac{\alpha}{2} = \frac{C}{2}$$

$$\tan \frac{\alpha}{2} = \frac{1}{20 \cdot 2}$$

$$\frac{\alpha}{2} = 1,432^\circ$$

$$C = \frac{D - d}{L}$$

$$L = \frac{D - d}{C}$$

$$L = \frac{(48mm - 40mm) \cdot 20}{1}$$

$$L = 160mm$$

(5)
$$x = \frac{C}{2} \cdot L$$

$$x = \frac{1}{2 \cdot 20} \cdot 200mm$$

$$x = 5mm$$

$$C = 1 : 20$$

(6)
$$\tan \frac{\alpha}{2} = \frac{D - d}{2L}$$

$$\tan \frac{\alpha}{2} = \frac{48mm - 30mm}{2 \cdot 90mm}$$

$$\frac{\alpha}{2} = 5,7^\circ$$

$$C = \frac{D - d}{L}$$

$$C = \frac{48mm - 30mm}{90mm}$$

$$C = 1 : 5$$

(7)
$$C = \frac{1}{10} = \frac{2 \cdot x}{4}$$

$$x = \frac{2}{10}$$

$$x = 0,2mm$$

(8)
$$C = \frac{D - d}{L}$$

$$L = \frac{D - d}{C}$$

$$L = \frac{(40mm - 32mm) \cdot 20}{1}$$

$$L = 160mm$$

$$C = \frac{D - d}{x}$$

$$x = \frac{D - d}{C}$$

$$x = \frac{(32mm - 30mm) \cdot 20}{1}$$

$$x = 40mm$$

(1)
$$p = \frac{F}{A}$$

$$F = p \cdot A$$

$$F = \frac{8daN \cdot 12,6cm^2}{cm^2}$$

$$F = 100,8daN = 1008N$$

$$1 bar = \frac{1daN}{cm^2}$$

(2)
$$p = \frac{F}{A}$$

$$p = \frac{500daN}{6,28cm^2}$$

$$p = 79,6\frac{daN}{cm^2} = 79,6bar$$

(3)
$$p = \frac{F}{A}$$

$$F = p \cdot A$$

$$F = 12\frac{daN}{cm^2} \cdot 4^2 \cdot 0,785 \ cm^2$$

$$F = 150,7daN$$

(4)
$$\frac{F_2}{A_2} = \frac{F_1}{A_1}$$

$$F_2 = \frac{F_1 \cdot A_2}{A_1}$$

$$F_2 = \frac{120N \cdot 3,6^2 \cdot 0,785 \ cm^2}{1,2^2 \cdot 0,785 \ cm^2}$$

$$F_2 = 1080N$$

⑤ $p = \frac{F}{A}$

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

$d = \sqrt{\frac{P \cdot 4}{p \cdot \pi}}$

$d = \sqrt{\frac{200 daN \cdot 4 \cdot cm^2}{63,7 daN \cdot \pi}}$

$\underline{d = 2cm = 20mm}$

⑥ $p = \frac{F}{A}$

$F = p \cdot A$

$F = 120 \frac{daN}{cm^2} \cdot 28,26 cm^2$

$\underline{\underline{F = 3391 daN = 33,91 kN}}$

⑦ $p = \frac{F}{A}$

$p = \frac{F}{(D^2 - d^2) \cdot \frac{\pi}{4}}$

$F = p \cdot (D^2 - d^2) \cdot \frac{\pi}{4}$

$F = 25 \frac{daN}{cm^2} \cdot (2,83^2 - 2^2) cm^2 \cdot \frac{\pi}{4}$

$\underline{F = 78,7 daN}$

⑧ a) $\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$\frac{F_1}{d_1^2 \cdot 0,785} = \frac{F_2}{d_2^2 \cdot 0,785}$

