UNIVERSITY OF BOTSWANA
Department of Physics

PHY111 : Semester 1 Examination Novemberl 2005

SHORT QUESTIONS WORKSHEETS (SECTION - A)

Name: _____

(Last/ Family name) (First/Other names)

ID No:_____Tutorial Group: _____

DO NOT write in the space below.
For Examiners' Use Only.

Question No:	Marks:	Section Marks
SECTION A		
SECTION (B)		
B1		
B2		
B3		
B4		
B5		
TOTAL (100)		

SECTION A: SHORT QUESTIONS: WEIGHTAGE 25%

INSTRUCTIONS: Answer **ALL FIVE (5)** Questions in Section A within the space provided below each question.

Where necessary, use the constants given on the front page

A1. Refractive index of an equiangular flint-glass prism is 1.66. Determine (i) the speed, and (ii) the angle of minimum deviation for a ray of light passing through the prism.

A2. Far point and the near point for a person with defective vision are 5 *m* and 1 *m* respectively whereas the corresponding distances for a healthy eye are ∞ and 25 *cm*. Determine the powers of lenses needed to restore the vision of the person to normal.

A3. The terminal velocity, V_t of a sphere, of density ρ and diameter d, falling freely in a fluid of coefficient of viscosity η is given by $V_t = f(\rho, d, g, \eta) = k\rho^a d^b \eta^c g$, where g is the acceleration due to gravity and k is a dimensionless quantity. Given that the dimensions of η are $ML^{-1}T^{-1}$, determine a, b and c and hence give the formula for V_t.

A4. A centrifuge rotating at 3000 rev/min takes 0.8 s to come to rest when switched off. Calculate (i) the angular acceleration and (ii) the number of times it rotates before it stops.

A5. The displacement for a light damped simple harmonic oscillator is given by

$$x = x_0 e^{-\frac{\Gamma}{2}t} \cos(\omega_1 t)$$

(a) Derive an expression for total energy of the oscillator using k for the force constant.
(b) Schematically plot energy as a function of time for the oscillator.

UNIVERSITY OF BOTSWANA
2005/06 SEMESTER 1 EXAMINATIONS
FRONT PAGE

COURSE No: PHY111 **CREDITS: 3** **DURATION: 2 Hrs.**
TITLE OF PAPER: GEOMETRICAL OPTICS, MECHANICS, VIBRATIONS AND WAVES
TITLE OF EXAMINATION: B.Sc./ B.Ed. I
SUBJECT: PHYSICS

INSTRUCTIONS:

SECTION - A: Answer ALL (FIVE) short questions of Section A within the space provided on the worksheets. At the end of the examination, hand in the worksheets (pages 5 to 8) along with your answer script. Each question carries 5 marks.

SECTION B: Answer **any THREE (3)** questions from Section B.
Each question carries 25 marks.

Wherever necessary use the following:

Speed of light in vacuum, $c = 3 \times 10^8$ m s^{-1}
Magnitude of acceleration due to gravity, $g = 10$ m s^{-2}

DO NOT OPEN THIS PAPER UNTIL YOU HAVE BEEN TOLD TO DO SO BY THE SUPERVISOR.

No. of Pages including this cover: **8 (EIGHT)**

SECTION B

Answer **ANY THREE (3)** out of FIVE (5) questions from Section B

B1. (a) Draw a labelled ray diagram to illustrate the formation of an image by a divergent (concave) lens. **[5]**

(b) Use the ray diagram drawn in part (a) to derive the lens equation, and the expression for magnification in terms of the object and image distances. (Use symbols x_o and x_i for object and image distances from the lens respectively).
[10]

