S6 PHYSICS

Paper 1 REVISION QUESTIONS

INSTRUCTIONS:
Attempt ***FIVE****questions*
Assume where necessary.

Acceleration due to gravity, g	= 9.81 ms^{-2}
Mass of the earth	= 5.97×10^{24} kg
Planck's constant, *h*	= 6.6×10^{-34}Js
Stefan's Boltzmann's constant, σ	= 5.7×10^{-8} Wm^{-2} K^{-4}
Wien's displacement constant	= 2.9×10^{-3} m K
Radius of Earth's orbit about the sun	= 1.5×10^{11} m
Radius of the sun	= 7.0×10^{8} m
Specific heat capacity of water	= 4.2×10^{3} J kg^{-1} K^{-1}
Specific latent heat of fusion of water	= 3.34×10^{5} J kg^{-1}
Specific latent heat of vaporization of water	=2.26×10^{6} J kg^{-1}
Specific heat capacity of copper	= 400 J kg^{-1} K^{-1}
Avogadro's number, N_A	= 6.02×10^{23} mol^{-1}
Density of water	= 1000 kg m^{-3}
Gas constant, R	= 8.31 J $mol^{-1}K^{-1}$

SECTION A

1. (a) A particle is projected vertically upwards from the top of a tree and attains the maximum height after 2s. For the first 5s sketch:

(i) thedisplacement-time graph (1)

(ii) thevelocity-time graph (1)

(b) The distance between two stations is 1800m. An electric train, which covers this journey in 3 minutes, starts from rest at one station with a uniform acceleration of 0.5 ms^{-2}. It comes to rest at the other station with a uniform retardation of 0.75 ms^{-2} and the speed in the intermediate portion of its journey is constant. Find

(i) the time taken during acceleration (5)

(ii) the maximum constant speed attained (2)

(c) (i) State the principle of conservation of momentum (1)

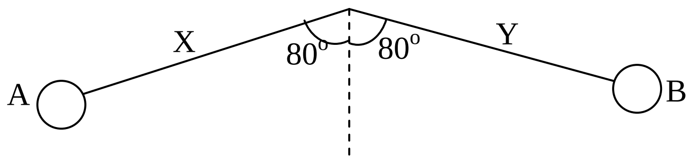
(ii) Show how Newton's laws of motion may be used to arrive at the principle of conservation of momentum. (5)

(d) A ball of mass 0.2kg is released from a height h above the ground and on hitting the ground the ball bounces off to a height of 3.0m after losing 70% of its mechanical energy.
(i) With what velocity does the ball bounce off the ground? (2)
(ii)Find the height h from which the ball was released. (3)
If the ground exerted a force of 43.0N on the ball, how long was the ball in contact with the ground before bouncing off? (3)

2. (a) (i) State the work-energy principle. (1)

(b) (i) Define gravitational potential. (1)
(ii) If r is the radius of the earth and g the gravitational acceleration, show that the gravitational potential at the earth's surface is **–gr**. (3)

(c) The diagram shows two balls A and B supported by strings X and Y respectively, each of length 1 m.



The balls are held so that the strings are taut and each makes an angle of 80°with the vertical, all in the same vertical plane. A has a mass of 300g and B of 200 g.
The balls are released. If the coefficient of restitution is 0.6, find
(i) the mechanical energy lost during collision (8)
(ii) the angle string Y makes with the vertical when B first comes to instantaneous rest. (3)

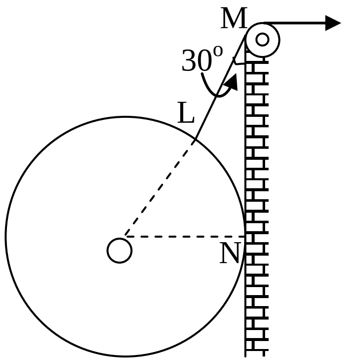
3. (a) (i) Distinguish between ***kinetic energy*** and ***potential energy*** (2)
(ii) Show that a mass m moving with a velocity v has kinetic energy given by $\frac{1}{2}mv^2$. (3)