$d_1 = \sqrt{\frac{F_1 \cdot d_2^2}{F_2}}$

$d_1 = \sqrt{\frac{80N \cdot 4^2 cm^2}{320N}}$

$\underline{\underline{d_1 = 2cm = 20mm}}$

b) $p = \frac{F}{A}$

$p = \frac{8daN}{2^2 \cdot 0,785 \ cm^2}$

$p = 2,5 \frac{daN}{cm^2}$

$\underline{\underline{p = 2,5 bar}}$

⑨ $p = \frac{F}{A}$

$F = p \cdot A$

$F = 4,5 \frac{daN}{cm^2} \cdot 254 cm^2$

$\underline{\underline{F = 1143 daN \quad ; \quad m = 1143 kg}}$

⑩

$A = \frac{(D^2 - d^2) \cdot 3,14}{4}$

$A = \frac{(6^2 cm^2 - 2^2 cm^2) \cdot 3,14}{4}$

$\underline{\underline{A = 25,13 cm^2}}$

$p = \frac{F}{A}$

$p = \frac{F}{(D^2 - d^2) \cdot 0,785}$

$F = p \cdot (D^2 - d^2) \cdot 0,785$

$F = 25 \frac{daN}{cm^2} (6^2 - 2^2) \cdot 0,785 cm^2$

$F = 628 daN$

⑪

$$\frac{F_2}{A_2} = \frac{F_1}{A_1}$$

$$F_2 = \frac{F_1 \cdot A_2}{A_1}$$

$$F_2 = \frac{25N \cdot 3,6^2 \cdot 0,785cm^2}{1,2^2 \cdot 0,785cm^2}$$

$$F_2 = 225N$$

⑫

$$p = \frac{F}{A}$$

$$F = p \cdot A$$

$$F = 45\frac{daN}{cm^2} \cdot 6^2 \cdot 0,785cm^2$$

$$\underline{F = 1272daN = 12,72kN}$$

⑬

$$p = \frac{F}{A}$$

$$p = \frac{100daN}{2^2 \cdot 0,785cm^2}$$

$$p = 31,8\frac{daN}{cm^2} = 31,8bar$$

⑮

$$p = \frac{F}{A}$$

$$F = p \cdot A$$

$$F = 24\frac{daN}{cm^2} \cdot (2,83^2 - 2^2)\, 0,785cm^2$$

$$\underline{F = 7,55daN = 75,5N}$$

⑯

$$p = \frac{F}{A}$$

$$F = p \cdot A$$

$$F = 80\frac{daN}{cm^2} \cdot 10,2cm^2$$

$$\underline{F = 816daN \; ; \; m = 816kg} \quad (g \approx 10\frac{m}{s^2})$$

⑭

$$\frac{F_2}{A_2} = \frac{F_1}{A_1}$$

$$F_2 = \frac{F_1 \cdot A_2}{A_1}$$

$$F_2 = \frac{70N \cdot 12,56cm^2}{3,14cm^2}$$

$$F_2 = 280N$$

①

$$A = \frac{12^2mm^2 \cdot 3,14}{4}$$

$$\underline{A = 113mm^2}$$

$$\sigma = \frac{F}{A}$$

$$\sigma = \frac{5000N}{113mm^2}$$

$$\underline{\sigma = 44\frac{N}{mm^2}}$$

②

$$\sigma = \frac{R_m}{S}$$

$$\sigma = \frac{500}{10}\,\frac{N}{mm^2}$$

$$\underline{\sigma = 50\frac{N}{mm^2}}$$

$$\sigma = \frac{F}{A}$$

$$F = A \cdot \sigma$$

$$F = \frac{8^2mm^2 \cdot 3,14}{4} \cdot 50\frac{N}{mm^2}$$

$$\underline{F = 2512N}$$

③

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

$$A = \frac{16^2mm^2 \cdot 3,14}{4}$$

$$\underline{A = 200,96mm^2}$$

$$\sigma = \frac{F}{A}$$

$$F = \sigma \cdot A$$

$$F = 100\frac{N}{mm^2} \cdot 200,96mm^2$$

$$\underline{F = 20,096kN}$$

(4) $A = 20mm \cdot 10mm$
$\underline{A = 200mm^2}$

$\sigma = \frac{F}{A}$

$\sigma = \frac{8000N}{200mm^2}$

$\sigma = 40\frac{N}{mm^2}$

(5) $A = \frac{1^2 mm^2 \cdot 3,14}{4}$

$\underline{A = 78,5mm^2}$

$R_m = \frac{F_m}{A}$

