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Kenya Certificate of Secondary Education
2020 Physics paper 1

NOTE: Questions have been re-arranged with questions from similar or related topics grouped together.

1. The diameter of a wire was measured as 2.43 mm. Name the instrument that was used to measure this diameter (1 mark)

Micro-meter screw gauge.

2) a) Define cohesive forces. (1 mark)

Cohesive force is the force of attraction between identical (or similar) molecules.

b). Figure 1 shows a capillary tube dipped in mercury in a beaker.

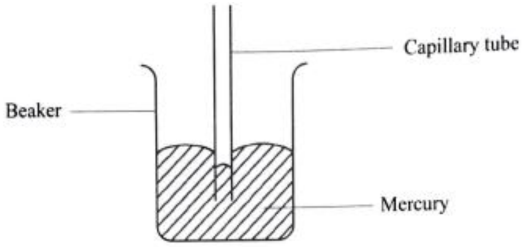


Figure 1

State with a reason the observation that would be made on the level of mercury in the capillary tube if the temperature of mercury is increased. (2 marks)

Heat reduces the cohesive force. The depression of mercury in the capillary tube would therefore reduce (mercury level rises).

3 a). Figure 2 shows the scale of a measuring instrument.

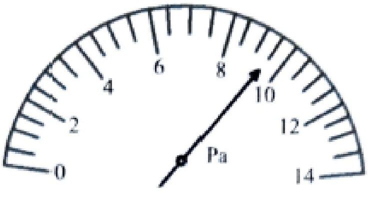


Figure 2

(i) State the physical quantity measured by this instrument. (1 mark)
pressure

Pressure because the units of measurement are Pascal (Pa).

(ii) Determine the reading indicated. (1 mark)

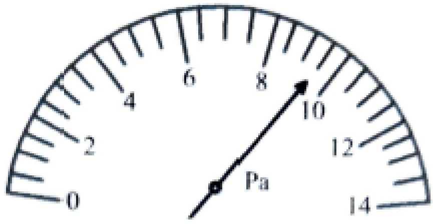


Figure 2

$$4\ div = 2\ pa$$

$$3\ div = \frac{2}{4} \times 3 = 1.5$$

$$Reading\ = 8 + 1.5 = 9.5\ Pa$$

b) Figure 5 shows a roof of a house over which wind is blowing.

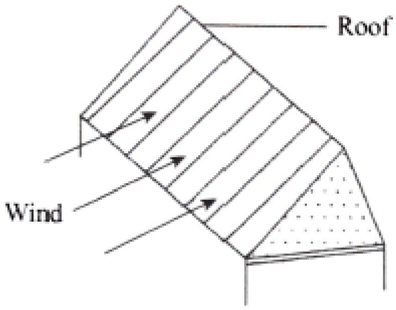


Figure 5

It was observed that, when the speed of the wind increased, the roof was blown off. Explain this observation. (2 marks)

The speed of air particles above the roof increases creating a region of low pressure in line with Bernoulli's principle. The higher pressure indoors forces the roof off the building.

c) (i) Figure 9 shows a setup used by a student to investigate how a siphon works.

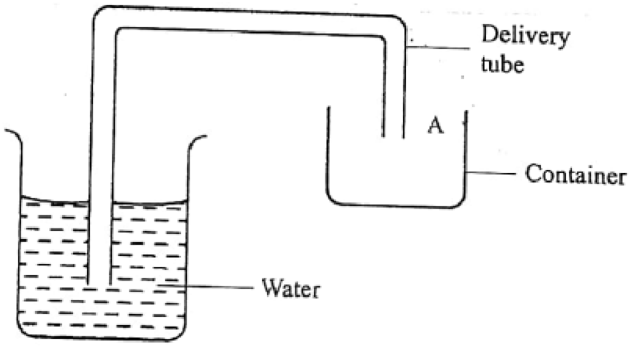


Figure 9

(ii) State what would be observed when the student sucks the tube at point A and releases it. (2 marks)

Liquid moves up the tube but moves back down when the student stops blowing (the liquid does not flow out)

(ii) Explain the observation in. (2 marks)

The outlet is above the inlet hence no pressure difference. The atmospheric pressure is not sufficient to move liquid over the bend.

d) Figure 10 shows a test-tube inverted and floating inside a plastic bottle containing some water. The bottle is then sealed.

