Name …… Class/Number……

GHS **MID OF TERM I EXAMIANTIONS** **S.4**

PHYSICS 2 **MARCH, 2020**

$1\frac{1}{2}$ HOURS

Instructions:

- *Attempt **only three** questions.*
- *Answers should be written on the answer sheets provided.*
- *Assume where necessary;*

Acceleration due to gravity, g $= 10ms^{-2}$

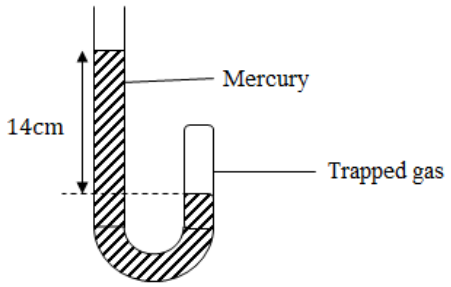
Density of water $= 1000kgm^{-3}$

Density of mercury $= 13600kgm^{-3}$

1. (a) (i) Define pressure and state its SI unit. (2 marks)

(ii) Explain why is a liquid used as the fluid in the hydraulic car brake system instead of a gas (3 marks)

(b)



A gas is trapped by mercury in a J-tube at atmospheric pressure of 760mmHg as shown in the diagram above. Calculate the pressure exerted by the trapped gas in Nm^{-2}. (2marks)

(c) Describe with the aid of a labeled diagram, how a force pump works. (5marks)

(d) (i) State the law of conservation of energy. (1mark)

(ii) A stone of mass 0.2kg is thrown vertically upwards attaining maximum potential energy of 16 J. Calculate its initial velocity. (3marks)

2. (a) State Archimedes' principle (1mark)

(b) The reading of a spring balance when a block of wood is suspended from it is 5N. When the block is completely submerged in water, the reading of the spring balance is 1N.

(i) State the forces that act on the block when it is completely immersed in water. (3marks)

(ii) Determine the volume of the block (3marks)

(c) What is meant by terminal velocity? (1mark)

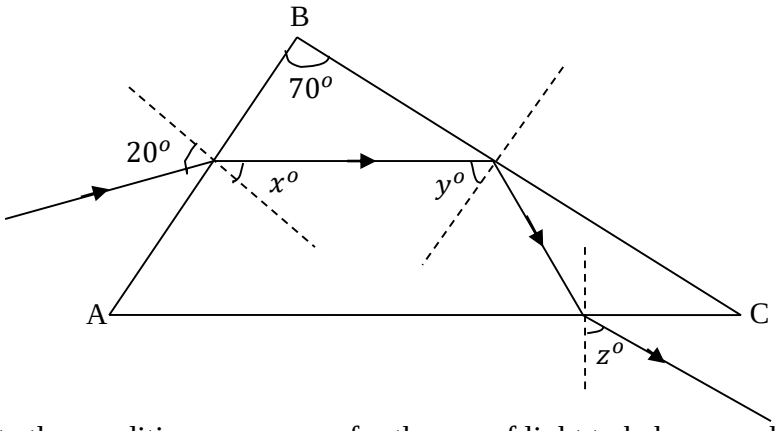
(d) A ball-bearing is released from just below the surface of lubricating oil contained in a tall glass tube.

(i) Describe the motion of a ball-bearing from release. (3marks)

(ii) Sketch the velocity-time graph for the motion in (d)(i) (2marks)

3. (a) What is meant by refraction of light? (1mark)

(b) (i) The figure below shows a light ray travelling from air as it enters and emerges from the prism ABC of refractive index, 1.5 . Find the angles x^o, y^o and z^o. (5marks)



(ii) State the conditions necessary for the ray of light to behave as shown in the diagram when it is incident on the face BC of the prism. (2marks)