$R_m = \frac{50000N}{78,5mm^2}$

$\underline{R_m = 637\frac{N}{mm^2}}$

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

$A = \frac{8^2 mm^2 \cdot 3,14}{4} \cdot 2$

$\underline{A = 100,48mm^2}$

$\sigma = \frac{R_m}{3}$

$\sigma = \frac{410}{8}\frac{N}{mm^2}$

$\sigma = 52,5\frac{N}{mm^2}$

(7) $A = (20 - 8)mm \cdot 4mm$

$\underline{A = 48mm^2}$

$\sigma = \frac{F}{A}$

$F = \sigma \cdot A$

$F = 100\frac{N}{mm^2} \cdot 48mm^2$

$\underline{F = 4800N}$

(8) $A = 2 \cdot 8mm \cdot 1,5mm$

$\underline{A = 24mm^2}$

$\sigma = \frac{F}{A}$

$\sigma = \frac{2400N}{24mm^2}$

$\sigma = 100\frac{N}{mm^2}$

$\sigma = \frac{G}{A}$

$G = \sigma \cdot A$

$G = 52,5\frac{N}{mm^2} \cdot 100,48mm^2$

$\underline{G = 5275N}$

(9) $\sigma = \frac{F}{A}$

$\sigma = \frac{8000N}{(45 - 15)mm \cdot 15mm}$

$\underline{\sigma = 17,8\frac{N}{mm^2}}$

(10) $A = 10^2 mm^2 \cdot 3,14 \cdot \frac{1}{4}$

$\underline{A = 78,5mm^2}$

$R_m = \frac{F_m}{A}$

$F_m = R_m \cdot A$

$F_m = 370\frac{N}{mm^2} \cdot 78,5mm^2$

$\underline{F_m = 29045N}$

(11) $\sigma = \frac{F}{A}$

$F = \sigma \cdot A$

$F = 85\frac{N}{mm^2} \cdot (120 - 13)mm \cdot 15mm$

$\underline{F = 136,4kN}$

(12) $m = 600kg$
$G = 6000N$

$\sigma_1 = \frac{G}{A}$

$\sigma_1 = \frac{6000N \cdot 4}{12^2 mm^2 \cdot 3,14}$

$\underline{\sigma_1 = 53\frac{N}{mm^2}}$

$2 F_2^2 = G^2$

$F_2 = \sqrt{\frac{G^2}{2}}$

$F_2 = \frac{G}{\sqrt{2}}$

$F_2 = \frac{6000N}{\sqrt{2}}$

$F_2 = 4243N$

$\sigma_2 = \frac{F_2}{A}$

$\sigma_2 = \frac{4243N \cdot 4}{12^2 mm^2 \cdot 3,14}$

$\underline{\sigma_2 = 37,5\frac{N}{mm^2}}$

(13) $800kg \mathrel{\hat{=}} 8000N$

$\sigma = \frac{G}{A}$

$\sigma = \frac{8000N \cdot 4}{15^2 mm^2 \cdot 3,14}$

$\underline{\sigma = 45\frac{N}{mm^2}}$

(14) $\sigma = \frac{F}{A}$

$F = \sigma \cdot A$

$A = 5mm(40mm - 10mm)$

$A = 150mm^2$

$F = 100\frac{N}{mm^2} \cdot 150mm^2$

$\underline{F = 15000N}$

(15) $4t \mathrel{\hat{=}} 40000N$
$G = 40000N$

$F = \mu \cdot G$

$F = 0,3 \cdot 40000N$

$F = 12000N$

$$\sigma = \frac{F}{A}$$

$$\sigma = \frac{12000N \cdot 4}{16^2 mm^2 \cdot 3,14}$$

$$\sigma = 60\frac{N}{mm^2}$$
=========

(16) $\sigma = \frac{F}{A}$

$$\sigma = \frac{800N \cdot 4}{2 \cdot 8^2 mm^2 \cdot 3,14}$$

$$\sigma = 8\frac{N}{mm^2}$$
=========

(1) $p = \frac{F}{A}$

$$p = \frac{360N}{1,5cm^2}$$

$$p = 240\frac{N}{cm^2}$$
=========

(2) $\underline{F = 40000N}$
=========

$$p = \frac{40000N}{4 \cdot 750cm^2}$$

$$p = 13,3\frac{N}{cm^2}$$
=========

(3) $p = \frac{F}{A}$

