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**S 5 PHYSICS TEST**

**September 2012**

**Paper 1**

**1 hour 05 minutes**

Answer **ALL** questions

Use, where necessary:

Gravitation acceleration, g = 9.81 ms-2

1. (a) (i) What is meant by the term ***conservative force***? (1)

(ii) Show that when a stone is projected vertically upwards in space, its mechanical energy is conserved. (4)

(b) (i) A wind turbine made of a blade of radius, r, is driven by a wind of speed, v. If σ is the density of air, derive an expression for the maximum power, P, which will be developed by the turbine in terms of σ, r and v. (3)

(ii) Explain why the power attained is less than the maximum value you have got in b(i) above. (1)

(c) A car, running on a level road, develops 10 kW of power to maintain a constant speed of 80 km h-1. If the mass of the car is 3000 kg, how much power does it need to develop in order to keep the same speed up an incline of 1 in 40?

(3)

(d) Two pendula of equal length, a, have bobs P and Q of masses 3M and M respectively. The pendula are hung with the bobs in contact as shown below.

P Q

The bob P is displaced so that the string makes an angle of 60o with the vertical and released. If P makes a ***perfectly inelastic*** collision with Q, find

(i) an expression for the energy lost (5)

(ii) the height to which Q rises (3)

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

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

(b) With the aid of a diagram, describe how the thermal conductivity of a poor conductor can be determined. (7)

(c) The diagram shows a uniform metal bar whose one end is maintained at 100oC and the other at 0oC. Part of the bar’s length is lagged as shown.

100oC

0oC

Heat

Bar

Lagging

Show and explain the temperature distribution along the bar. (3)

(d) A is a composite slab made up of two layers of thicknesses d1 and d2 with thermal conductivities k1 and k2­ respectively. B is a slab of thickness d1 + d2 with thermal conductivity k. One face of each of the slabs is maintained by heating at a temperature θ1 and the other end at θ2. If the rate of conduction per unit area through the two slabs is the same, find k in terms k1, k2, d1 and d2. (6)