P510/1
PHYSICS
Paper 1
Nov 2015
2½ HOURS

Uganda Advanced Certificate of Education
S.5 PHYSICS
Paper 1
2hours 30minutes

INSTRUCTIONS TO CANDIDATES:
Attempt four questions but not more than two from each of the sections A and B.
Non-programmable scientific electronic calculators may be used

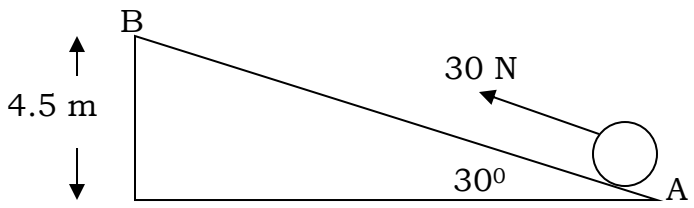
The following values of physical constants may be used.

Acceleration due to gravity	g	=	$9.8 ms^{-2}$
Specific heat capacity of water		=	$4200 Jkg^{-1}K^{-1}$
Specific heat capacity of copper		=	$400 Jkg^{-1}K^{-1}$
Velocity of light	C	=	$3.0 \times 10^{8} ms^{-1}$
Avogadro's number	N_A	=	6.02×10^{23}

SECTION A

1. (a) Define the term work and state its S.I unit. *(01 marks)*

(b) A particle of mass 3.0kg is pulled by a constant force of 30N along an inclined plane AB with height 4.5 m inclined at an angle 30o to the horizontal as shown below.



(i) Calculate the work done by the force to move the particle from A to B. *(03 marks)*

(ii) The acceleration of the particle. *(03 marks)*

(c) (i) State Newton's laws of motion. *(03 marks)*

(ii) Define the term impulse. *(01 mark)*

(d) Explain why a heavy truck takes longer to brake than a light truck when both are moving with the same velocity. *(03 marks)*

(e) (i) What is meant by the term perfectly inelastic collision? *(01 mark)*

(ii) A bullet of mass 50g is fired from a gunat 250 ms^{-1} and hits ablock of wood of mass 2kg which is suspended by a light vertical string 2m long. Calculate the maximum angle the string the string makes with the vertical if the bullet got embedded in the wood after collision. *(04marks)*

(iii) State two (2) factors on which the angle of swing depends on. *(02 marks)*

2(a) (i) Derive an expression centripetal acceleration of a body moving in a circular path of radius r. *(03 marks)*

(ii) Explain why it is necessary for a bicycle rider moving around a circular path to lean towards the center of the path. *(03 marks)*

(iii) Derive the expression for the angle inclination to the horizontal necessary for a rider moving a round a circular track of radius **r** without skidding at a speed **v**, in terms of **g**, **r**, and **v**. *(04 marks)*

(ii) A uniform beam AB of mass 4.00kg and length 3m is pivoted at a point P and kept in equilibrium by two masses of 20.75kg and 1.50kg at points A and B respectively. What is the distance of P from A? *(04 marks)*

(ii) Describe how the centre of gravity of an irregular piece of card board may be determined. *(4 marks)*

(b) (i) State any two conditions necessary for a rigid body to be in equilibrium. *(02 marks)*

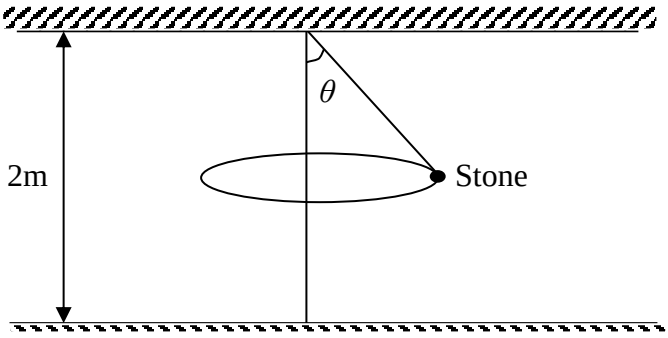
3. (a) (i) Define moment of a force and state its units. *(02 marks)*

