ST. STEPHEN'S COLLEGE BBAJJA

S.6 PHYSICS PAPER 1

INSTRUCTIONS:

Attempt all questions

Where neccessary assume due

- Accelation due to gravity $9.81ms^{-2}$
- Stefan's constant = $5.67 \times 10^{-8}\ Wm^{-2}\ k^{-4}$
- Avogadro's constant, NA = $6.02\times 10^{23}\ mol^{-1}$

1. (a)(i) what is meant by **uniformly accelerated motion**? (1mark)

(ii) Sketch the speed against time graph for a uniform accelerated body. (1 mark)

iii) A body traveling with a velocity, **u** is accelerated uniformly at a rate of **a** ms^{-2} to a velocity, **v** in a distance, **s**. show that

$$v^2 = u^2 + 2as\,.$$ (4 marks)

(b)(i) Define **projectile motion**. (1 mark)

(ii) With the aid of a velocity- time graph, describe the motion of a body projected vertically upwards. (3marks)

(c) A projectile is fired horizontally from the top a cliff 250m high. The projectile lands 1.52 x 10^3m from the bottom of the cliff.

Find the velocity of the projectile just before it hits the ground. (6 marks)

(d) Describe an experiment to determine the centre of gravity of a plane sheet of material having an irregular shape. (4 marks)

2. (a) State the **laws of friction**. (4 marks)

(b) A block of mass 8kg resting on the floor is given a horizontal velocity of $8ms^{-1}$ and comes to rest in a distance 10m. Find the coefficient of kinetic friction between the block and the floor. (4 marks)

d)(i) Distinguish between **perfect inelastic collision** and **perfect elastic collision**. (2 marks)

(ii) A car of mass 800kg rolls from rest down a road inclined to the horizontal at an angle of 30^0, through 40m. The car collides with another car of mass 1000kg at the bottom of the incline. If the two vehicles interlock on collision, and the coefficient of kinetic friction in 0.20, find the common velocity of the vehicles. (8 marks)

(e) Describe the energy transformations which occur in (d) above.(2 marks)

SECTION B

3. a) Define the thermal conductivity (01 mark)

b) Explain the mechanism of thermal conduction in plastic materials and metallic materials. (04 marks)

c) Describe with the aid of a diagram an experiment to determine thermal condutivity of a cork in form of a thin disc. (06 marks)

d) Two brick walls of thickness 20cm are separated by an air gap of thickness 10cm. The outer faces of the brick walls are maintained at 25^oc and 4^oc respectively

i) Calculate the temperature of the inner surfaces of the walls.(6 marks)

ii) Calculate the heat through the arrangement in 0.5 minutes. (Thermal conductivity of air and brick are $0.02Wm^{-1}k^{-1}$ and $0.6Wm^{-1}k^{-1}$ respectively) (03 marks)

4. a) What is meant by a black body? (01 mark)

b) Describe how an approximate black body can be realised in practice (02 marks)

c) Draw sketch graphs to show the variation of relative intensity of black body radiation with wave length for three different temperatures. (03 marks)

d) i) State the laws of black body radiation. (2 marks)

ii) The energy intensity recieved by a spherical planet from a star is $1400Wm^{-2}$. The star is of radius 7.0×10^5km and $1.4 \times 10^8 km$ from the planet. Calculate the surface temperature of the star and state any assumption made. (04 marks)

e) A solid copper sphere of radius 5mm and temperature of 150k is placed in an enclosure maintained at a temperature of 290k . Calculate stating assumptions made the initial rate of rise of temperature of the sphere. (Density of copper = 8.93×10^3 kg/m^3, specific heat capacity of copper $400\,Jkg^{-1}k^{-1}$)

f) With the aid of a labelled diagram, describe how a thermo pile can be used to detect Infar red radiation. (03 marks)

SECTION C

5. a) Define the terms half life and decay constant. (02 marks)

b) A radio –active nuclide X decays by emission of an alpha particle and a beta particle to form a nuclide$^{92}_{45}Y$. Find

i) The number of protons and the number of neutrons in a nuclide X.

(02 marks)

ii) The activity of 7.0g of a sample of X if the half-life of X is 3.4 days.

(05 marks)

c) Describe the structure and action of an Ionization chamber. (05 marks)

d) i) What are cathode rays? (01 mark)

ii) An election gun operating at $3 \times 10^3 V$ is used to project electrons into the space between two oppositely charged parallel plates of length 10cm and separation 5cm. Calculate the deflection of the electrons as they emerge from the region between the charged plates when the potential difference is $1.0 \times 10^3\,V$. (05 marks)

6. a) Define

i) Radio – activity (01 mark)

ii) Radio – Isotope (01 mark)

b) i) The half-life of a radio – active substance is 750 hours. If a laboratory assistant keeps 90 kg of the substance in his cup board. What mass will remain after 55 days? (04 marks)

ii) State two uses and hazards of radio – activity. (02 marks)

c) i) Define binding energy of a nuclide. (01 mark)

ii) Sketch a graph showing how binding energy per nucleon varies with mass number. (01 mark)

d) i) Distinguish between nuclear fission and nuclear fusion and account for the energy released. (03 marks)

ii) The nuceus of $^{210}_{84}po$ decays to 206_{pb} by emission of an alpha particle. Determine the binding energy per nucleon if

Mass of$^{210}_{84}po = 210.049\ U$

Mass of$206_{pb} = 206.034\ U$

Mass of alpha particle $= 4.0034\ U$

$1\ \text{U} = 931\ Me\ V$.

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