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232/1
Physics
Paper 1

Kenya Certificate of Secondary Education (KCSE)
Physics Paper 1

Instructions to candidates

- This paper consists of two sections ***A*** and ***B***.
- Answer **all** the questions in the two sections in the spaces provided after each question
- All working **must** be clearly shown.
- Electronic calculators andMathematical tables may be used.
- All numerical answers **should be expressed** in the **decimal** notations.

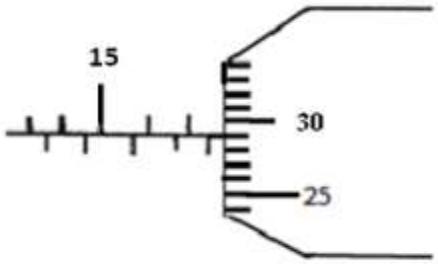
For Examiner use only

SECTION	QUESTION	MAX MARKS	CANDIDATE'S SCORE
A	1 – 11	25	
B	12	08	
	13	07	
	14	10	
	15	06	
	16	09	
	17	07	
	18	08	
TOTAL		80	

This paper consists of 14 printed pages. Candidates should check to ascertain that all pages are printed as indicated and that no questions are missing.

Section A (25Marks)

1. The diagram below shows a micrometer screw gauge. What is the reading in SI units? (2 marks)



Sleeve scale = 17.50mm

Thimble scale = 29 X 0.01 = 0.29mm ✓

Total reading = 17.50 + 0.29

= 17.79mm

= 1.779 X 10^{-2} m ✓

2. Apart from friction, name another factor that reduces efficiency in machines. (1 mark)

Energy lost/used to lift the machine parts / Weight of machine parts ✓

3. Diffusion in gases is faster than in liquids; state two reasons why this is so. (2 marks)

-Density of gases is lower than in liquids ✓

-Kinetic energy of gas particles is higher than that of liquids

-Intermolecular forces in gasesare weaker than in liquids. ✓

4. A tube of radius 9 mm has a constriction of diameter 10mm. Water flows in the tube at $3ms^{-1}$. Determine the velocity of water in the constriction. (3 marks)

Rate of flow; $a_1 v_1 = a_2 v_2$ ✓

$\pi x0.009^2 \times 3 = v_2 \times \pi \times 0.005^2$ ✓

$v_2 = \underline{9.72\ ms^{-1}}$ ✓

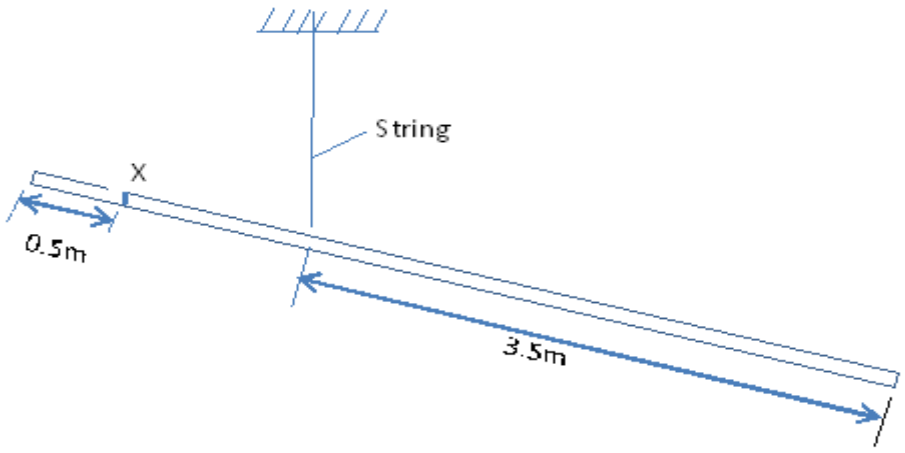
5. (a) A student obtained ice at 0°Cfrom a refrigerator and placed it in a beaker on a bench. After 4 minutes, the temperature rose to 4°C. State the changes that would be observed in the water in terms of;

(i) density ***Increases*** (1 mark)

(ii) mass ***remains constant*** (1 mark)

(ii) volume ***Decreases*** (1 mark)