(ii) Outline any four applications of principle of moments. *(02 marks)*

(d) The period T of oscillation of a simple pendulum depends on length l, of the string and acceleration due to gravity, g as shown in the formula $T = 2\pi \sqrt{\frac{l}{g}}$ Show that the equation is dimensionally consistent. *(04 marks)*

c. Explain any two applications of dimensions of a physical quantity. *(02 marks)*

(b) A stone of mass 0.5kg is tied to one end of a string 1m long. The point of suspension of the string is 2m above the ground. The stone is whirled in a horizontal circle with increasing angular velocity.



The string will break when the tension in it is 12.5N and angle θ is a maximum.

(i) Calculate the maximum value of θ *(03 marks)*

(ii) How far from point **G** will the stone hit the ground? *(04 marks)*

(iii) What will be the velocity of the stone when it hits the ground? *(03 marks)*

SECTION B

4 a.i) Define specific latent heat of vaporization. *(01 mark)*

ii) Explain why specific latent heat of vaporization is always greater than specific latent heat of fusion for the same substance using the molecular theory. *(02 marks)*

b) Describe an experiment to determine the specific latent heat of vaporization of water using method of mixtures. *(06 marks)*

c) A calorimeter of negligible heat capacity is filled with 1.5 kg of molten substance. The rate of cooling just before solidification begins is 8.4 Ks^{-1} and complete solidification takes 25 minutes. Given that the total heat lost in the process was 236100J

(i) Sketch the cooling curve. *(01 mark)*

(ii) If the specific latent heat of fusion of the substance is 31400JKg^{-1}, calculate its specific heat capacity. *(04 marks)*

d) (i) State Newton's law of cooling. *(01 mark)*

(ii) Describe an experiment to verify Newton's law of cooling. *(05 marks)*

5. (a) (i) What is meant by a thermometric property of a substance? *(01 mark)*

(ii) Give any two examples of these properties. *(01 mark)*

(i) Define the term fixed point. *(01 mark)*

(b) (i) Define the scale of temperature on a constant volume gas thermometer. *(01 mark)*

(ii) With the aid of a labeled diagram, describe the mode of operation of a practical constant volume gas thermometer. *(04 marks)*

(iii) State the corrections necessary in the thermometer in b(i) above. *(02 marks)*

(c) Explain using the kinetic theory why temperature remains constant during change of phase. *(03 marks)*

(d) State any two effects of heat on substances. *(02 marks)*

(e) (i) Explain briefly what is meant by absolute zero temperature. *(02 marks)*

(ii) A piece of material of mass 500g at a temperature of 90^0C is carefully dropped in a copper calorimeter containing 450g of water at 25^0C. The set-up reaches a temperature of 35^0C .

Ignoring any heat losses calculate the specific heat capacity of the material. *(03 marks)*

6. (a) (i) State assumptions made in the derivation of the kinetic theory expression for the pressure of an ideal gas? (04 marks)

(ii) Show that the pressure **P** exerted by an ideal gas of density **ρ** is given by $\mathbf{P=\frac{1}{3}\rho c^2}$ where **c** is the mean square speed of the gas molecules. *(07marks)*

(ii) State any two ways in which real gases differ from ideal gases. *(02 marks)*

(b) A cylinder contains 0.25 m^3 of a gas atapressure of $2.0x10^6$ Pa and a temperature of 17°C. Calculate

(i) the number of moles of the gas in the cylinder. *(02 marks)*

(ii) the pressure that the gas would exert at a temperature of 37 oC if its volume is kept constant.Distinguish between saturated and unsaturated vapours. *(02 marks)*

(c) Draw sketch graphs to show, for a saturated vapour, the variation of:

(i) Pressure with volume, temperature remaining constant. *(01 mark)*

(ii)Explain the shape of the curve in (i) above, using the kinetic Theory of matter. *(02 marks)*

END