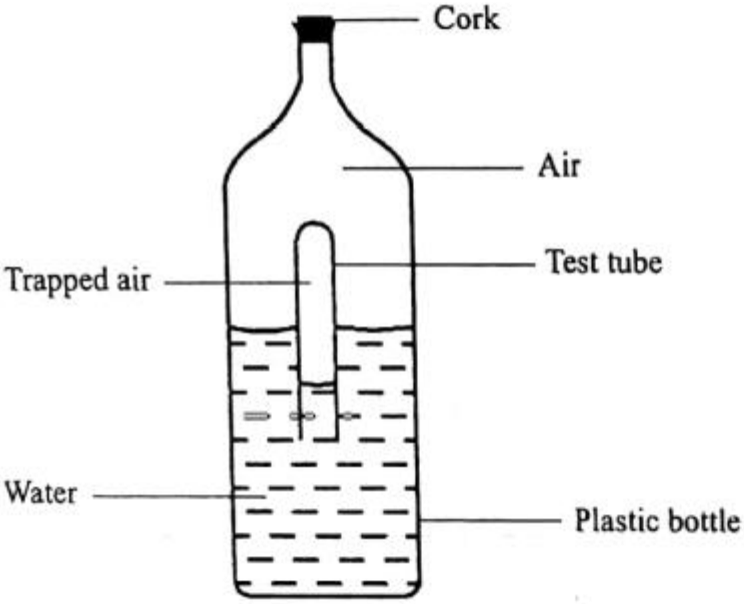


Figure 10

It is observed that when the sides of the bottle are squeezed, the test-rube sinks. Explain this observation. (3 marks)

When the sides are squeezed, air pressure inside the bottle increases. The high air pressure forces the liquid up the test tube. Test tube gains weight and therefore sinks.

(e) A metallic box weighs 188N and measures 10cm by 30 cm by 8 cm. Determine the maximum pressure it can exert when lying on one of its surfaces. (3 marks)

From the definition of pressure;

$Pressure = \frac{Force}{Area}$

Pressure is maximum when the box is lying on its smallest side (side with least cross-sectional area).

$Least\ area = 0.1 \times 0.08 = 0.008$

$Max\ Pressure = \frac{188}{0.008} = 23{,}500\ N/m^2$

4. An object placed on the surface of water in a beaker starts to sink immediately. It is observed that it stops sinking when half of its volume is below the water surface. State the reason for this observation. (1 mark)

Initially, weight of the body is greater than the upthrust (weight of the liquid displaced). As more of the body goes under the liquid, more liquid is displaced hence upthrust increases. The body come to rest when upthrust becomes equal to the weight.

5. Figure 3 shows a traditional stool resting on a level surface.

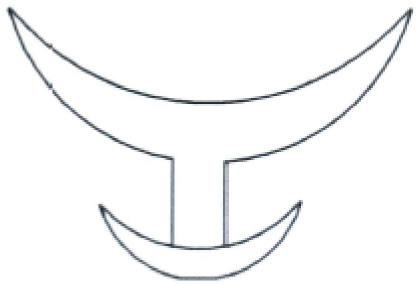


Figure 3

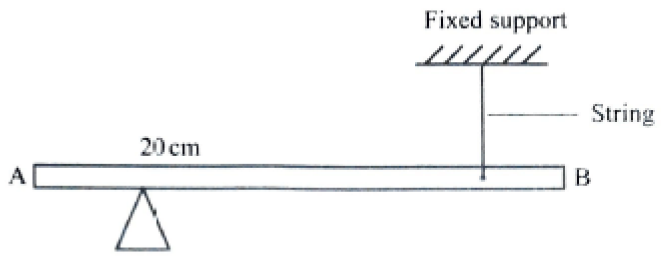
(a) Identify its state of equilibrium. (1 mark)

