# **P510/1**

**PHYSICS**

**Paper 1**

# practical 012

**SECTION A**

1. (a). Write the equations of ***uniformly accelerated motion***. (03 marks)

(b). (i) Briefly distinguish between ***conservative*** and ***non-conservative*** forces. Give **two** examples in each case. (04 marks)

(ii) State the ***principle of conservation*** of energy. Show that a projectile fired with a speed at an angle to the horizontal obeys this principle throughout its motion. (04 mark)

(c). The engine of a 5-tonne lorry can develop 30kW, and its maximum speed on level road is. Assuming that the friction resistance is constant, calculate the greatest speed at which the lorry can climb a hill of 1 in 25. (04 marks)

(d). (i) Define ***moment*** of a force. (01 marks)

(ii) A wheel of radius is pivoted at its centre. A tangential force of  acts on the wheel so that the wheel rotates with uniform velocity. Find the work done by the force to turn the wheel through 20 revolutions. (04 marks)

2. (a) (i) Define the term angular velocity. (1mark)

(ii) A car of width c and whose centre of gravity is at a height h above the ground goes

round a bend of radius r. Show that it will overturn if its speed exceeds .

(5 marks)

(iii) A bucket of water is swung at constant tangential speed in a vertical circle of radius 0.5 m in such a way that the bucket is upside down when it is at the top of the circle. Find the minimum speed that the bucket may have if the water is to remain in it? (3marks)

(b) State Kepler’s laws of gravitation. (3 marks)

(c) (i) Define gravitational field strength. (1mark)

(ii) With aid of a sketch, qualitatively explain the variation of acceleration due to gravity with distance from the centre of the earth. (3marks)

(d) A satellite of mass m is to be launched into an orbit of radius R round the earth of radius r. Show that the minimum launching velocity is given by . (4 marks)

3. (a)(i) What is meant by the term **dimensions of a physical quantity**? (1 mark)

(b) The volume per second of a liquid ejected from a pipe of radius  under steady flow is given by the expression, where is the pressure gradient with dimensions and. By dimensional analysis, find the values of x, y and z. (5 marks)

(c ) (i) Define the terms ***range*** and ***time of flight*** as applied to projectile motion.(2marks)

(ii) A shell is fired from a gun with a velocity U at an angle  to the horizontal. Show that the vertical distance  covered is given by .

(4 marks)

(d) A shell is fired with a velocity of  at an angle of  to the horizontal from a gun placed at the top of a hill of vertical height 800 m above the ground. Find the:

(i) time taken by the shell to hit the enemy on the ground assuming the shell is on target. (4 marks)

(ii) velocity with which the shell hits the target. (4 marks)

4. (a) (i) Distinguish between **scalar** and **vector** physical quantities. Give **two**

examples of each. (4marks)

(ii) The diagram below shows three coplanar forces acting on a particle.

4N

60o

150o

8N

3N

Find the magnitude, and inclination to the 8N force, of the resultant force. (5marks)

(b) State the laws of friction. (3marks)

(c) With aid of a labeled diagram, describe an experiment to determine the coefficient of static friction. (4marks)

(d) The figure below shows two particles M and N each of mass 2 kg. M is held at A on an inclined plane and is connected to N by a light inelastic string that passes over a smooth pulley P. The coefficient of friction between particle M and the plane is 0.5.

P

M 2kg N

2kg

Find the acceleration of the masses and the tension in the string when M is released from rest. (4marks)

**SECTION B**

5. (a) (i) What is meant by a ***thermometric property*** and ***triple point of water***? (2 marks)

(ii) Describe how you would measure the temperature of a body on the thermodynamic scale using a thermocouple. (3 marks)

(iii) The resistance of a platinum wire at the triple point of water is . What will be the resistance at ? (2 marks)

(b) The resistance of a platinum wire varies with the gas temperature according to the equation , where is the resistance at and and are constants. For a platinum resistance wire thermometer,and respectively. Calculate the reading of the platinum thermometer when the gas thermometer reads. (5 marks)

(c) Define the term **specific latent heat of vapourisation**. (1 mark)

(d) An electrical heater rated at 500 W is immersed in a liquid of mass 2.0 kg contained in a large thermos flask of heat capacity 840 J kg-1at 280C. Electrical power is supplied to the heater for 10 minutes. If the specific heat capacity of the liquid is , its specific latent heat of vapourization is and its boiling point is , estimate the amount of liquid which boils off.

State any assumptions made in your calculation. (7 marks)

6. (a) (i) State **Boyle’s law**. (1 mark)

(ii) The pressure P of an ideal gas of density and mean square speed is given by . Use this expression to derive Boyle’s law. (3 marks)

(b) Air contains approximately of 20% oxygen and 80% nitrogen. The relative molecular masses of oxygen and nitrogen are 32 and 28 respectively. Calculate the ratio of the:

(i) mean-square speed of oxygen to that of nitrogen. (3 marks)

(ii) partial pressure of oxygen to that of nitrogen in air. (4 marks)

(c) A fixed mass of a gas is contained in a cylinder of volumeand pressure .The gas is allowed to expand to a volume and pressure. Assuming that the temperature remained constant, show that the work done by the gas is given by . (3 marks)

(d) A litre of hydrogen gas at a temperature of 270C and a pressure 105 Nm-2 expands isothermally until its volume is doubled and is then adiabatically expanded until the new volume is again doubled. Given that ,

(i) Show the above processes on a P-V diagram, (2 marks)

(ii) Calculate the final pressure of the gas. (4 marks)

7. (a) (i) Define **thermal conductivity** of a material (1 mark)

(ii)Briefly account for the fact that metals are better conductors of heat than insulators.

(3 marks)

(b) A wall of a building consists of two brick layers each of thickness 10.0 cm and between which there is a layer of air 2.0 cm thick.

Find the rate of heat flow through one m2 of the wall if the inner and outer temperatures of the building are 250C and 150C respectively. (6 marks)

(c) Describe with the aid of a labeled diagram, how the temperature of a furnace may be

measured. (5 marks)

(d) The total power output of the sun is . Given that the mass of the sun is and its density is , estimate the temperature of the sun. State any approximations made. (5 marks)

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