$$p = \frac{2000N}{2,5cm \cdot 2,5cm}$$

$$p = 320\frac{N}{cm^2}$$
=========

(4) $p = \frac{F}{A}$

$$A = 200mm \cdot 75mm - 66,5mm \cdot 177mm$$

$$A = 3230mm^2$$

$$p = \frac{20000N}{3230mm^2}$$

$$p = 6,2\frac{N}{mm^2}$$
=========

(5) $p = \frac{F}{A}$

$$F = p \cdot A$$

$$F = 15\frac{N}{mm^2} \cdot 50mm \cdot 50mm$$

$$\underline{F = 37500N = 3750daN}$$

(6) $p = \frac{F}{A}$

$$p = \frac{20000N}{12cm \cdot 24cm}$$

$$p = 69\frac{N}{cm^2}$$
=========

(7) $p = \frac{F}{A}$

$$A = (D^2 - d^2) \cdot \frac{\pi}{4}$$

$$A = (30^2 - 17^2)mm^2 \cdot \frac{3,14}{4}$$

$$A = 480mm^2$$

$$p = \frac{2500N}{480mm^2}$$

$$p = 5,2\frac{N}{mm^2}$$
=========

(8) $p = \frac{F}{A}$

$$p = \frac{200000N}{200mm \cdot 120mm}$$

$$p = 8,3\frac{N}{mm^2} = 83\frac{daN}{cm^2}$$
=========

(1) $A = 1 \cdot d$

$$A = 100mm \cdot 66mm$$

$$\underline{A = 6000mm^2}$$

$p = \frac{F}{A}$

$$p = \frac{5000N}{6000mm^2}$$

$$p = 0,83\frac{N}{mm^2}$$
=========

② $A = 1 \cdot d$

$A = 10mm \cdot 12mm$

$\underline{A = 120mm^2}$

$p = \dfrac{F}{A}$

$p = \dfrac{6000N}{120mm^2}$

$\underline{p = 50\dfrac{N}{mm^2}}$

③ $p = \dfrac{F}{A}$

$A = \dfrac{F}{p}$

$A = \dfrac{2400N \cdot cm^2}{50N}$

$A = 48cm^2$

$A = 1 \cdot d$

$d = \dfrac{A}{1}$

$d = \dfrac{48cm^2}{8cm}$

$\underline{d = 6cm = 60mm}$

④ $A = 1 \cdot d$

$A = 16mm \cdot 10mm$

$\underline{A = 160mm^2}$

$p = \dfrac{F}{A}$

$p = \dfrac{8000N}{160mm^2}$

$\underline{p = 50\dfrac{N}{mm^2}}$

⑤ $A = 1 \cdot d$

$A = 8mm \cdot 12mm$

$\underline{A = 96mm^2}$

$p = \dfrac{F}{A}$

$F = p \cdot A$

$F = 50\dfrac{N}{mm^2} \cdot 96mm^2$

$\underline{F = 4800N = 4.8kN}$

⑥ $A = 1 \cdot d$

$A = 10mm \cdot 11mm$

$\underline{A = 110mm^2}$

$p = \dfrac{F}{A}$

$p = \dfrac{4000N}{110mm^2}$

$\underline{p = 36.4\dfrac{N}{mm^2}}$

⑦ $p = \dfrac{F}{A}$

$A = \dfrac{F}{p}$

$A = \dfrac{3000N \cdot mm^2}{2N}$

$\underline{A = 1500mm^2}$

$A = 1 \cdot d$

$1 = \dfrac{A}{d}$

$1 = \dfrac{1500mm^2}{30mm}$

$\underline{1 = 50mm}$

⑧ $A = 1 \cdot d$

$A = 15mm \cdot 10mm$

$\underline{A = 150mm^2}$

$p = \dfrac{F}{A}$

$p = \dfrac{6000N}{150mm^2}$

$\underline{p = 40\dfrac{N}{mm^2}}$

① $A = \dfrac{d^2 \cdot \pi}{4}$

$A = \dfrac{10^2mm^2 \cdot 3.14}{4}$

$\underline{A = 78.5mm^2}$

$\tau = \dfrac{F}{A}$

$\tau = \dfrac{12000N}{78.5mm^2}$

$\underline{\tau = 153\dfrac{N}{mm^2}}$

② $A = \dfrac{d^2 \cdot \pi}{4}$

$A = \dfrac{12^2mm^2 \cdot 3.14}{4}$

$\underline{A = 113mm^2}$

$\tau = \dfrac{F}{A}$

$F = \tau \cdot A$

$F = 80\dfrac{N}{mm^2} \cdot 113mm^2$

