

Hooke's Law

Question Paper 8

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Hooke's Law
Sub Topic	
Booklet	Question Paper 8

Time Allowed: 51 minutes

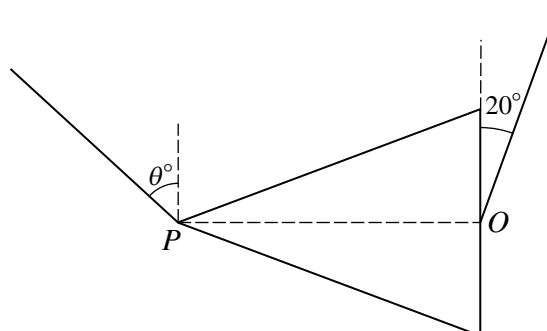
Score: /42

Percentage: /100

Grade Boundaries:

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

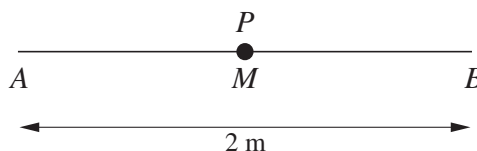
1



P is the vertex of a uniform solid cone of mass 5 kg, and O is the centre of its base. Strings are attached to the cone at P and at O . The cone hangs in equilibrium with PO horizontal and the strings taut. The strings attached at P and O make angles of θ° and 20° , respectively, with the vertical (see diagram, which shows a cross-section).

- (i) By taking moments about P for the cone, find the tension in the string attached at O . [4]
- (ii) Find the value of θ and the tension in the string attached at P . [6]

2



A particle P of mass 1.6 kg is attached to one end of each of two light elastic strings. The other ends of the strings are attached to fixed points A and B which are 2 m apart on a smooth horizontal table. The string attached to A has natural length 0.25 m and modulus of elasticity 4 N, and the string attached to B has natural length 0.25 m and modulus of elasticity 8 N. The particle is held at the mid-point M of AB (see diagram).

- (i) Find the tensions in the strings. [2]
- (ii) Show that the total elastic potential energy in the two strings is 13.5 J. [2]

P is released from rest and in the subsequent motion both strings remain taut. The displacement of P from M is denoted by x m. Find

- (iii) the initial acceleration of P , [2]
- (iv) the non-zero value of x at which the speed of P is zero. [4]

- 3 One end of a light elastic rope of natural length 2.5 m and modulus of elasticity 80 N is attached to a fixed point A . A stone S of mass 8 kg is attached to the other end of the rope. S is held at a point 6 m vertically below A and then released. Find the initial acceleration of S . [4]

- 4 A light elastic string has natural length 4 m and modulus of elasticity 2 N. One end of the string is attached to a fixed point O of a smooth plane which is inclined at 30° to the horizontal. The other end of the string is attached to a particle P of mass 0.1 kg. P is held at rest at O and then released. The speed of P is $v \text{ m s}^{-1}$ when the extension of the string is x m.

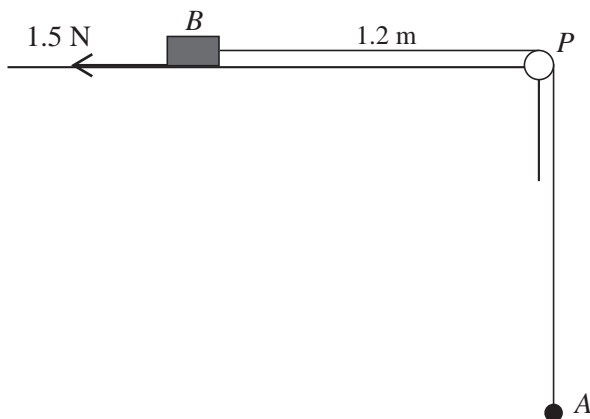
(i) Show that $v^2 = 45 - 5(x - 1)^2$. [5]

Hence find

(ii) the distance of P from O when P is at its lowest point, [2]

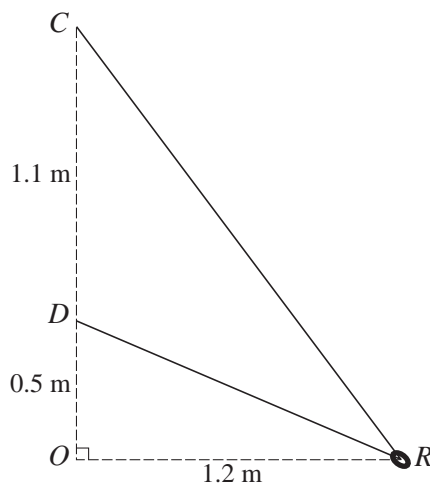
(iii) the maximum speed of P . [2]

5



A particle A and a block B are attached to opposite ends of a light elastic string of natural length 2 m and modulus of elasticity 6 N. The block is at rest on a rough horizontal table. The string passes over a small smooth pulley P at the edge of the table, with the part BP of the string horizontal and of length 1.2 m. The frictional force acting on B is 1.5 N and the system is in equilibrium (see diagram). Find the distance PA . [3]

6



One end of a light inextensible string is attached to a point C . The other end is attached to a point D , which is 1.1 m vertically below C . A small smooth ring R , of mass 0.2 kg, is threaded on the string and moves with constant speed $v \text{ m s}^{-1}$ in a horizontal circle, with centre at O and radius 1.2 m, where O is 0.5 m vertically below D (see diagram).

- (i) Show that the tension in the string is 1.69 N, correct to 3 significant figures. [3]
- (ii) Find the value of v . [3]