Hooke's Law

Question Paper 2

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Hooke's Law
Sub Topic	
Booklet	Question Paper 2

Time Allowed: **59 minutes**

Score: **/49**

Percentage: **/100**

Grade Boundaries:

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

1 A light elastic string has natural length 0.8 m and modulus of elasticity 16 N. One end of the string is attached to a fixed point O, and a particle P of mass 0.4 kg is attached to the other end of the string. The particle P hangs in equilibrium vertically below O.

(i) Show that the extension of the string is 0.2 m. [2]

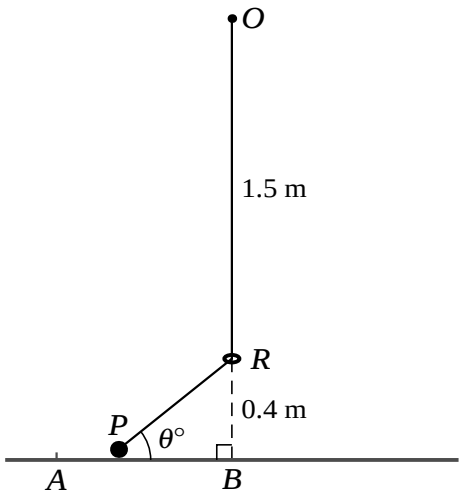
P is projected vertically downwards from the equilibrium position. P first comes to instantaneous rest at the point where $OP = 1.4$ m.

(ii) Calculate the speed at which P is projected. [3]

(iii) Find the speed of P at the first instant when the string subsequently becomes slack. [2]

2 A light elastic string has modulus of elasticity 5 N and natural length 1.5 m. One end of the string is attached to a fixed point O and a particle P of mass 0.1 kg is attached to the other end of the string. P is released from rest at the point 2.4 m vertically below O. Calculate the speed of P at the instant the string first becomes slack. [3]

3



A particle P of mass 0.6 kg is attached to one end of a light elastic string of natural length 1.5 m and modulus of elasticity 9 N. The string passes through a small smooth ring R fixed at a height of 0.4 m above a rough horizontal surface. The other end of the string is attached to a fixed point O which is 1.5 m vertically above R. The points A and B are on the horizontal surface, and B is vertically below R. When P is on the surface between A and B, RP makes an acute angle $\theta°$ with the horizontal (see diagram).

(i) Show that the normal force exerted on P by the surface has magnitude 3.6 N, for all values of θ. [3]

P is projected with speed 2.5 m s^{-1} towards B from its initial position at A where $\theta = 30$. The speed of P when it passes through B is 3 m s^{-1}.

(ii) Find the work done against friction as P moves from A to B. [4]

(iii) Calculate the value of the coefficient of friction between P and the surface. [2]

4 A particle P of mass 0.3 kg is attached to one end of a light inextensible string of length 0.6 m. The other end of the string is attached to a fixed point O of a smooth horizontal plane. P moves on the plane at constant speed 5 m s^{-1} in a circle with centre O. Calculate the tension in the string. [2]

5 A particle P of mass 0.4 kg is attached to one end of a light elastic string of natural length 0.8 m and modulus of elasticity 32 N. The other end of the string is attached to a fixed point O. The particle is released from rest at O.

(i) Calculate the distance OP at the instant when P first comes to instantaneous rest. [4]

A horizontal plane is fixed at a distance 1 m below O. The particle P is again released from rest at O.

(ii) Calculate the speed of P immediately before it collides with the plane. [3]

(iii) In the collision with the plane, P loses 96% of its kinetic energy. Calculate the distance OP at the instant when P first comes to instantaneous rest above the plane, given that this occurs when the string is slack. [3]

6 A particle P of mass 0.1 kg is attached to one end of a light elastic string of natural length 0.4 m and modulus of elasticity 12 N. The other end of the string is attached to a fixed point O on a smooth horizontal surface. P moves on the surface in a horizontal circle with centre O and radius 0.6 m. Calculate the speed of P. [3]

7 One end of a light elastic string of natural length 0.8 m and modulus of elasticity 50 N is attached to a fixed point O. A particle P of mass 0.4 kg is attached to the other end of the string. P is projected downwards with speed 1.5 m s^{-1} from a point 0.82 m vertically below O.

(i) Find the greatest speed of P. [5]

(ii) Show that P cannot reach O. [3]

8 A particle P of mass 0.4 kg is attached to one end of a light elastic string of natural length 1.2 m and modulus of elasticity 19.2 N. The other end of the string is attached to a fixed point A. The particle P is released from rest at the point 2.7 m vertically above A. Calculate

(i) the initial acceleration of P, [3]

(ii) the speed of P when it reaches A. [4]