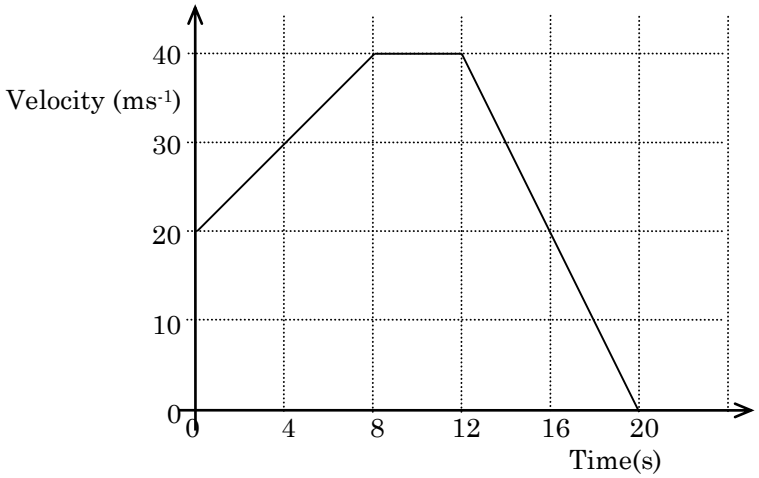
(iii) State two reasons why reflecting prisms are better reflectors than plane mirrors. (2marks)

(c) Describe an experiment to determine the refractive index of the material of a glass block. (6marks)

4. (a) (i) Distinguish between scalar and vector quantities. (2marks)

(ii) Give one example of a vector and one example of a scalar quantity. (1 mark)

(b)

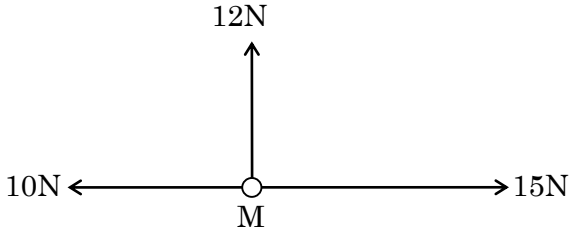


The graph represents a velocity – time graph of a body in motion.

(i) Describe the motion of the body (5 marks)

(ii) Calculate the total distance travelled. (2 marks)

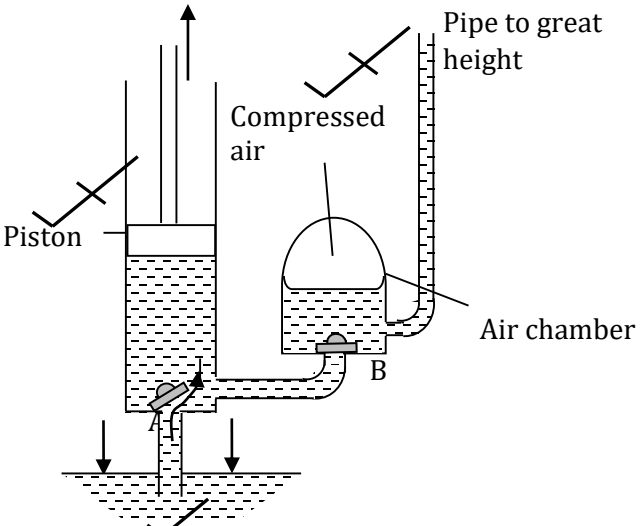
(c)