Stable equilibrium

(b) State the reason for the answer in (a). (1 mark)

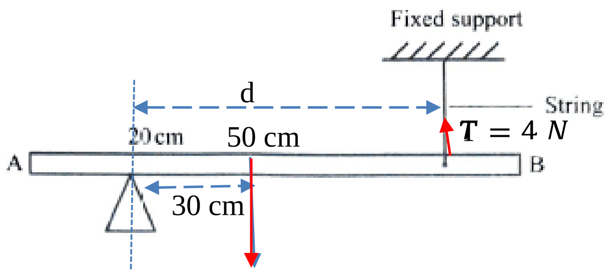
A small amount of force tilts the object but when withdrawn, the object goes back to its initial equilibrium position.

(c) Figure 4 shows a uniform rod AB of length 1m and weight 8N pivoted at 20 cm from one end. It is balanced by supporting it with a string attached to a fixed support.



The tension in the string is 4N. Determine the position of the string from end A. (3 marks)

Weight (W) acts downwards at the center (50 cm mark of the meter rule), a distance 30 cm from pivot and is responsible for clockwise moments. Tension (T), say at a distance d from the pivot acts upwards and is responsible for the anticlockwise moments.



$Clockwise\ moments = anticlockwise\ moments$

$8 \times 30 = 4 \times d$

$d = \frac{8 \times 30}{4} = 60\ cm$

60 cm from pivot (80 cm mark on the meter-rule.

6. (a)Figure 6 shows the velocity-time graph of the motion of a stone thrown vertically upwards.

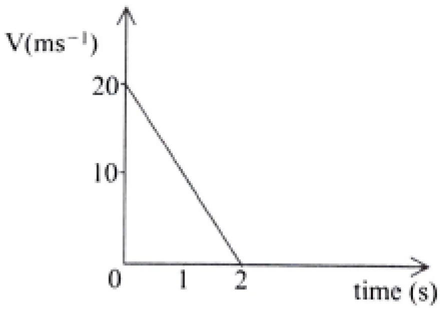


Figure 6

From the graph, determine the maximum height reached by the stone. (3 marks)

Initial velocity $u = 20\ m/s$

At max height s, final velocity $v = 0$

$v^2 = u^2 - 2gs$

$0 = u^2 - 2gs$

$u^2 = 2gs$

$s = \frac{u^2}{2g} = \frac{20^2}{2 \times 10} = 20\ m$

(b). Figure 7 shows a box placed on a weighing balance. The balance is placed on the floor of a lift.

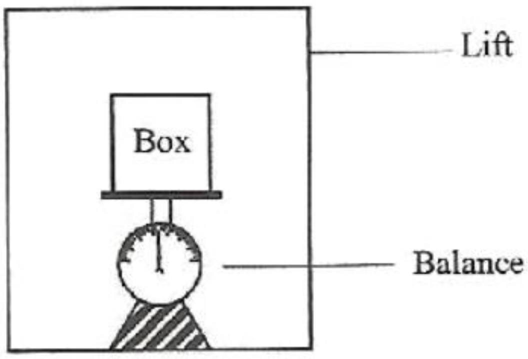


Figure 7

State what would be observed on the reading of the balance when the:

(i) lift is accelerating downwards (1 mark)

The effective weight is lower than the actual weight. The balance indicates a lower value

(ii) lift moves downwards with a uniform velocity (1 mark)

The effective weight is equal to the actual weight. Balance indicates the actual weight.

(iii) lift is accelerating upwards (1 mark)

The effective weight is greater than the actual weight. The balance reads a higher value.

7.(a) Figure 8 shows a bucket filled with water and tied to one end of a string which is used to whirl it in a vertical circular path with a uniform speed v.

