UGANDA MARTYRS' HIGH SCHOOL
S.3 HOLIDAY WORK TERM 1 2020
PHYSICS

INSTRUCTIONS:
Attempt ALL questions.
These values of physical quantities may be useful to you.

Acceleration due to gravity	$= 10ms^{-2}$
Specific heat capacity of water	$= 4200\ Jkg^{-1}\ K^{-1}$
Specific heat capacity of ice	$= 2100\ Jkg^{-1}\ k^{-1}$
Specific latent heat of ice	$=340{,}000\ J\ kg^{-1}$
Specific latent heat of steam	$= 2{,}260{,}000\ Jkg^{-1}$
Speed of light in vacuum	$= 3.0 \times 108\ ms^{-1}$
Speed of sound in air	$= 340\ ms^{-1}$
Density of water	$= 1000kgm^{-3}$

1. (a) Define surface tension

   (b) Two capillary tubes of same radii are dipped in a beaker of water and the other in a beaker of mercury
   (i) Draw the levels of liquids in the two tubes
   (ii) Explain your observation in (b) (i) above

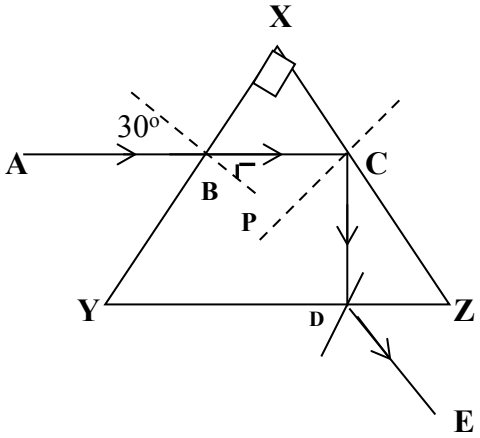
   (c) An oil drop of volume $10^{-9}\ m^3$ spreads out on water to form a film of area $0.2m^2$. Estimate the length of an oil molecule from this information. What assumption have you made in your calculation?
   (d) Explain how a gas exerts a pressure on the walls of its containers.
   (e) Outline very briefly two situations in which the phenomenon of surface tension is exhibited.

2. (a) State Archimedes principle and the law of flotation.
   (b) A metal cube weighs 1.0N in air and 0.8N when totally immersed in water. Calculate
   (i) the volume of the cube
   (ii) its density

   (c) Describe an experiment to determine the relative density of a liquid using Archimedes principle.
   (d) Explain how a submarine can float on the surface of the sea though it is made of steel.

3. (a) State the laws of refraction of light

(b)



The figure above shows the path of a ray AB incident on a glass prism XYZ with angles of 90°, 45°, 45° and finally emerging along DE.

(i) Explain the statement "The refractive index of the glass is 1.5"
(ii) Why does the ray AC not emerge into the air at C?
(iii) Why does the ray De refract away from the normal at d to the side YZ?
(iv) When the angle of incidence the ray AB makes with the normal at point B is 30°. What is the value of angle r and angle BCP.

(c) Briefly explain how a mirage occurs during hot sunny days
(d) State two uses of total internal reflection

4. (a) explain the meaning of
   (i) echo
   (ii) Resonance

(b) Describe in detail how echo can be used to determine the speed of sound in air
(c) A radio station broadcasts on a frequency of 200,000Hz and the wavelength of its signal is 1500m. Calculate
(i) the speed of radio waves in ms^{-1}
(ii) the wavelength of the signal of another
Station that broadcasts on a frequency of 1,250,000Hz

(d) State the factors that affect the velocity of sound in air

5. (a) (i) Distinguish between elastic and inelastic collision.
   (ii) A truck of mass 16,000 kg travelling at 24 kmh^{-1} collides with air on coming 20,000 kg truck travelling at 16 kmh^{-1}. If the 16,000 kg truck rebounds at 5kmh^{-1}, what would be the velocity and direction of the other truck (3 marks)

(b) A car moving at 25 ms^{-1} is uniformly retarded until it stops within a distance of 200m. Calculate its uniform retardation (3 marks)

(c) (i) Give two reasons why the efficiency of any practical machine is always less than 100% (2 marks)

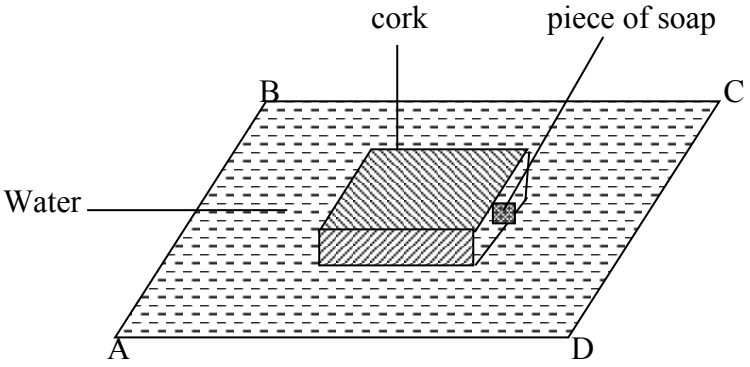
(ii) Draw a block and tackle pulley system with velocity ratio 5 (1 mark)

(iii) If a force of 150N is used to raise a mass of 45kg, calculate the efficiency of the pulley system. (4 marks)

(iv) State two ways in which the efficiency can be increased (2 marks)

6. (a) Define the following terms:
   (i) cohesion
   (ii) Adhesion
   (iii) Capillarity (3 marks)

