S.6 PHYSICS PAPER I REVISION QUESTIONS (26th JUNE 2020)

Assume where necessary;

Acceleration due to gravity, g = 9.8 ms^{-2}
Electron charge, *e* = 1.6 x10^{-19} C
Stefan's Boltzmann's constant, σ = 5.7x10^{-8} Wm^{-2} K^{-4}
Speed of light in a vacuum, *c* = 3.0 x $10^{8}$$ms^{-1}$

1. (a) (i) Derive an expression for the tangential speed of a particle describing a circle of radius r at an angular velocity ω. (3)

(ii) A coin is placed on a horizontal turntable at a point 5 cm from the centre of the turntable. If the coefficient of friction between the coin and the turntable is 0.5, find the maximum frequency of the turntable for the coin to remain at the same point. (3)

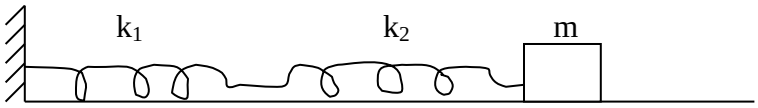
(b) (i) Define gravitational potential. (1)

(ii) Find an expression for the total energy of a satellite of mass m circling the earth of mass M in an orbit of radius R. (3)

(iii) Explain the effect of friction between such a satellite and the atmosphere in which it moves. (4)

(c) (i) Define simple harmonic motion. (1)

(ii) The figure below shows two springs of respective constants k_1 and k_2 joined in series. A mass m resting on a smooth horizontal surface is fixed to one end of the combination.



The other end of the combination is fixed so that the springs are horizontal. If m is now pulled a short distance along the surface and then released, show that it executes simple harmonic motion and find the period. (5)

2 (a) (i) Define thermal conductivity (1)

(ii) Explain the mechanism of heat transfer in metals (3)

(iii) Describe an experiment to determine the thermal conductivity of a metal. (6)

(b) (i) What is a black body? (1)

(ii) Draw sketch graphs to show the variation of relative intensity of black body radiation with wavelength for different temperatures. (2)

(iii) Explain the appearance of a metal ball placed in a dark room when its temperature is progressively raised from room temperature to just below melting. (3)

(c) A heating element in form of a cylinder 30 cm long and 1.5 cm in diameter has an output of 1.8 kW. If its radiation is 85% that of a black body, find its temperature. (4)

3. (a) (i) Distinguish between X-rays and cathode rays. (2)

(ii) In an X-ray tube explain the features adopted for the structure and materials of the anode. (4)

(b) (i) State Bragg's law. (1)

(ii) What is the condition for obtaining many orders of X-ray diffraction. (1)

(iii) A monochromatic beam of X-rays of wavelength 1.187×10^{-10} m is incident on a set of parallel atomic planes of spacing 3.00×10^{-10} m. Determine the maximum order of diffraction. (3)

(c) (i)In photoelectricity, what is meant by the work function? (1)

(ii) Describe how you could determine Planck's constant in a school laboratory. (5)

(iii) When monochromatic light of frequency 6.0×10^{14} Hz falls on a metal surface the stopping potential is 0.6 V while when the same surface is struck by light of frequency 1.0×10^{15} Hz the stopping potential becomes 2.2 V. Determine the work function of the metal. (3)

END