$\underline{F = 9040N = 9.04kN}$

③ $A = 2 \cdot \dfrac{d^2 \cdot \pi}{4}$

$A = \dfrac{10^2mm^2 \cdot 3.14}{2}$

$A = 157mm^2$

$\tau = \dfrac{F}{A}$

$F = \tau \cdot A$

$F = 50\dfrac{N}{mm^2} \cdot 157mm^2$

$\underline{F = 7850N = 7.85kN}$

④ $\dfrac{d - 4mm}{10mm} = \dfrac{1}{50}$

$d = \dfrac{10}{50}$ mm + 4mm

$d = 4,2mm$

$\tau = \dfrac{F}{A}$

$\tau = \dfrac{1600N \cdot 4}{4,2^2 \cdot 3,14}$

$\tau = 116\dfrac{N}{mm^2}$

⑦

$\tau = \dfrac{F}{A}$

$A = \dfrac{F}{\tau}$

$A = \dfrac{22600N \cdot mm^2}{100N}$

$A = 226mm^2$

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

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

$d = \sqrt{\dfrac{4 \cdot A}{2 \cdot \pi}}$

$d = \sqrt{\dfrac{4 \cdot 226mm^2}{2 \cdot 3,14}}$

$d = 12mm$

⑤

$M = F \cdot r$

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

$F = \dfrac{50Nm}{0,02m}$

$F = 2500N$

$\tau = \dfrac{F}{A}$

$\tau = \dfrac{2500N \cdot 4}{5^2 mm^2 \cdot 3,14}$

$\tau = 127\dfrac{N}{mm^2}$

⑧ $F_2 \cdot 20mm = F_1 \cdot 100mm^{\,5}$

$F_2 = F_1 \cdot 5$

$F_2 = 500N \cdot 5$

$F_2 = 2500N$

$\tau = \dfrac{F \cdot 4}{2 \cdot d^2 \cdot \pi}$

$\tau = \dfrac{2500N \cdot 4}{2 \cdot 8^2 mm^2 \cdot 3,14}$

$\tau = 25 \dfrac{N}{mm^2}$

⑥ $F \cdot 8mm = F_1 \cdot 500mm$

$F = \dfrac{F_1 \cdot 500mm}{8mm}$

$F = \dfrac{50N \cdot 500}{8}$

$F = 3125N$

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

$A = 2 \cdot \dfrac{4^2 mm^2 \cdot 3,14}{4}$

$A = 25,12mm^2$

$\tau = \dfrac{F}{A}$

$\tau = \dfrac{3125N}{25,12mm^2}$

$\tau = 124\dfrac{N}{mm^2}$

① $\tau = \dfrac{F}{A}$

$\tau = \dfrac{8000N \cdot 4}{19^2 mm^2 \cdot 3,14}$

$\tau = 28,23\dfrac{N}{mm^2}$

$p = \dfrac{F}{A}$

$p = \dfrac{8000N}{19mm \cdot 15mm}$

$p = 28\dfrac{N}{mm^2}$

② $\tau = \dfrac{F}{A}$

$F = \tau \cdot A$

$F = 100\dfrac{N}{mm^2} \cdot 13^2 mm^2 \cdot 3,14 \cdot \dfrac{1}{4}$

$F = 13267N$

$p = \dfrac{F}{A}$

$p = \dfrac{13267N}{8mm \cdot 13mm}$

$p = 128\dfrac{N}{mm^2}$

③ $\tau = \dfrac{F}{A}$

$\tau = \dfrac{15000N \cdot 4}{2 \cdot 17^2 mm^2 \cdot 3,14}$

$\tau = 33\dfrac{N}{mm^2}$

$p = \dfrac{F}{A}$

$p = \dfrac{15000N}{17mm \cdot 12mm}$

$p = 74\dfrac{N}{mm^2}$

④ $\tau = \frac{F}{A}$

$A = \frac{F}{\tau}$

$A = \frac{18000N \cdot mm^2}{40N}$

$A = 450mm^2$

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

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

$d = \sqrt{\frac{2 \cdot A}{\pi}}$

$d = \sqrt{\frac{2 \cdot 450mm^2}{3,14}}$

$\underline{d = 17mm}$

⑤ $\tau = \frac{F}{A}$