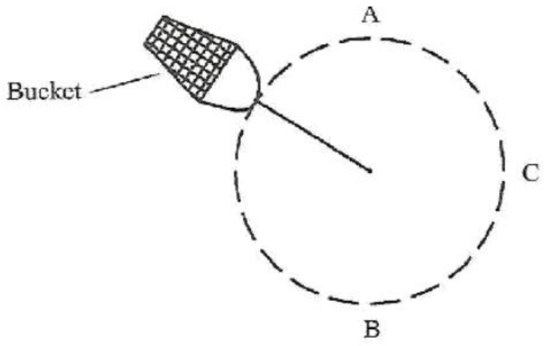


Figure 8

(i) State two forces acting on the bucket at any instant. (2 marks)

Forces on object:

- Weight
- Tension

(ii) Explain why the tension is lowest at point A. (2 marks)

The weight and tension are in the same direction. Weight counters some of the tension hence the reduction in tension.

(iii) The speed of the bucket is gradually reduced. Explain what is likely to be observed when the bucket is at point A. (2 marks)

When the bucket is rotating at high velocity, the centripetal force F_c (force towards the center is equal to centrifugal force F_f (force directed away from the center) in accordance with Newton's third law of motion. It therefore follows that if *m* be the mass of the liquid and v the velocity, then;

$$F_f = F_c = \frac{mv^2}{r}$$

For contents not to spill when the bucket is upside down (at point A),

$$F_f = F_c = \frac{mv^2}{r} \geq mg$$

Where mg is the weight of the bucket contents. As speed v reduces, the centrifugal force reduces. When;

$$F_f = F_c = \frac{mv^2}{r} < mg$$

the spillage occurs

(b) A stone of mass 40g is whirled at the end of a string in a horizontal circular path at (b) speed of $12ms^{-1}$. (The string and the stone are in the same horizontal plane). If the string is 1m long, determine the tension in the string. (3 marks)

$$F = F_c = \frac{mv^2}{r}$$

The radius of the circular path is equal to the length of the string hence;

$$F = F_c = \frac{0.04 \times 12^2}{1} = 5.76\ N$$

8. Two similar containers A and B are filled with equal masses of water at the same temperature. Container A is made of copper while container B is made of glass. Heat is then supplied to the containers at the same rate. State with a reason, the container in which water boils first. (2 marks)

Good conductors like most metals have a large coefficient of thermal conductivity while poor conductors such as glass and wood have a smaller coefficient of thermal conductivity.

Copper is a good conductor of heat relative to glass hence the water in A boil first

9) State the kinetic theory of gases. (1 mark)

Gas molecules are in constant random motion, colliding with each other and with the walls of the container they are placed in.

10.(a) Figure 11 shows a setup that can be used to verify Charles' Law.

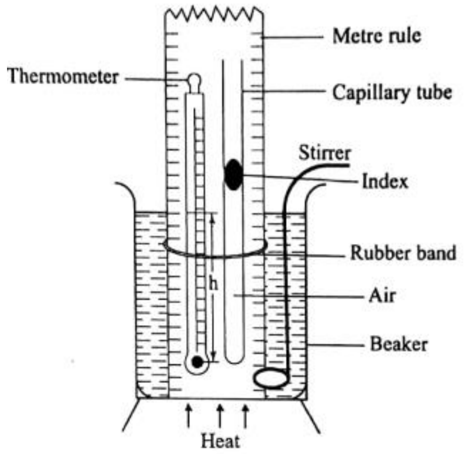


Figure 11

(i) Explain how the:

(I) temperature of air in the tube is measured;(2 marks)

NOTE: According to Charles law, volume of a fixed mass of gas is directly proportional to the temperature, pressure constant.

$V \infty T$

For a column of air, $V = Al$

Where *A* is the cross-sectional area and *l* the length of the air column. If the cross-sectional area is kept constant, then Charles law can be expressed as;

$l \infty T$

To the question:

By measuring temperature of water since the temperature of water equals the temperature of the air trapped in the test-tube.