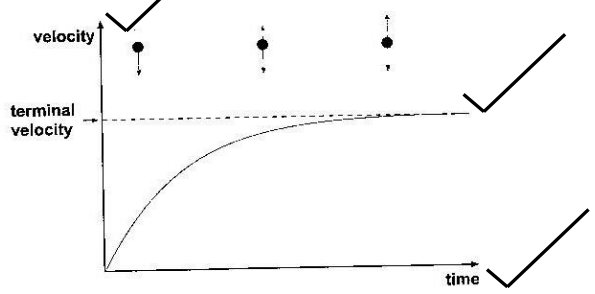


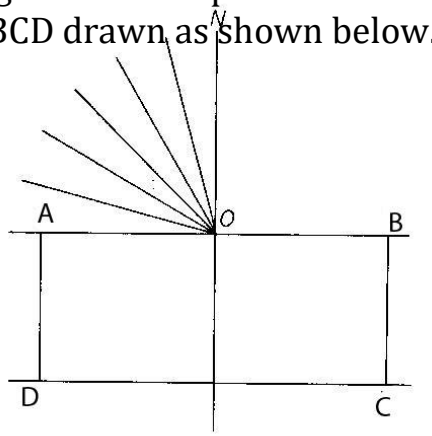
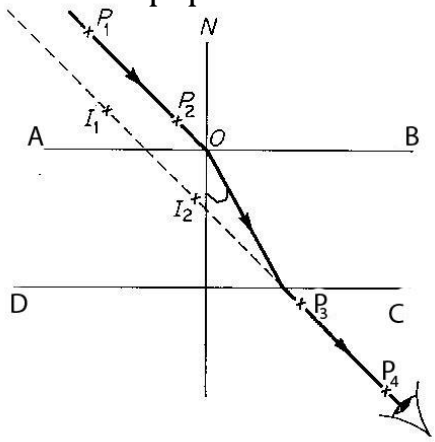
Forces of 10N, 12N and 15N act on a body of mass of M of mass 4kg, initially at rest. Find the magnitude of the acceleration with which the body moves. (6 marks)

END.

MARKING GUIDE $\boxed{x/48 \times 100\%}$

1(a)(i)	Pressure is the force acting normally per unit area. SI unit of pressure is newton per square metre or Pascal	(2marks)
(ii)	Liquids are incompressible; pressure at any point is transmitted equally, to other points (Pascal's principle). Gases are compressible, and if used, any pressure exerted on it reduces, the volume and hence the pressure is not transmitted equally.	(3marks)
(b)	Gas pressure = Atmospheric pressure + liquid pressure $P_{gas} = P_{atm} + P_{liquid}$ $P_{gas} = P_{atm} + h\rho g$ $P_{gas} = \frac{760}{1000} \times 13600 \times 10 + \frac{14}{100} \times 13600 \times 10$ $P_{gas} = 122400 \text{Nm}^{-2}$	(2marks)
(c)	 During the up stroke the atmospheric pressure pushes water through the inlet pipe and forces open the foot valve, A. So, water flows into the barrel. Meanwhile valve B is kept closed by the pressure of the compressed air in the air chamber and the great water head in the delivery pipe. During the down stroke, the foot valve is closed by the force of the piston. The same force pushes the valve in the chamber to open letting water into the chamber. Because air is compressible it acts as a cushion that maintains a continuous flow of water in the delivery pipe.	(5marks)
(d)(i)	This principle states that energy is neither be created nor destroyed but can change from one form to another.	(1mark)
(ii)	Potential energy gained = kinetic energy lost $\therefore mgh = \frac{1}{2}mv^2$ $16 = \frac{0.2u^2}{2}$ $u = \sqrt{160}$ $u = 12.649 \text{ms}^{-1}$	(3marks)

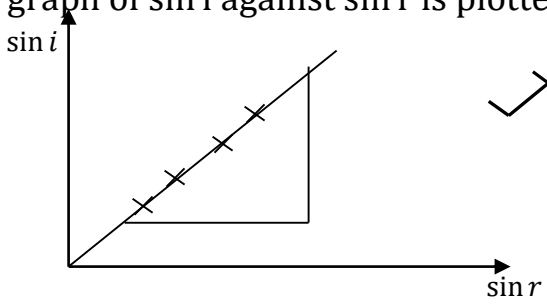
2 (a)	Archimedes' principle states when a body is wholly or partially immersed in a fluid, it experiences an up thrust equal to the weight of the fluid it displaces.	(1mark)
(b)(i)	Weight of the body Viscous force Up thrust	(3marks)
(ii)	Up thrust = weight in air – weight in water = 5 – 1 = 4N Up thrust = weight of displaced water $W = p \times V \times g$ $4 = 1000 \times V \times 10$ $V = \frac{4}{10000}$ $V = 0.0004 m^3$ or $4.0 \times 10^{-4} m^3$	(5marks)
(c)	Terminal velocity is the uniform velocity attained by a body falling through a fluid when the net force on the body is zero. Or This is a constant or uniform velocity with which a body falling through a fluid moves such that the upward forces acting on it are equal to its weight.	(1mark)
(d)(i)	On releasing the ball, it accelerates from rest, with time the ball attains a maximum constant velocity called terminal velocity. The body then moves with this constant velocity.	(3marks)
(ii)		(3marks)
3 (a)	Refraction is the bending of light as it crosses from one medium to another of different optical density.	(1mark)
(b)(i)	$\cap_1 \sin i_1 = \cap_2 \sin i_2$ $1 \times \sin 20^0 = 1.5 \sin x$ $x = 13.18^0$ $13.18 + y = 70^0$ $y = 56.82^0$ $70^0 + 60^0 + < C = 180^0$ $< C = 50^0$	(5marks)