6. The diagram below shows a uniform 5m long metal rod of mass 800g. It is suspended by a string tied at a point 3.5m from one end. Determine the load which should be hung at point X to keep the plank horizontal. (3 marks)



At equilibrium, sum of clockwise moments = sum of anticlockwise moments

$$8N \times 1m = X \times 1m$$

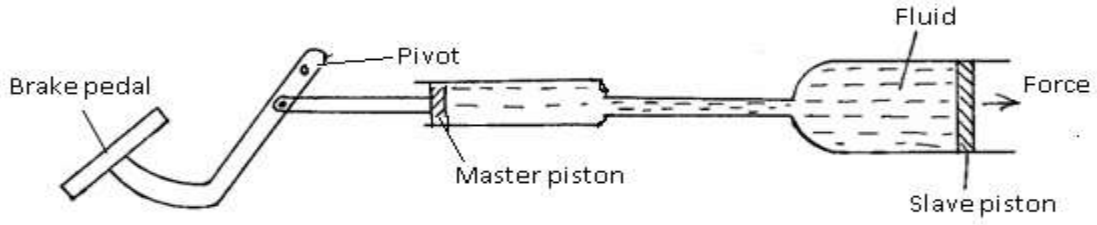
$$X = \underline{8\ N}$$

7. Explain why ice skaters use sharp-edged shoes to slide on ice (2 marks)

Sharp edged shoes exert high pressure on ice which lowers the melting point of ice.✓

Melted water below provides lubrication/ lowers friction✓ ***hence skidding/ sliding occurs.***

8. The diagram below shows a braking system.



Why is the master piston, made smaller than the slave piston? (1 mark)

A small piston exerts high pressure transmitted✓ ***to the larger/slave piston,***

This produces a larger force in the slave piston.

9. A faulty thermometer reads 2^{o}C when dipped in ice at 0^{o}C and 95^{o}C when dipped in steam at 100^{o}C. What would this thermometer read if placed in water at room temperature at 18^{o}C?

(3 marks)

0------ 100 ⟶ 100 units

2 ------ 95 ⟶ 93 units

1 unit = 93/100 = 0.93 units✓

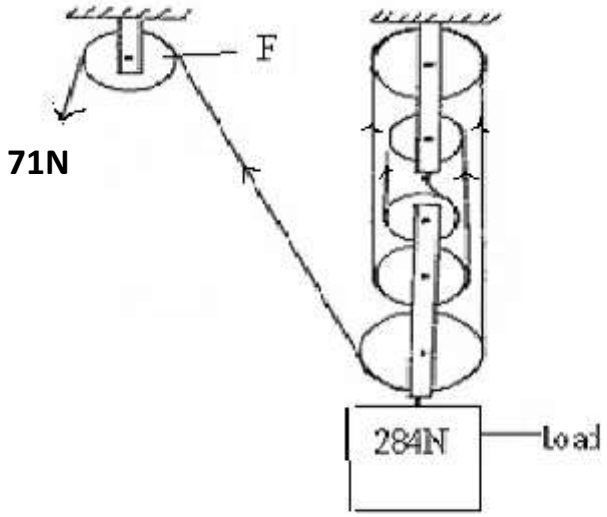
18 units = 18 X 0.93

= 16.74✓

Reading = 2 + 16.74

= 18.74 º C✓

10. The figure **below** shows a machine being used to raise a load. Use the information given in the figure to answer questions **below**.



(a) Determine the efficiency of the machine. (3 marks)

V.R. = 5

M.A. = $^{284}/_{71}$

= 4 ✓

Efficiency = $^{M.A}/_{V.R}$ X 100

= $^{4}/_{5}$ X 100 ✓

= 80% ✓

11. Using Kinetic theory of matter, explain why solids expand when heated (2 marks)

Heat <u>increases the kinetic energy of molecules</u> ✓

This leads to increase in the <u>distance covered my moving molecules, hence its length increases</u> ✓

Section B (55 Marks)

12. A bullet of mass 24g travelling in a horizontal path with a velocity of 450ms^{-1} strikes a wooden block of wood of mass 976g resting on a rough horizontal surface. After impact, the bullet and the block move together for a distance of 7.5m before coming rest.

