S.6 PHYSICS PAPER I HOLIDAY WORK

Physics Paper 1

Time allowed : 2½hrs

*Attempt **five questions**, including atleast one but not more than **two** from each of sections A ,B and C.*

Where necessary assume:

Acceleration due to gravity, g	=	$9.81ms^{-2}$
Electron charge ,e	=	$1.6 \times 10^{-19}C$
Stefan's constant, δ	=	$5.7 \times 10^{-8}Wm^{-2}T^{-4}$
Speed of light in vacuum, c	=	$3 \times 10^{8}ms^{-1}$
Universal gas constant, R	=	$8.314Jmol^{-1}k^{-1}$
Specific heat capacity of water	=	$4.2 \times 10^{3}Jkg^{-1}k^{-1}$
Planck's constant, h	=	$6.63 \times 10^{-34}Js$
Charge to mass ratio , e/m	=	$1.8 \times 10^{11}Ckg^{-1}$
Avagadro's number, NA	=	$6.02 \times 10^{23}Jmol^{-1}$
Electron mass	=	$9.1 \times 10^{-31}kg$

1 a. i) State the laws of *solid friction*. (03)

ii) Using the molecular theory explain the laws stated in a(i). (03)

b) Describe an experiment to determine the coefficient of static friction for an interface between a rectangular block of wood and a plane surface. (04)

c) i) State the difference between conservative and non conservative forces, giving one example of each. (03)

ii) State the *work-energy theorem*. (01)

iii) A block of mass 6.0kg is projected with a velocity of $12ms^{-1}$ up to a rough plane inclined

at 45° to the horizontal. If it travels 5.0m up the plane, find the frictional force. (04)

d) Explain the effect of temperature on the viscosity of a liquid. (02)

2 a) Define *thermal conductivity* of a substance and state its S.I unit. (02)

b) Describe an experiment to determine the thermal conductivity of copper. (06)

c) Two ends of a metal bar of length 1.0m are perfectly lagged up to 20cm from either end. The ends of the bar are maintained at 100°c and 0°c respectively.

i) Sketch a graph of temperature against distance along the bar. (02)

ii) Explain the features of the graph in c(i) above. (03)

d) A double-glazed glass window of height 1.0m and 1.5m contains two single glass panes each of thickness 4.0mm separated by an air gap of thickness 2.0mm. Calculate the rate at which heat is conducted through the window if the temperature difference between the external surfaces of glass is 10°c.

[Thermal conductivities of glass and air are $0.72Wm^{-1}k^{-1}$ and $0.025Wm^{-1}k^{-1}$ respectively] (06)

e) State any one factor that determines the rate of loss heat from a body. (01)

3. a(i) Define *latent heat*. (01)

ii) Explain the significance of latent heat in the regulation of body temperature. (03)

b(i) Using the kinetic theory, explain boiling of a liquid. (03)

ii) Describe how you would determine the specific latent heat of vaporization of water by the method of mixtures. (06)

iii) Explain why latent heat of vaporization is always greater than that of fusion. (03)

c) In an experiment to determine the specific latent heat of vaporization a liquid using the continuous flow calorimeter, the following results were obtained.

Voltage V/v	Current I/A	Mass collected in 600s/g
7.4	2.6	5.8
10.0	3.6	11.3

Calculate the power of the heater required to evaporate 3.0g of water in 2minutes.

(04).

4. a(i) Define *linear momentum*. (01)

. (ii) State the law of *conservation of momentum*.
(01)

b) A body of mass M_1 and velocity U_1 collides head on with a body of mass M_2 and velocity U_2 in the same direction as U_1. Use Newton's laws of motion to show that total momentum of the system is conserved.
(05)

c) A bullet of mass 20g is fired horizontally at $150ms^{-1}$ at a wooden block of mass 2.0kg resting on a smooth horizontal plane. The bullet passes through the block and emerges undeviated with a velocity of $90ms^{-1}$. Calculate:

i) the velocity acquired by the block.
(03)

ii) the total kinetic energy before and after penetration and account for their difference. (04)

b) A car of mass $1500\,kg$ rolls from rest down a road inclined to the horizontal at an angle of 35^0, through $50\,m$. The car collides with another car of identical mass at the bottom of the incline. If the two vehicles interlock on collision, and the coefficient of kinetic friction is $0.20,$ find

the common velocity of the vehicles.
(06)