	Let i be the angle of incidence at boundary AC $i + 90^0 + 50^0 + 90^0 - 56.82^0 = 180^0$ $i = 6.82^0$ $\cap_1 \sin i_1 = \cap_2 \sin i_2$ $1.5 \times \sin 6.82^0 = 1 \sin z$ $z = 10.26^0$	
(ii)	• Light must be traveling from an optically dense medium to a less dense medium. • The angle of incidence in the denser medium must be greater than its critical angle.	(2marks)
(iii)	• No energy is lost to refraction and reflection. • They form clear images	(2marks)
(c)	• A white sheet of paper is fixed on a soft cardboard using thumb tacks. • A glass block is placed on a white sheet of paper and its outline ABCD drawn as shown below.   • The glass block is then removed. Using a protractor; the normal is drawn at a point O along AB and an angle of incidence i is measured. • Pins P_1 and P_2 are fixed on the line making an angle of $i = 10^0$ to the normal and the glass block replaced on its outline ABCD. • While looking through side CD, two other pins P_3 and P_4 are fixed so as to appear in lines of images P_1 and P_2. • The glass block, pins P_3 and P_4 are removed and a line drawn through points where P_3 and P_4 were fixed. This line is called the emergent ray. It is drawn to meet CD at E. • Point O is joined to E. The line is called the refracted ray. • The angle of refraction r is measured. • The experiment is repeated using other angles of incident 20, 30, 40, and 50. • The values of i, r are tabulated as shown.	(6marks)

i(°)	r(°)	sin i	sin r	$\frac{\sin i}{\sin r}$
20				
30				
40				
50				

- The values in the column for the ratio of sin i to sin r are the same within experimental errors. This is Snell's law.

Alternatively, a graph of sin i against sin r is plotted as below:



A straight line graph of constant slope is obtained. The slope/gradient of the graph is equal to the refractive index of the glass.

4(a)(i)	A Scalar quantity is one that is fully describes by its size (or magnitude) only whereas A vector quantity is one that is fully described by both magnitude and direction.	(2marks)
(ii)	**Examples of Scalar Quantities include:** Time, distance, mass, density, area, volume, speed, energy, work, power, etc. **Examples of vector quantities include:** Velocity, displacement, acceleration, force, moment of a force, momentum, etc.	(1mark)
(b) (i)	A body moving with a velocity of $20ms^{-1}$ accelerates uniformly for 8 s to a velocity $40ms^{-1}$. It then moves at this constant velocity for 4 s before retarding uniformly to rest for 8.	(5marks)
(ii)	$$\text{Total distance} = A_1 + A_2$$ $$\text{Total distance} = \frac{h}{2}(a+b) + \frac{h}{2}(a+b)$$ $$\text{Total distance} = \frac{8}{2}(20+40) + \frac{40}{2}(4+12)$$ $$\text{Total distance} = 560\text{m}$$ **or** $$\text{Total distance} = A_1 + A_2 + A_3$$ $$\text{Total distance} = \frac{h}{2}(a+b) + l \times w + \frac{1}{2}bh$$	(2marks)

	$\text{Total distance} = \frac{8}{2}(20+40) + 4 \times 40 + \frac{1}{2} \times 40 \times 8$ $\text{Total distance} = 560\text{m}$	
©	$(\rightarrow)\ 15 - 10 = 5\text{N}$ ✓ $\text{RF} = \sqrt{(12^2 + 5^2)}$ ✓ $\text{RF} = 13\text{N}$ ✓ $\text{F} = \text{ma}$ ✓ $13 = 4\text{a}$ ✓ $\text{a} = 3.25\text{ms}^{-2}$ ✓	(6marks)

END.