Kenya Certificate of Secondary Education
2019 Physics paper 1

SECTION A: (25 marks)

1. A micrometre screw gauge has a -0.03 mm error. State the reading that is observed on the instrument when used to measure the diameter of a wire whose actual diameter is 0.38 mm. (1 mark)

$0.38 - 0.03 = 0.35\ mm$

2.It was observed that upon sucking the straw, milk did not rise up the straw. Explain this observation. (2 marks)

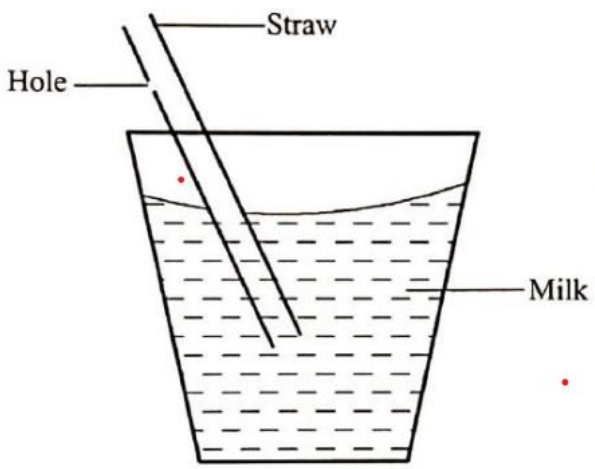


Figure 1

A straw with a hole on the side cannot be used to draw up a liquid as air sucked out is balanced by air getting in through the hole. The pressure in the straw is therefore always equal to the atmospheric pressure.

2. For a fluid flowing at a velocity V in a tube of cross-sectional area A, VA = constant; State the assumptions=made in deriving this equation. (2 marks)

- Flowing steadily
- Incompressible
- Non-viscous

3. State two ways of reducing surface tension of a liquid. (2 marks)

- heating (increasing the temperature)
- adding detergent

4. Figure 2 shows a round bottomed flask containing a coloured liquid.

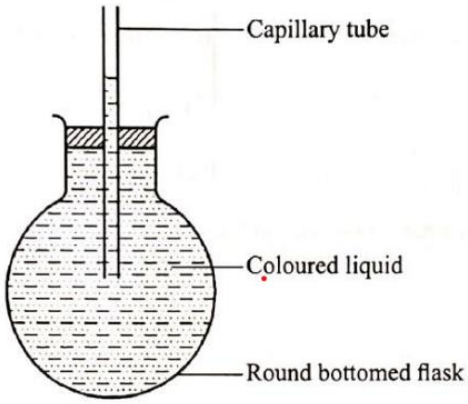


Figure 2

The flask is fitted with a capillary tube. It is observed that on holding the flask with bare hands, the level of the liquid in the capillary tube initially drops slightly and then rises. Explain this observation. (3 marks)

The glass expands at a higher rate compared to a liquid hence the initial reduction of liquid level. As the liquid gains more heat, it expands more and the level goes up.

5. figure, 3 shows two metal rods A and B of equal length made of the same material but different diameters.

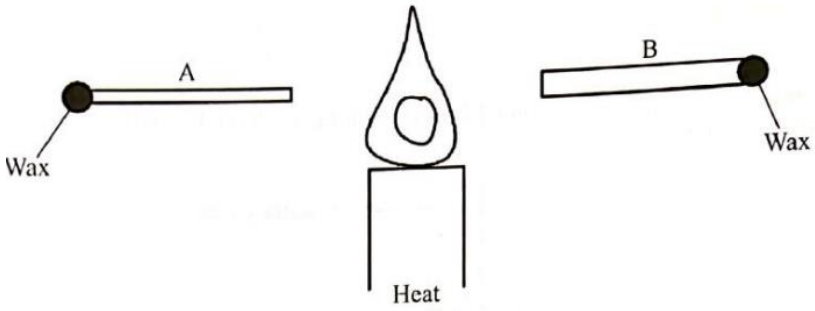


Figure 3

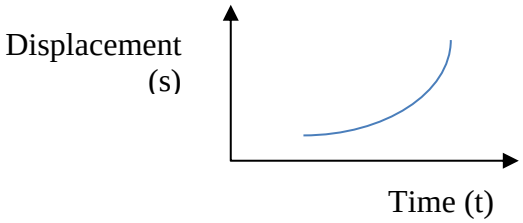
Wax is attached at one end of each rod. A source of heat is placed between the two metal rods. State with a reason, what is observed on the wax. (2 marks)

Wax on rod B drops off first. The larger the cross-sectional area the higher the rate of heat flow.