(b) (i) What is meant by the term ***conservative force***? (1)
(ii) Show that for a particle moving in the gravitational field the total mechanical energy is conserved. (4)

(c) (i) Define the ***moment of a force***. (1)

(ii) The inner end of a concentrically coiled spring is fixed to the axle of a wheel of radius 0.5 m. When two tangential parallel forces, each of 6N acting in opposite directions, are applied to the wheel to form a couple, the wheel turns through an angle of 120^o.
Find the energy stored in the spring. (3)

(d)



The figure shows a uniform circular hoop with centre O and of radius 0.5 m. The hoop has aweight of 200 N and is being hauled up along a verticalwall ported by astring LM fixed at point L on the hoop.LM makes an angle of 30^o with the wall andthe angle between radii OL and ON is 40^o.
Find the

(i) tension in the string LM. (3)

(ii) coefficient friction between the hoop and the wall. (4)

4. (a) (i) Define simple harmonic motion. (1)

(ii) A particle performs simple harmonic motion with amplitude **a** and angular frequency, **ω.** Derive an expression relating the velocity of the particle and its displacement x, without the time. (3)

(b) (i) Show that a small mass attached to the free end of a suspended inextensible string, executes simple harmonic motion when displaced through a small angle and then released. (4)

(ii) Explain briefly how you can use the experimental arrangement in (b)(i) above to determine acceleration due to gravity. (5)

(c) A particle of mass 0.1kg is executing simple harmonic motion of amplitude 3.6 x 10^{-2}m between two points A and B about point O as the centre of oscillation. The maximum restoring force on the particle has a magnitude 3.52 N.Calculate

(i) the period of the motion (2)

(ii) the kinetic energy of the particle at a point in the path of the motion a distance 4.5 x 10^{-2}m from A. (3)

(iii) the total energy of the particle (2)

SECTION B

5. (a) (i) State any two factors that could be considered when choosing a thermometer to be used. (1)

(ii) State four characteristics a physical property should exhibit in order to be used as a thermometric property. (2)

(b) What is meant by a

(i) fixed point in thermometry (1)

(ii) triple point of water (1)

(c) (i) Describe the structure of a liquid in glass clinical thermometer. (4)

(ii) State how the thermometer in (b)(i) can be made sensitive and quick acting. (2)

(d) At a temperature of 90°C the resistance of a platinum wire is 2.000 Ω. What will the resistance be at the triple point of water? (3)

(e) (i) What is meant by pyrometry? (1)

(ii) With the aid of a diagram describe how an optical pyrometer may be used to measure the temperature of furnace. (5)

6. (a) (i) Define ***specific latent heat of vaporisation***. (1)

(ii) Explain why at the boiling point of a liquid heat is absorbed without change of temperature. (2)

(iii) With the aid of a well labelled diagram, describe an electrical method of determining the specific latent heat of vaporisation of water.(7)

(b) A 1.0kW electric heater is immersed in 4 kg of water at 25°C contained in a copper vessel of mass 0.5 kg. Neglecting any loss of heat to the surroundings and the heat capacity of the heater, find:

(i) how long it will take to heat the water to its boiling point of 100°C (3)

(ii) how long it will take to boil off all the water, starting from 25°C? (2)

(iii) how much it will cost to achieve b(ii) above if 1 kWh is Sh 615.00? (2)

(c) Explain why a smaller body cools faster than a bigger one of the same shape. (3)

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

(ii) 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)

(iii) Explain why cavities in a fire look brighter than the rest of the fire. (3)

(b) (i) State Wien's and Stefan's laws of black body radiation. (1)

(ii) The intensity of radiant energy from a black body is a maximum at a wavelength of 1.5×10^{-6} m. Calculate the temperature of the black body. (2)

(iii) Describe an experiment to compare surfaces as absorbers of radiation. (4)

(c) The energy intensity received by a spherical planet from a star is 1.4×10^{3} W m^{-2}. The star is of radius 7.0×10^{5} km and is 1.4×10^{8} km from the planet from the planet.

(i) Calculate the surface temperature of the star. (4)

(ii) State any assumptions you have made in (b)(i) above. (1)