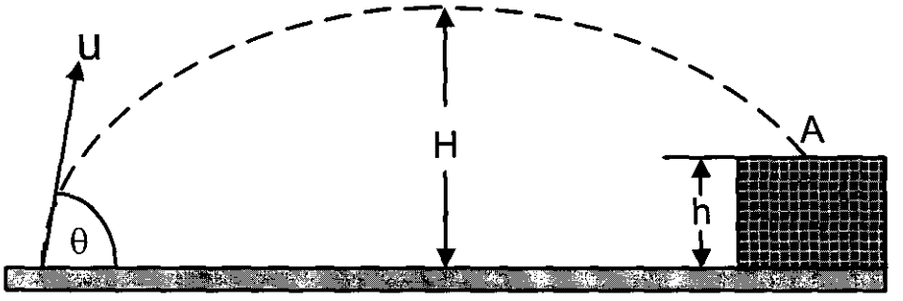
(c) A convergent (convex) lens of focal length 30 *cm* is used to produce the images of an object which have magnifications +3 and -3 respectively. Calculate the distance of the object from the lens for each case. **[10]**

B2. (a) In the figure, a stone is projected towards a building of height h with an initial speed of 42.0 m s^{-1} directed at an angle $\theta = 60^0$ above the horizontal. The stone strikes at A, 5.5 s after launching. Find the

(i) the height **h** of the building, **[4]**

(ii) the speed of the stone just before impact at A, and **[4]**

(iii) the maximum height **H** reached above the ground. **[4]**



(b) A certain sprinter has a top speed of 11.0 m s^{-1}. If the sprinter starts from rest and accelerates at a constant rate, he is able to reach his top speed in a distance of 12.0 m. He is then able to maintain this top speed for the remainder of a 100 m race.

i) What is his time for the 100 m race? **[7]**

ii) In order to improve his time, the sprinter tries to decrease the distance required for him to reach his top speed. What must this distance be if he is to achieve a time of 10.0 s for the race. **[6]**

B3. (a)A 5.0 kg body moving in the +x direction at 5.5 m s^{-1} collides head-on with a 3.0 kg body moving in the –x direction at 4.0 m s^{-1}. Find the final velocity of each mass if:

(i) the bodies stick together **[3]**

(ii) the 5.0 kg body comes to rest after the collision **[2]**

(iii) the collision is perfectly elastic. **[11]**

(b) Three vectors $\vec{A}$, $\vec{B}$ and $\vec{C}$ are such that $\vec{A} = 5\hat{i} + 3\hat{j} - 2\hat{k}$, $\vec{B} = a\hat{i} + b\hat{j} + c\hat{k}$ and $\vec{C} = 6\hat{i} - 5\hat{k}$. Given that $\vec{A} \times \vec{B} = \vec{C}$, find $\vec{B}$. **[9]**

B4. A 6.0 kg block is pushed 7.0 m up a rough 37.0^0 inclined plane by a horizontal force of 75 N. If the initial speed of the block is 2.2 m s^{-1} up the plane and the coefficient of kinetic friction between the block and the plane is 0.27, calculate:

(a) the initial kinetic energy of the block **[3]**

(b) the work done by the 75-N force **[3]**

(c) the work done by gravity **[3]**

(d) the work done by the friction force **[8]**

(e) the final kinetic energy of the block. **[8]**

B5.(a) (i) Write down the expression for the displacement and velocity for a simple harmonic motion of amplitude y_o and angular frequency ω. Show that velocity at displacement y is given by $V_y = \omega\sqrt{y_o^2 - y^2}$ **[5]**

(ii) If the period of a simple harmonic motion is 8 s, and the particle oscillates through a distance of 1.2 m on each side of the central position, find the maximum speed, and also the speed when the particle is 0.6 m from the central position. **[6]**

(b) (i) Draw the first three harmonics of a pipe of length L closed at one end and obtain the expression for the frequency, f, in terms of the velocity, V, and the length of the pipe. Use the expressions to deduce the frequency of the m^{th} harmonic, where m is odd. **[8]**

(ii) In an experiment to determine the speed of sound, resonance of a pipe closed at one end occurs at a frequency of 566.7 Hz when the air column is 75 cm and the next resonance frequency is 595 Hz when the air column is 1 m. Calculate the speed of sound in air. **[6]**

END OF SECTION B QUESTIONS

MAKE SURE YOU:

(i) Fill-in all your details on the answer script and on the Section-A cover sheet.
(ii) Submit Section-A work sheets along with your answer script.

-=::End of PHY111 Examination Novemberl 2005::=-