6. On the axes provided, sketch a displacement — time graph for a trolley moving down a frictionless inclined plane till it reaches the end of the incline. (1 mark)

When an object moves along a straight line, it is said to undergo linear motion. If it moves

Body is uniformly accelerating hence displacement-time graph curve upwards.



State two ways in which an inclined plane can be made to reduce the applied effort when pulling a load along the plane. (2 marks)

- The steeper the inclination, the higher the acceleration hence the higher the effort required to counter this motion. To reduce the effort therefore, the angle of inclination should be reduced.
- Friction opposes motion and as such should be reduced for example by oiling the surface or placing the load on rollers.

Two boxes E and F of masses 2.0kg and 4.0kg respectively are dragged along a frictionless surface using identical forces. State with a reason which box moves with a higher ~~velocity~~ acceleration. (2 marks)

From newton's second law of motion,

$F = ma$

$\Longrightarrow a = \frac{F}{m}$

For box E; $a_E = \frac{F}{2}$

For box F; $a_F = \frac{F}{4}$

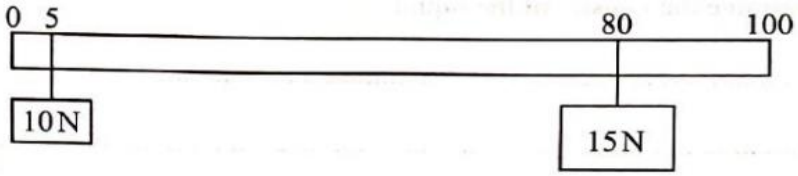
Considering that the force is equal, it follows that $a_E > a_F$

E moves with a higher acceleration because it has a smaller mass.

7. A student carrying a heavy box using the right fund is observed to lean towards the left-hand side. Explain this observation. (2 marks)

The box shifts the position of the center of gravity of the system towards the right hand and consequently to balance moments and hence maintain balance, the student leans in the opposite direction

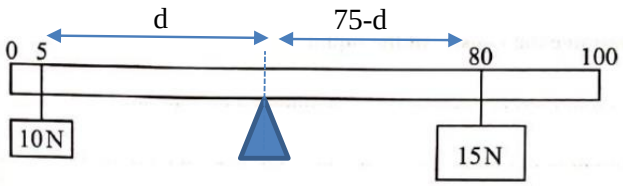
8. Figure 4 shows a one-meter-long uniform rod of negligible weight supporting two weights.



Determine the position of the fulcrum from O cm for the rod to remain in equilibrium. (3 marks)

The distance between the two loads equals 75 cm.

Say d be the distance between 10 N load and the fulcrum, then the distance between the fulcrum equals $75 - d$ hence;



Equilibrium (balance) occurs when:

$$Anticlockwise\ moment = clockwise\ moment$$

$$10d = (75 - d) \times 15$$

$$10d + 15d = 75 \times 15$$

$$25d = 75 \times 15$$

$$d = \frac{75 \times 15}{25} = 45\ cm$$

Fulcrum is 45 cm from the 10 N force of at the 50 cm mark of the meter rule.

9. State the meaning of the term "radian" as a unit of measurement. (1 mark)

To the question now;

$1\ Radian = 360/2\pi$

10. Moved up

11. A stone of volume 800 cm^3 experiences an upthrust of 6.5 N when fully immersed in a certain liquid. Determine the density of the liquid. (2 marks)

$upthrust = weight\ of\ water\ displaced = mg = 6.5N$

$\Rightarrow m = \frac{6.5}{g} = \frac{6.5}{10} = 0.65\ kg$

But $g = 10m/s^2$ hence;

$m = \frac{6.5}{10} = 0.65\ kg = 650g$

Mass of water displaced = 650 g

Volume of water displaced = volume of the object= 800 cm^3

Density $\rho = \frac{mass}{volume} = \frac{650}{800} = 0.8125\ g/cm^3$

12. Moved to section B

13. moved up

SECTION B (55 marks)

Answer all the questions in this section

Figure 5 shows two springs C and D of the same length and equal number of turns made from the same wire.

