

Hooke's Law

Question Paper 4

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Hooke's Law
Sub Topic	
Booklet	Question Paper 4

Time Allowed: 56 minutes

Score: /46

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 A small ball B of mass 0.2 kg is attached to fixed points P and Q by two light inextensible strings of equal length. P is vertically above Q , the strings are taut and each is inclined at 60° to the vertical. B moves with constant speed in a horizontal circle of radius 0.6 m .

(i) Given that the tension in the string PB is 7 N , calculate

(a) the tension in string QB , [2]

(b) the speed of B . [3]

(ii) Given instead that B is moving with angular speed 7 rad s^{-1} , calculate the tension in the string QB . [4]

2



Two particles P and Q , of masses 0.4 kg and 0.2 kg respectively, are attached to opposite ends of a light inextensible string. P is placed on a horizontal table and the string passes over a small smooth pulley at the edge of the table. The string is taut and the part of the string attached to Q is vertical (see diagram). The coefficient of friction between P and the table is 0.5 . Q is projected vertically downwards with speed 5 m s^{-1} , and at time $t \text{ s}$ after the instant of projection the speed of the particles is $v \text{ m s}^{-1}$. The motion of each particle is opposed by a resisting force of magnitude $0.9v \text{ N}$. The particle P does not reach the pulley.

(i) Show that $\frac{dv}{dt} = -3v$. [4]

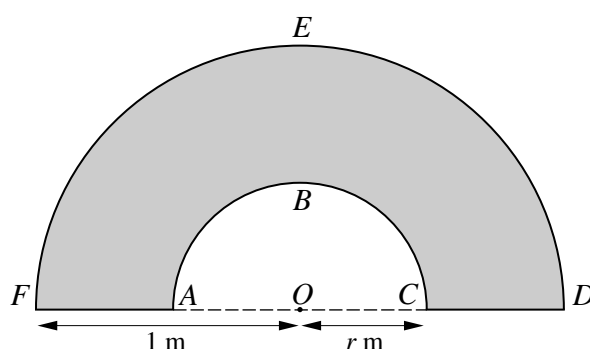
(ii) Find the value of t when the particles have speed 2.5 m s^{-1} and the distance that each particle has travelled in this time. [7]

- 3 A light elastic string has natural length 2.2 m and modulus of elasticity 14.3 N. A particle P of mass m kg is attached to the mid-point of the string. The ends of the string are attached to fixed points A and B which are 2.4 m apart at the same horizontal level. P is released from rest at the mid-point of AB . In the subsequent motion P has its greatest speed at a point 0.5 m below AB .

(i) Find m . [4]

(ii) Calculate the greatest speed of P . [3]

4



The diagram shows a uniform lamina $ABCDEF$, formed from a semicircle with centre O and radius 1 m by removing a semicircular part with centre O and radius r m.

(i) Show that the distance in metres of the centre of mass of the lamina from O is

$$\frac{4(1 + r + r^2)}{3\pi(1 + r)}. \quad [4]$$

The centre of mass of the lamina lies on the arc ABC .

(ii) Show that $r = 0.494$, correct to 3 significant figures. [3]

The lamina is freely suspended at F and hangs in equilibrium.

(iii) Find the angle between the diameter of the lamina and the vertical. [2]

- 5** A light elastic string has natural length 3 m and modulus of elasticity 45 N. A particle P of mass 0.6 kg is attached to the mid-point of the string. The ends of the string are attached to fixed points A and B which lie on a line of greatest slope of a smooth plane inclined at 30° to the horizontal. The distance AB is 4 m, and A is higher than B .

(i) Calculate the distance AP when P rests on the slope in equilibrium. [3]

P is released from rest at the point between A and B where $AP = 2.5$ m.

(ii) Find the maximum speed of P . [4]

(iii) Show that P is at rest when $AP = 1.6$ m. [2]