(a) Name the type of collision which takes place above (1 mark)

Inelastic collision ✓

(b) What's the velocity of the two bodies when they start sliding (2marks)

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v \quad \checkmark$$

$$^{22}/_{1000}X450 + {}^{976}/_{1000}X\ 0 = (^{976}/_{1000} + {}^{26}/_{1000})v \quad \checkmark$$

$$v = \underline{10.8ms^{-1}}$$

(c) Calculate the force which brings the two bodies to rest (3 marks)

$$V^2 = u^2 + 2\,a\,s \quad \checkmark$$

$$0 = 10.8^2 + 2\ X\ a\ X\ 7.5$$

$$a = -\ 10.8^2/_{15}$$

$$a = \underline{-\ 7.7776\ ms^{-1}} \quad \checkmark$$

$$F = ma = 1\ X\ -7.7776\ \underline{ms^{-1}}$$

$$F = \underline{-7.7776\ N} \quad \checkmark$$

(d) Determine the coefficient of friction between the block and the surface during this motion.

(2 marks)

$$F = \mu R = \mu\, mg$$

$$= m\,a = \mu X\ 1\ X\ 10$$

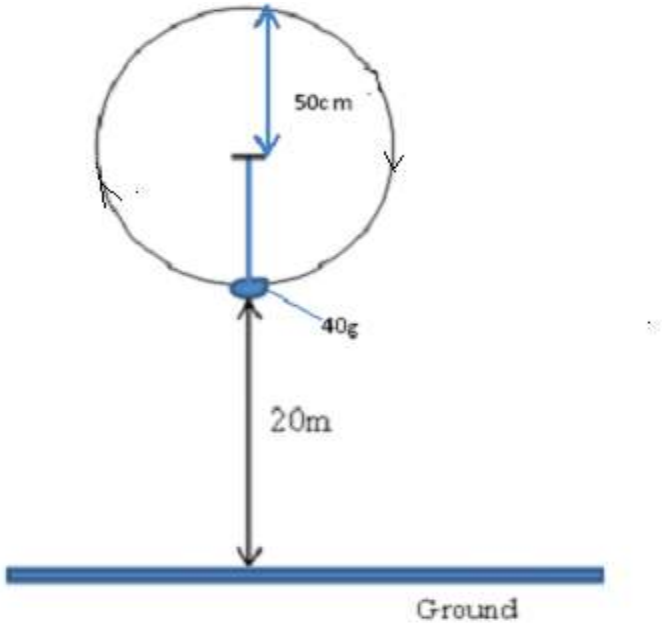
$$\mu = {}^{1\ X\ 7.776}/_{10}$$

13 (a) Give reason why a body moving in a circular path with constant speed is said to be accelerating. (1mk)

This is due to constant change in direction of body

hence change in velocity is acceleration

(b) A stone of mass 40g is tied to the end of a string 50cm long such that it is 20m above the ground at its lowest level as shown in the diagram below. It is whirled in a vertical circle at 2rev/s.



(i) If the string breaks at its lowest levelas shown, what is the velocity with which it travels?

(2 mark)

$$\omega = 2\pi f = 2 \text{ X } 3.142 \text{ X } 2$$

$$\omega = 12.567 rads^{-1} \surd$$

$$v = r\,\omega = 0.5 \text{ X } 12.567$$

$$v = 6.283 ms^{-1} \surd$$

(ii) Calculate the maximum tension in the string. (2 mks)

$$T = mv^2/r - mg$$

$$= 40/1000 \text{ X } 6.2832^2/0.5 - 40/1000 \text{ X } 10 \surd$$

$$= 2.7583N \surd$$

(d) Determine the maximum horizontal distance it travels from the breaking point (2 marks)