(II) volume of air in the tube is measured. (2 marks)

By measuring the length of the air column trapped in the test-tube since the cross-sectional area is constant.

(ii) State how the pressure is kept constant during the experiment.

The test tube is kept open and the index is free to move up and down.

(iii) State how the measurements in (i) can be used to verify Charles' law. (3 marks)

The test-tube is dipped in cold water and after the index has stabilized the temperature of air *T* (which is equal to the temperature water) and the corresponding position of the index *L* obtained. The water is gradually heated while being continuously stirred and the temperature of air in the tube, *T* and the corresponding position of the index *L* obtained. This is repeated for different values of temperature. A graph of *L* against *T* is plotted. A straight line inclined to the horizontal proves Charles' law.

(iv) State one precaution that must be taken to ensure that the temperature of air is accurately measured. (1 mark)

Water should be continuously stirred

(b) A fixed mass of gas initially at 20°C is heated at constant pressure until its volume doubles. Determine its final temperature. (4 marks)

$V \infty T$

$$\frac{V}{T} = constant$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Temperature should be in Kelvin hence;

$T_1 = 273 + 20 = 293\ K$ when $V_1 = V_1$

$T_2 = T_2$ when $V_2 = 2V_1$

$$\frac{V_1}{293} = \frac{2V_1}{T_2}$$

$$\frac{1}{293} = \frac{2}{T_2}$$

$T_2 = 293 \times 2 = 586\ K$

11.(a) State the meaning of the term matter (1 mark)

Matter refers to anything that has mass and occupies space.

(b) It's observed that when a liquid is heated its volume increases. Explain this observation using the kinetic theory of matter (3marks)

According to the kinetic theory, matter is made up of particles that either in constant translatory motion (liquids and gases) or vibratory motion (solids). The particles therefore possess kinetic energy. For a liquid, an increase in temperature leads to an increase in the kinetic energy of the molecules. The molecules consequently drift further apart leading to an increase in volume.

(c) Figure 15 shows a setup used to study Brownian motion in liquids.

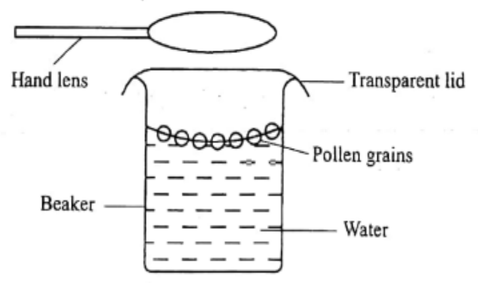


Figure 15

(i) State the function of the hand lens. (1 mark)

To magnify the small grains that make up pollen grain particles.

(ii) State what is observed on the pollen grains. (1 mark)

They move about randomly, colliding with each other in the process

(iii) Explain the observation made in (ii). (2 marks)

Liquid molecules undergo Brownian motion which means that they move about randomly colliding with each other. As the water molecules in Figure 15 move about, they randomly collide with the minute pole grain particles making them to also start moving randomly.

(iv) State and explain what would be observed on the pollen grains if the water is heated. (3 marks)

In accordance with kinetic theory, an increase in temperature leads to an increase in kinetic energy of the molecules hence increased motion. The pollen grain would therefore be observed to move faster.

12.(a) Figure 12 shows a simple machine.