(b) The diagram below shows the surface of water in a rectangular trough ABCD. A piece of cork to which a slice of soap is attached is lowered on the water surface as shown



(i) State the forces acting on the cork (2 marks)
(ii) In what direction will the cork move (1 mark)
(iii) Explain what causes the motion (2 marks)

(c) (i) What is meant by a **ductile material**? (1 mark)
(ii) State two properties of concrete that make it good for construction (2 marks)

(d) (i) State Hooke's law
(ii) An unloaded wire has length 1.5m. If a load of 400N is supported by the wire, its length becomes 2.5m. What force will cause its length to increase to 1.75m? (4 marks)

7. (a) State the laws of reflection of light (2 marks)
(b) (i) An object of height 10cm is placed 5cm from a concave mirror. If a virtual image produced is three times as long as the object, determine by graphical means, the focal length of the mirrors (3 marks)

(ii) State two uses of concave mirrors (2 marks)

(c) (i) Define the terms critical angle and total internal reflection (4 mark)
(ii) State the conditions for total internal reflection to occur (2 marks)

(i) Calculate the critical angle or air-glass interface if refractive index of glass is 1.5 (2 marks)

(d) Briefly explain how a mirage is formed (3 marks)

8. (a) State the principle of moments

(b) A uniform metre rule of weight 1N is pivoted on a wedge 5cm away from one end and suspended by a string 30cm from the other end

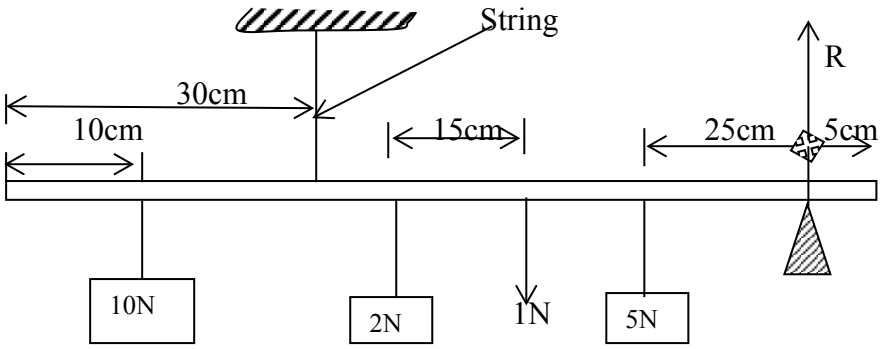


Fig 1

If the metre rule is in equilibrium when weights of 10N, 2N and 5N are attached to it as shown in figure 1, calculate the:

(i) tension in the string (4 marks)

(ii) normal reaction, R at the wedge (1 mark)

(c) Describe, with the aid of a diagram, an experiment to locate the centre of gravity of an irregular lamina (5 marks)

(d) (i) State Hooke's law (1 mark)

(ii) A weight of 4.0N stretches an elastic spring by 0.02m. What weight would stretch the same spring by 8cm? (4 marks)

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

(b) (i) State how the pressure in a liquid depends on the depth of the liquid. (1 mark)

(ii) Describe an experiment to verify your statement in (b) (i) above (4 marks)

(c) Find the length of the mercury column in a simple barometer when the barometer is raised from sea level to a height of 2.5 km given that the average density of air is $1.2 kgm^{-3}$ and the density of mercury is $13600\ kgm^{-3}$.
Atmospheric pressure at sea level is 76cm of mercury. (4 marks)

(d) (i) State Archimedes' principle (1 mark)

(ii) The reading of a spring balance is 7.0N when a solid metal ball is suspended in air. The density of the metal is $9.75 g/cm^3$ and that of water is $1000 kg/m^3$. The ball is lowered into the water in an overflow vessel until it is completely immersed. Find the volume, in cm^3, of water which overflows. Also find the reading of the spring balance in Newtons when the ball is completely immersed in the water. (4 marks)

10. (a) State the laws of refraction of light (2 marks)
(b) A light ray is incident at various angles at an air-glass boundary. The corresponding angles of incidence and refraction are given below

Angle of incidence **i** (degrees)	0	20	40	60	80
Angle of refraction **r** (degrees)	0	13	25	35	41

(i) Using the information above draw a graph of sin i (along vertical axis) against sin r (along horizontal axis) (4 marks)
(ii) Use your graph to determine the refractive index of glass (2 marks)

(c) (i) State one property of light that a pinhole camera illustrates (1 mark)
(ii) State two differences between a pinhole camera and a lens camera (2 marks)

(d) With the aid of diagrams explain how total internal reflection occurs (5 marks)

11. (a) State the difference between transverse and longitudinal waves (1 mark)
(b) Define the following terms and state their units; amplitude, frequency and wavelength (3 mks)
(c) (i) Define the term resonance (1 mark)
(ii) Give two cases of resonance that you know of. (2 marks)

(d) (i) Describe an experiment to determine the speed of sound in air by resonance tube method (5 marks)

(ii) A resonance tube and a turning fork of frequency 220 Hz were used to determine the velocity of sound in air. The first resonance length was 18.75 cm and the second resonance length was 93.75 cm. Determine the velocity of sound in air. (4 marks)

12. (a) (i) State the law of electrostatics (2 marks)
(ii) Draw the electric field pattern for two parallel plates with opposite charges at a small distance apart. (2 marks)

(b) Explain how a gold leaf electroscope can be charged negatively by induction (5 marks)

(c) (i) With the aid of a diagram briefly describe how an a.c. generator operates. (5 marks)
(ii) How can an a.c. generator be converted to a d.c generator? (1 mark)

(d) State two advantages of a.c. over d.c (2 marks)