5 a. i) State the laws of *solid friction*. (03)

ii) Using the molecular theory explain the laws stated in a(i).
(03)

b) Describe an experiment to determine the coefficient of static friction for an interface between a rectangular block of wood and a plane surface.
(04)

c) i) State the difference between *conservative* and non *conservative forces*, giving one example of each.
(03)

ii) Define the terms *stress, strain* and *young's ,modulus*. (03)

iii) A body of mass 2kg is suspended from a metallic wire of length 1m, and

diameter 0.02mm whose other end is attached to a fixed support. Given that Young's modulus for the wire is $2\ x\ 10^{11} Nm^{-1}$, Find the extension produced in the wire.
(04)

6 a(i) Define the terms *range* and *time of flight* as applied to projectile motion.
(02)

ii) A shell is fired from a gun with a velocity u at an angle $\propto$ to the horizontal. Show

that the show that the vertical distance y covered is given by

$$y = x\tan \propto\ -\frac{gx^2 sec^2 \propto}{2u^2}.$$ (05)

b) A shell is fired with a velocity of 100ms^{-1} at an angle of 60° to the horizontal from

a gun placed at the top of a hill of vertical height 800m above the ground. Find the

i) time taken by the shell to hit the enemy on the ground assuming the shell is on target

ii) velocity with which the shell hits the target.

(04)

c)

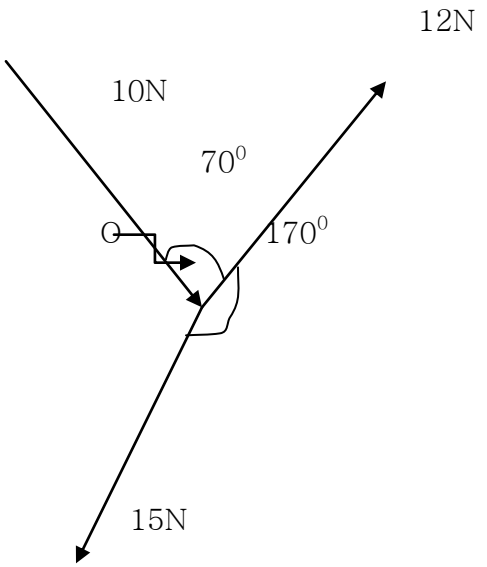
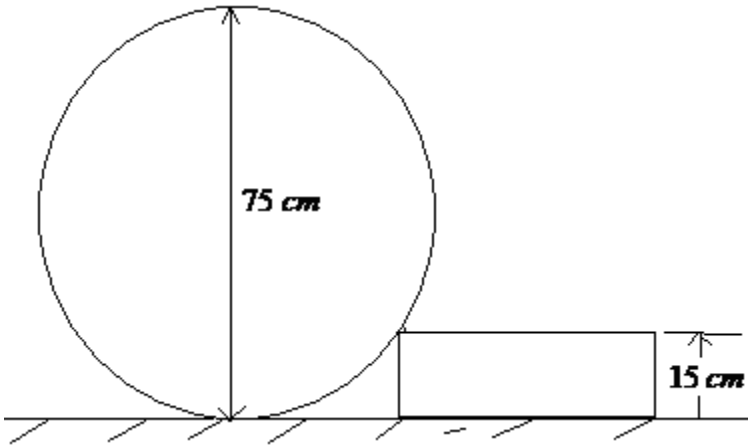


Figure shows a body of mass 5kg acted upon by forces of magnitudes 10N, 12N and 15N. Find the distance covered by body in 5 seconds.

(04)

d(ii) State the conditions under which a body is in equilibrium under the action of coplanar forces. (02)

iii) An oil drum of diameter $75\,cm$ and mass $90\,kg$ rests against a stone as shown below.



Find the least horizontal force applied through the centre of the drum, which will cause the drum to roll up the stone of height $15\,cm$.

(03)

5 a(i) What is meant by *triple point of water*?
(01)

ii) With reference to an electrical resistance thermometer, describe the steps involved in setting up a Kelvin scale of temperature. (03)

b) describe with the aid of a diagram how you would calibrate a thermocouple thermometer. (08)

c) Two identical aluminium calorimeters each have a mass of 30g. One contains 45g of water and the other ethanol. Both calorimeters are heated and then allowed to cool under the same conditions. The time taken for the temperature of water to fall from 60^0c to 50^0c is 270s whereas the corresponding time for ethanol between 60^0c and 50^0c is 179s. Calculate the mean specific heat capacity of ethanol.
[Specific heat capacity of aluminium = $910 Jkg^{-1}k^{-1}$] (04)

d) Explain briefly the how the kinetic theory of matter accounts for existence of the three states of matter. (04)