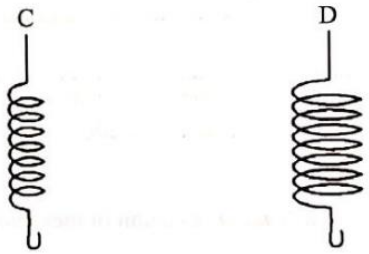


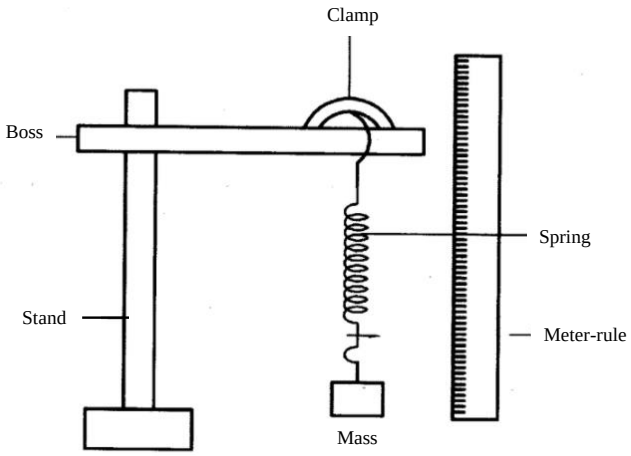
Figure 5

State with a reason which of the two springs can support a heavier load before attaining the elastic limit. (2 marks)

Spring C given that it has a smaller cross-sectional area hence a larger spring constant.

14. (a) A student is provided with five 20g masses, a meter rule, a spring with a pointer, a stand, a boss and a clamp.

(i) In the space provided, sketch a labelled diagram of the setup that may be used in order to verify Hooke's law using this apparatus. (3 marks)



(ii) State two measurements that should be recorded in order to plot a suitable graph so as to verify Hooke's law. (2 marks)

- Weight /force ($F = W = mg$) aafter masses are mass hung.
- Extension produced by every set of masses

(iii) Describe how the measurements made in (ii) can be used to determine the spring constant. (2 marks)

- Arrange the apparatus as shown in (i) above.
- Suspend first mass, measure the new length
- Determine the extension ($new\ length - original\ length$)
- Keep adding more masses and noting the weight (F) and new extension (e) every time.
- Plot a graph of weight against extension (it should be a straight line where the spring obeys Hooke's law).
- Determine the gradient (k) of the linear part
- The gradient represents the spring constant

(b) A helical spring stretches by 0.6 cm when supporting a weight of 40 g. Determine the extension when the same spring supports a weight of 65 g. (3 marks)

Determine spring constant first;

$F = ke$

$$\Longrightarrow k = \frac{F}{e} = \frac{mg}{e} = \frac{0.04 \times 10}{0.006} = 66.67\ N/m$$

Then;

$F = ke$

$$\Longrightarrow e = \frac{F}{k} = \frac{mg}{k} = \frac{0.065 \times 10}{66.67}$$
$$e = 9.75 \times 10^{-3}\, m = 0.975\, cm$$

15. (il) Figure 6 shows a bottle top opener being used to open a bottle.

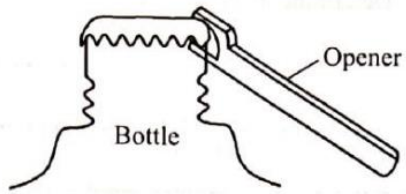
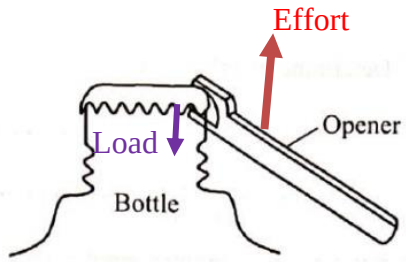


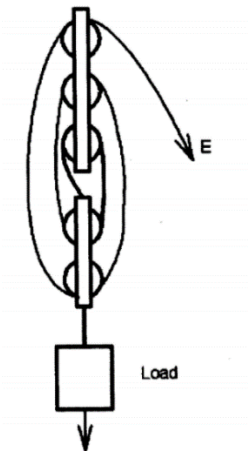
Figure 6

Indicate on the diagram the direction of the load and the effort. (2 marks)



(b) Moved to section A

(c) A block and tackle system has three pulleys in the upper fixed block and two pulleys in the lower movable block.
(i) Draw a diagram to show how the system can be set up in order to lift a load and indicate the position of the load and effort. (3 marks)



(ii) State the velocity ratio of the set up. (1 mark)

$VR = 5$

(iii) In such a block and tackle system an effort of 200N is required to lift a load of 600 N. Determine its efficiency. (3 marks)

$$Efficiecy = \frac{MA}{VR} \times 100\%$$

$$MA = \frac{Load}{Effort} = \frac{600}{200} = 3$$

$$Efficiecy = \frac{3}{5} \times 100\% = 60\%$$

16. (a) State the meaning of the term "heat capacity." (1 mark)

Heat capacity is the quantity of heat energy required to raise the temperature of a substance by 1 K.