$h = \frac{1}{2} gt^2$

$20 = 5t^2$

$t^2 = 4$ $t = 2s \surd \longrightarrow$

$R = ut$

$= 6.283 \text{ X } 2$

$= 12.566m \surd$

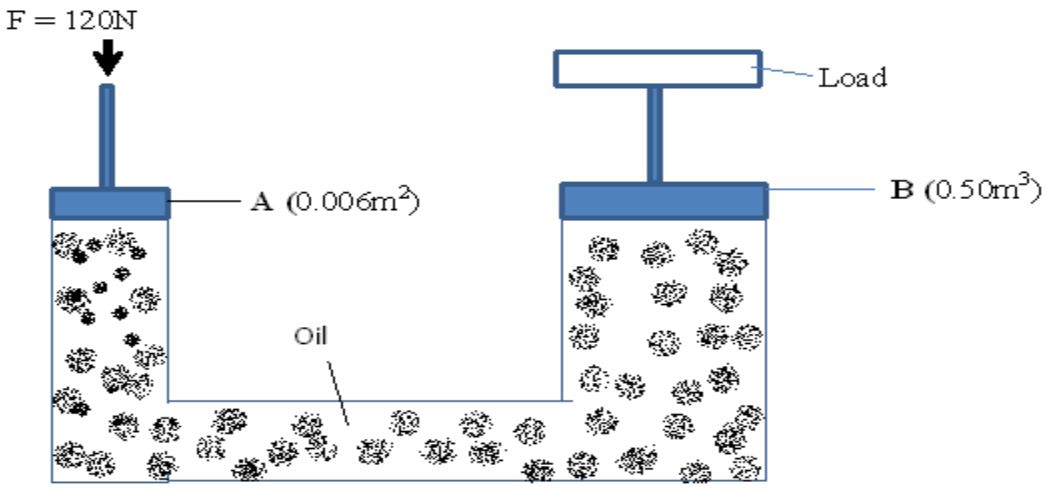
14 (a) Give reason why ink is most likely to ooze out of a pen when one is up in an airplane.

(1mark)

The pressure in the pen is higher than that outside the pen (atmospheric pressure).

This causes the ink to flow outwards due to difference in pressure. $\surd$

(b) The figure below is a simple hydraulic machine used to raise heavy loads.



Calculate;

(i) The pressure exerted on the oil by the force applied at A (2marks)

$$P = F/A = 120/0.006 = \underline{20{,}000Nm^{-2}}$$

$F = P \times A$

$= 20{,}000 \times 0.50$

$= \underline{10{,}000N}$

(iii) Give two properties which make the oil suitable for use in this machine (2marks)

- *Should be incompressible*
- *Should be non corrosive*
- *Should have high boiling point and low melting point*

(c) The height of a mountain is 1360m. The barometer reading at the base of the mountain is 74cmHg. Given that the densities of mercury and air are 13,600Kgm^{-3} and 1.25Kgm^{-3} respectively, determine the barometer reading at the top of the mountain. (3 marks)