$\tau = \frac{F \cdot 4}{2 \cdot 3 \cdot d^2 \cdot \pi}$

$\tau = \frac{64000N \cdot 4}{2 \cdot 3 \cdot 13^2 mm^2 \cdot 3,14}$

$\underline{\tau = 80\frac{N}{mm^2}}$

⑥ $\tau = \frac{F}{A}$

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

$F = \frac{\tau \cdot \pi \cdot d^2}{2}$

$F = \frac{80N \cdot 13^2 mm^2 \cdot 3,14}{mm^2 \quad 2}$

$\underline{F = 21226N = 21,226kN}$

⑦ $\tau = \frac{F}{A}$

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

$\tau = \frac{60000N \cdot 4}{2 \cdot 4 \cdot 13^2 mm^2 \cdot 3,14}$

$\underline{\tau = 56,5\frac{N}{mm^2}}$

⑧ $\tau = \frac{F}{A}$ $p = \frac{F}{A}$

$\tau = \frac{F \cdot 4}{4 \cdot d^2 \pi}$ $p = \frac{70650N}{4 \cdot 15mm \cdot 6m}$

$F = \tau \cdot d^2 \pi$ $\underline{p = 196\frac{N}{mm^2}}$

$F = 100\frac{N}{mm^2} \cdot 15^2 mm^2 \cdot 3,14$

$\underline{F = 70650N = 70,65kN}$

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① $\tau_m = \frac{F_m}{A}$

$F_m = \tau_m \cdot A$

$F_m = 320\frac{N}{mm^2} \cdot 20mm \cdot 3,14 \cdot 3mm$

$\underline{F_m = 60288N = 60,288kN}$

② $\tau_m = \frac{F_m}{A}$ $A = 30mm \cdot 3,14 \cdot x$

$A = \frac{F_m}{\tau_m}$ $x = \frac{A}{30mm \cdot 3,14}$

$A = \frac{45000N \cdot mm^2}{240N}$ $x = \frac{187,5mm^2}{30mm \cdot 3,14}$

$A = 187,5mm^2$ $\underline{x = 2mm}$

③ $\tau_m = \frac{F_m}{A}$

$F_m = \tau_m \cdot A$

$F_m = 200\frac{N}{mm^2} \cdot 50^2 mm^2 \cdot 3,14 \cdot \frac{1}{4}$

$\underline{F_m = 392500N = 392,5kN}$

④ $\tau_m = \frac{F_m}{A}$

$F_m = \tau_m \cdot A$

$F_m = 160\frac{N}{mm^2} \cdot 21mm \cdot 3,14 \cdot 2,5mm$

$\underline{F_m = 26376N = 26,376kN}$

⑤ $\tau_m = \frac{F_m}{A}$

$F_m = \tau_m \cdot A$

$F_m = 180\frac{N}{mm^2} \cdot (2 \cdot 100 + 2 \cdot 80)mm \cdot 4mm$

$\underline{F_m = 259200N = 259,2kN}$

⑥ $A = (2 \cdot 50 + 2 \cdot 30)mm \cdot 4mm$

$A = 640mm^2$

$\tau_m = \frac{F_m}{A}$

$F_m = \tau_m \cdot A$

$F_m = 200\frac{N}{mm^2} \cdot 640mm^2$

$\underline{F_m = 128000N = 128kN}$

⑦ $x^2 = 24^2 + 40^2$

$x = \sqrt{24^2 + 40^2}$

$x = 46,6mm$

$A = (24+40+46,6)mm \cdot 3mm$

$A = 332mm^2$

$\tau_m = \frac{F_m}{A}$

$F_m = \tau_m \cdot A$

$F_m = 160\frac{N}{mm^2} \cdot 332mm^2$

$\underline{F_m = 53088N = 53kN}$

⑧ $A_1 = 10,5mm \cdot 3,14 \cdot 2mm$

$A_1 = 66mm^2$

$A_2 = 21mm \cdot 3,14 \cdot 2mm$

$A_2 = 132mm^2$

$F_{m1} = \tau_m \cdot A_1$

$F_{m1} = 180\frac{N}{mm^2} \cdot 66mm^2$

$\underline{F_{m1} = 11880N = 11,9kN}$

$F_{m2} = \tau_m \cdot A_2$

$F_{m2} = 180\frac{N}{mm^2} \cdot 132mm^2$

$\underline{F_{m2} = 23760N = 23,8kN}$