(b) State how pressure affects the melting point of a substance. (3 marks)

Increase in pressure lowers the melting point while decrease in pressure raises the melting point.

(C) Figure 7 Shows a setup of apparatus that may be used to measure the specific latent heat of vaporisation of steam.

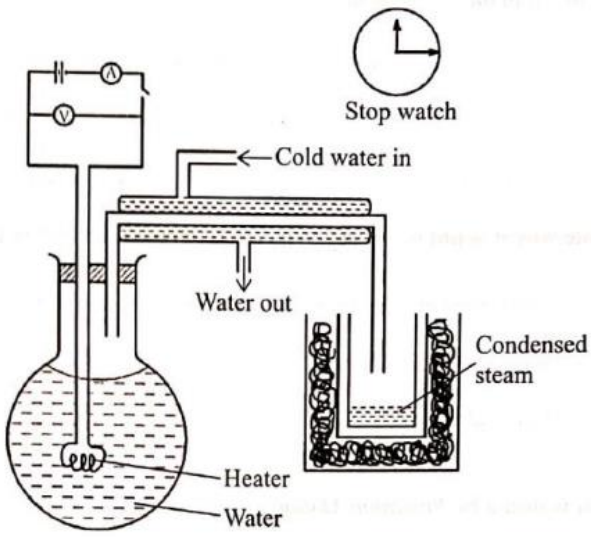


Figure 7

(i) Describe how the mass of condensed steam is determined. (3 marks)

- Measure the mass of the empty beaker m_1
- Measure the mass of the beaker plus the condensed steam m_2

- Mass of condensed steam $m = m_2 - m_1$

(ii) Other than mass and time, state two other measurements that should be taken during the experiment. (2 marks)

- Voltage
- current

(iii) Show how the measurements in (c)(ii) can be used to determine the specific latent heat of vaporisation of water. (2 marks)

Assuming no heat is lost,

Heat generated by electric heater = Heat used to produce steam

$Vlt = mL$

$L = \frac{VIt}{m}$

(iv) State the precautions that should be taken so that the mass of the condensed steamed measured corresponds to the actual mass of steam collected during the time recorded in the experiment (1 mark)

- Covering the beaker to reduce loss of vapour
- Placing the beaker collecting the condensed steam in crashed ice to lower the temperature of the condensed vapour thereby reducing evaporation
- The flask for boiling water should be tightly sealed so that steam generated does not escape.

(v) State why it is not necessary to measure temperature in this set up. (1 mark)

The temperature of a boiling liquid is constant

17. (a) State what is meant by Brownian Motion (I mark)

Continuous random motion of particles

(b) Figure 8 shows the graph of velocity against time for a small steel ball falling in a viscous liquid.