$h_1\rho_1 g = h_2\rho_2 g$ ✓

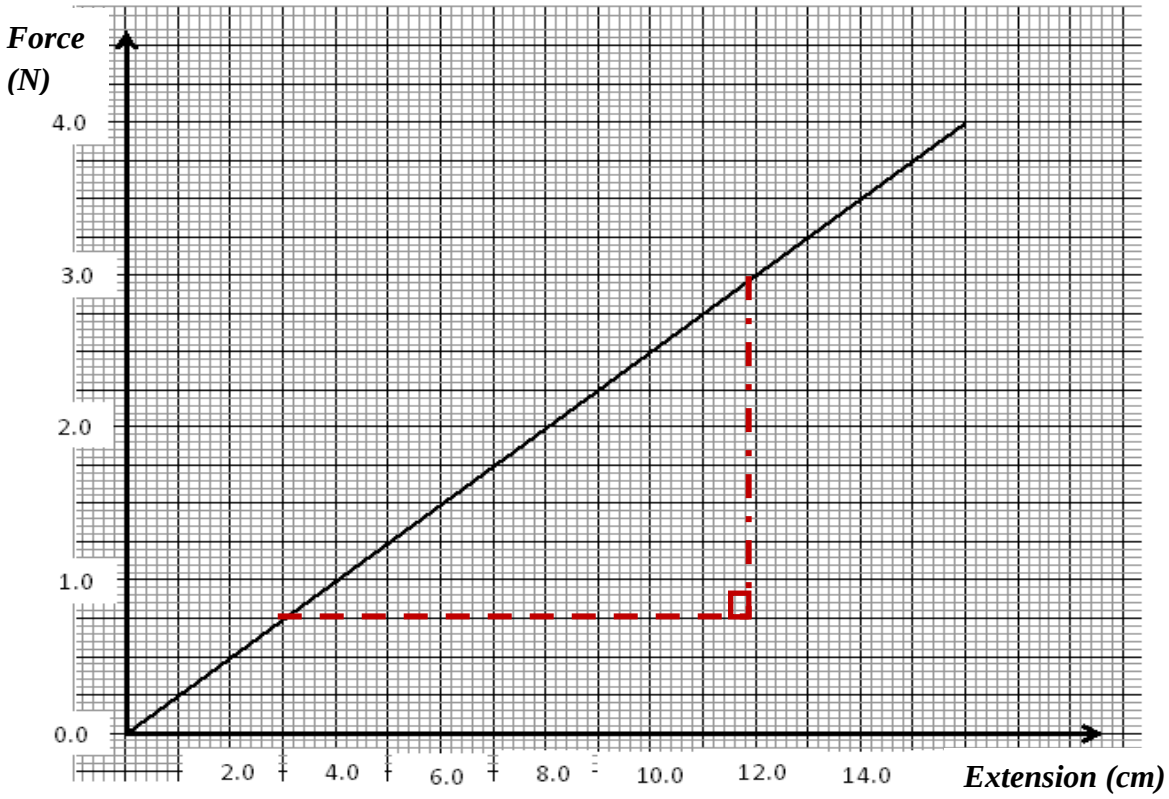
$1360 \text{ X } 1.25 = {}^{(74-x)}/_{100}\text{X } 13600$ ✓

$x = 61.5cm$ ✓

15 (a) State Hooke's Law (1mark)

For a helical spring or any other elastic material, the extension of a string is directly proportional to the force applied, so long as the elastic limit is not exceeded ✓

(b) The diagram below shows a graph of force against extension for a certain spring.



(i) What is the spring constant of the spring? (2 marks)

***Gradient* = $^{(3-1)}/_{(12-4)}$ √**

= *0.25Ncm*$^{-1}$ √

(ii) What force would cause two such springs placed side by side to stretch by10cm (3 marks)

***In parallel arrangement, k = 25 X 2 = 50 Ncm*$^{-1}$ √**

***F = k e = 50 X 0.1* √**

= *5Ncm*$^{-1}$ √

16. (a) What is meant by specific latent heat of fusion of a substance? (1mk)

The amount of heat energy required to change a unit mass of solid to liquid at constant temperature. ✓

(b) In an experiment to determine the specific latent heat of vaporization of water, steam at 100ºC was passed into water contained in a well-lagged copper calorimeter. The following measurements were made:

- Mass of calorimeter = 60g
- mass of water + calorimeter = 145g
- Final mass of calorimeter + water + condensed steam = 156g
- Final temperature of the mixture = 48ºC

[Specific heat capacity of water = $4200JKg^{-1}k^{-1}$ and specific heat capacity of copper = $390JKg^{-1}k^{-1}$]

Determine the;

(i) mass of condensed steam. (1mk)

Mass of steam = 156 - 145

= 11 g ✓

(ii) The heat gained by the water and calorimeter if the initial temperature of the calorimeter and water is 20ºC. (3mks)

Heat gained by water + heat gained by calorimeter= 0.085 X 4200 (48-20) + 0.06 X 390(48-20)

= 10,651.2 J ✓

(iii) Given that $\mathbf{L_v}$is the specific latent heat of vaporization of steam, write an expression for the heat given out by steam. (1mark)

Heat lost by steam=Heat lost by condensing steam + heat lost by condensed steam

$= 0.011 \ X \ L_v + 0.011 \ X \ 4200 \ X \ (100 - 48)$ ✓

$= 0.011L_v + 2,402.4$

(iv) Determine the value of L_v above (2mks)