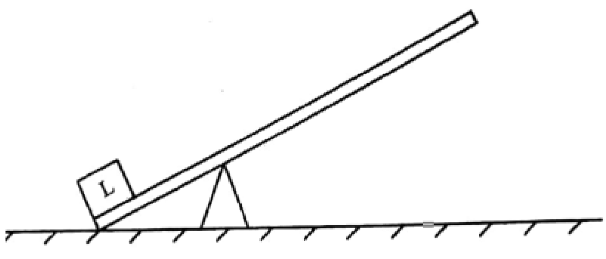
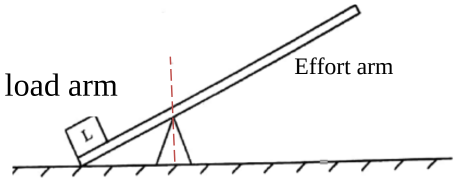


Figure 12

On the same figure, mark and label the following parts:

(i) Effort and load arms (2 mark)



(b) Figure 13 shows a pulley system used to raise a mass of 5 kg through a height of 2 m when a force of 60N is applied. (Acceleration due to gravity g is $10ms^{-2}$)

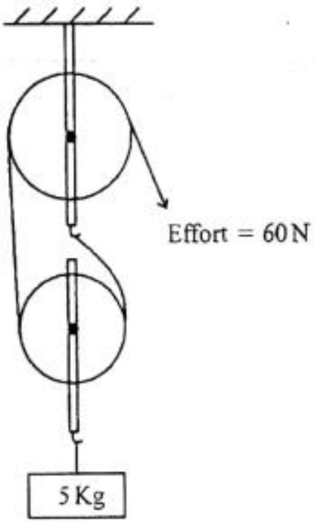


Figure 13

Determine the:

(i) distance moved by the effort;(1 mark)

$$VR = \frac{d_E}{d_L}$$

VR=number of ropes supporting the load =2

5 kg through a height of 2 m when a force of 60N is applied

$$2 = \frac{d_E}{2}$$

$$d_E = 2 \times 2 = 4\, m$$

(ii) work done on the load;(3 marks)

$$W_{out} = Ld_L$$

$$W_{out} = 5 \times 10 \times 2 = 100\, J$$

(iii) potential energy gained by the load (g = 10 Nkg^{-1}). (1 mark)

$$PE = work\ done\ on\ the\ load = 100\, J$$

13. (a) Figure 14 shows a setup that can be used to determine the specific latent heat of vaporisation of water. A beaker containing some water was placed on a weighing balance and an immersion heater rated 500 W immersed in the water.

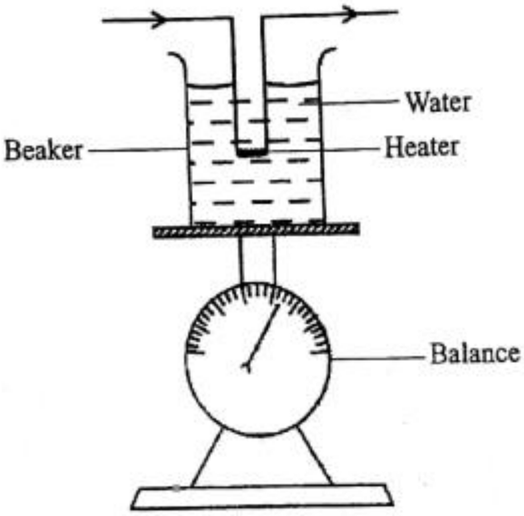


Figure 14

The water was then heated until it boiled. When the water started boiling, the initial reading on balance was noted and the stop watch started immediately. The final reading on the balance was then noted after a time t seconds.

(i) State how the mass of steam can be measured using this setup. (1 mark)

Mass of steam (m) produced equals the difference between final (m_2) and initial (m_1) balance readings. That is;

$m = m_2 - m_1$

(ii) Write down an expression for the heat supplied by the heater. (1 mark)

$E = Pt$

$E = 500t$

(iii) Determine the specific latent heat of vaporisation of water. (3 marks)

the heat supplied by the heater (electrical energy, E) is used to turn water into steam. If no heat is lost, then;

$E = mL$

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

$L = \frac{500t}{m}$

b) It is observed that when methylated spirit is poured on the palm, the palm feels colder as it dries up. Explain this observation. (2 marks)

Methylated spirit has a relatively low specific heat capacity and latent heat of vaporization. Heat drawn from the palm is used to vaporize the methylated spirit hence the palm feels cold.

END