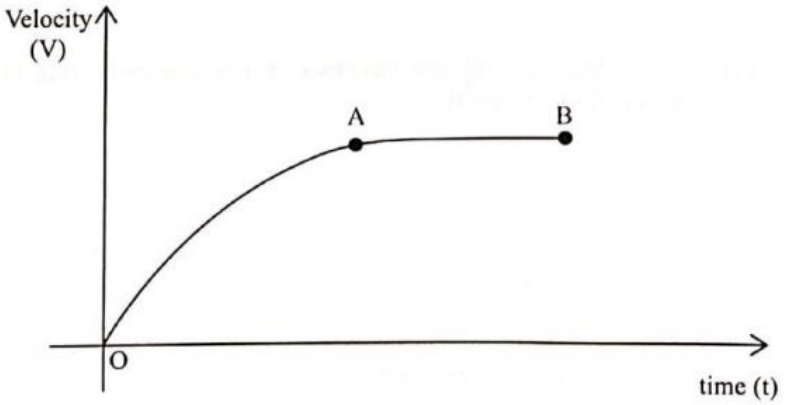


Figure 8

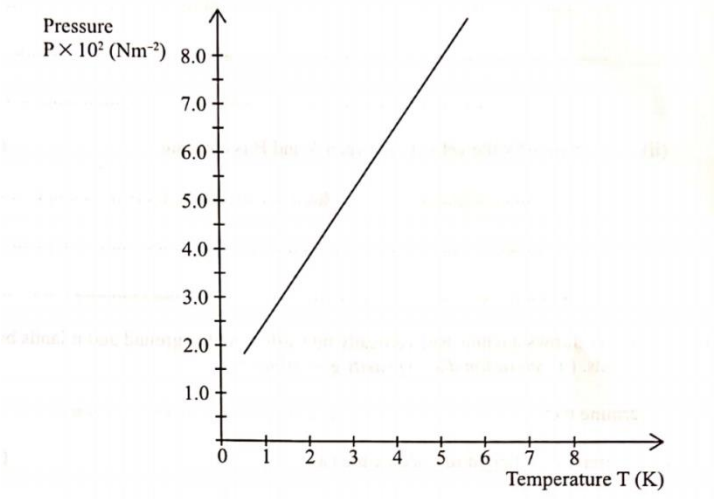
(i) Describe the motion of the steal ball as represented my part OA. (1 mark)

part OA; force downwards is greater than total force upwards hence the body is accelerating.

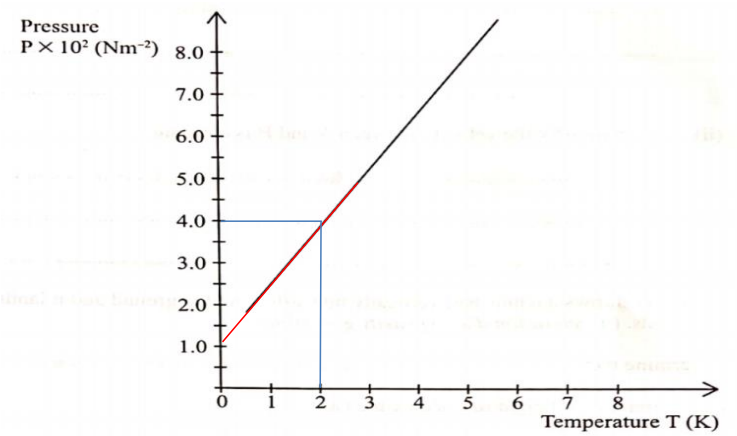
(ii) Explain why the velocity between A and B is constant. (3 marks)

As the ball falls through the fluid, the viscous drag increases until the sum of the viscous drag and the upthrust becomes equal the weight of the steel ball, hence the net force and consequently acceleration falls to zero and the body moves at a constant velocity called terminal velocity.

18. (a) Figure 9 shows a graph of pressure against temperature for a fixed mass of gas at constant volume



From the graph, determine the values of n and c given that $P = nT + c$ where *n* and *c* are constants. (4 marks)



A linear graph is represented by the equation;

$y = mx + c$

where m is the gradient of the graph and c is the value of y when x=0.

|From the equation $P = nT + c$

$$n = gradient\ of\ the\ graph = \frac{\Delta P}{\Delta T} = \frac{(4-1)\times 10^2}{2-0} = \frac{3\times 10^2}{2}$$

$n = 1.5 \times 10^2\ N/m^2K$

c is the value of P when $T = 0$ hence $c = 1 \times 10^2\ N/m^2$

(b) Explain why it is not possible to obtain zero pressure of a gas in real life situation. (2 marks)

According to pressure law, $p \infty T$. This means that as pressure reduces, so does the temperature. At very low temperature, gases turn to liquids.

NOTE: A gas can be made to liquify if exposed to extremely high pressure. For example, LPG gas used for cooking is liquid gas under pressure. LPG gas cylinders must therefore be strong enough to withstand the high pressure.

(c) A fixed mass of a gas occupies 1.5 x $10^{-3}m^3$ at a pressure of 760 mmHg and a temperature of 273 K. Determine the volume the gas will occupy at a temperature of 290 K and a pressure of 720 mmHg. (3 marks)

$$\frac{p_1V_1}{T_1} = \frac{p_2V_2}{T_2}$$

$$\frac{760\times 1.5\times 10^{-3}}{273} = \frac{720\times V_2}{290}$$

$$V_2 = \frac{760\times 1.5\times 10^{-3}\times 290}{273\times 270} = 1.682\times 10^{-3}\ \text{m}$$

(d) State any three assumptions made in kinetic theory of gases. (3 marks)

- Molecules of a given gas are identical
- Collisions between particles and the container are perfectly elastic and therefore energy and momentum are conserved.

- Molecules do not exert any force on other molecules except during collisions. The influence of gravity on the particles is also ignored.
- The number of particles is high enough for statistics to be meaningfully applied.
- The size of molecules is negligible compared to their separation.
- The laws of Newtonian (classical) mechanics apply (as opposed to quantum mechanics).

END