Heat lost by steam+heat lost by condensed water = heat gained by water + heat gained by calorimeter

$0.011\ XL_v + 0.011\ X\ 4200\ X\ (100 - 48) = 0.085\ X\ 4200\ (48-20) + 0.06\ X\ 390(48-20)$ ✓

$L_v = 749{,}890.9091 JKg^{-1}$ ✓

(v) State the assumption made in the above experiment (1 mark)

- ***There are no heat losses*** ✓
- ***There is no change in mass***

17. A cork of volume $100cm^3$ is floating on water. If the density of the cork is $0.25\ gcm^{-3}$ and that of water is $1\ gcm^{-1}$;

(a) Calculate the mass of the cork (2 marks)

Mass = density X volume

$= 100\ X\ 0.25$ ✓

$= \underline{25g}$ ✓

(b) Hence, find the upthrust force on the cork (2 marks)

Upthrust = Weight of the liquid displaced

$= {}^{100}/_{1000}\ X\ 1\ X\ 10$ ✓

$= \underline{1\ N}$ ✓

(c) What minimum force is required to immerse the cork completely (2 marks)

Weight of the cork $= {}^{25}/_{1000}\ X\ 10$

$= 0.25N$ ✓

∴ ***Minimum downward force required = 1.0 - 0.25***

$= 0.75\ N$ ✓

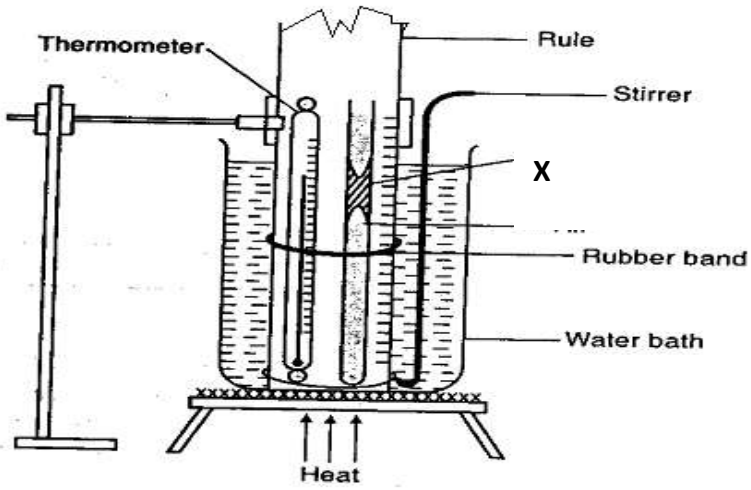
(d) What is the effect on the upthrust force in a liquid when the temperature of the liquid is reduced? (1mark)

- ***Upthrust reduces*** ✓

18. (a) State Pressure Law (1mark)

The pressure of a fixed mass of gas is directly proportional to its absolute temperature provided volume is kept constant.✓

(b) The following diagram shows a set up of apparatus used to verify Charles Law.



(i) Give the name of part labelled X (1 mark)

- ***Sulphuric acid index***✓

(ii) What is the function of the part named in (i) above? (1 mark)

- *A drying agent*
- *Indicate the volume of gas*

(iii) Briefly explain how the set up above is used to verify Charles Law (3 marks)

- The apparatus are set up as shown and the water bath heated

- The temperature and volume /length of index is recorded at regular intervals of time

- A graph of volume of versus absolute temperature is drawn and graph analysed.

- a straight line cutting the temperature axis at about -273K is obtained; hence volume is directlyproportional to absolute temperature.

(c) A certain mass of hydrogen gas occupies a volume of $1.6m^3$ at a pressure of $1.5x10^5Pa$ and a temperature of 12^0c. Determine the volume when the temperature is 0^0c at a pressure of $1.0x10^3Pa$.

(2 marks)

$$P_1V_1/T_1 = P_2V_2/T_2$$

$$1.5 \times 10^5 \times 1.6 / 285 = 1.0 \times 10^3 \times V_2 / 273$$

$$V2 = 1.5 \times 10^5 \times 1.6 \times 273 / (2.85 \times 1.0 \times 10^3)$$

$$= \underline{229.89\ m^3}$$