Hooke's Law

Question Paper 9

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Hooke's Law
Sub Topic	
Booklet	Question Paper 9

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%

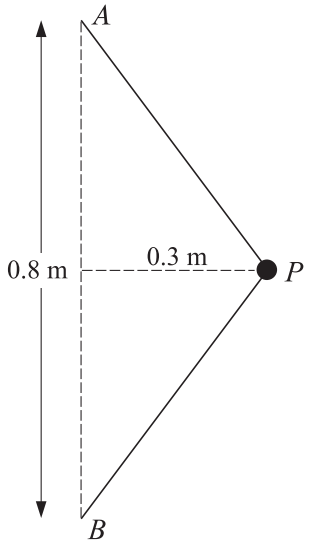
1 One end of a light elastic string of natural length 1.25 m and modulus of elasticity 20 N is attached to a fixed point O. A particle P of mass 0.5 kg is attached to the other end of the string. P is held at rest at O and then released. When the extension of the string is x m the speed of P is v m s^{-1}.

(i) Show that $v^2 = -32x^2 + 20x + 25$. [4]

(ii) Find the maximum speed of P. [3]

(iii) Find the acceleration of P when it is at its lowest point. [4]

2



Each of two identical light elastic strings has natural length 0.25 m and modulus of elasticity 4 N. A particle P of mass 0.6 kg is attached to one end of each of the strings. The other ends of the strings are attached to fixed points A and B which are 0.8 m apart on a smooth horizontal table. The particle is held at rest on the table, at a point 0.3 m from AB for which $AP = BP$ (see diagram).

(i) Find the tension in the strings. [2]

(ii) The particle is released. Find its initial acceleration. [3]

3 Each of two light elastic strings, S_1 and S_2, has modulus of elasticity 16 N. The string S_1 has natural length 0.4 m and the string S_2 has natural length 0.5 m. One end of S_1 is attached to a fixed point A of a smooth horizontal table and the other end is attached to a particle P of mass 0.5 kg. One end of S_2 is attached to a fixed point B of the table and the other end is attached to P. The distance AB is 1.5 m. The particle P is held at A and then released from rest.

(i) Find the speed of P at the instant that S_2 becomes slack. [4]

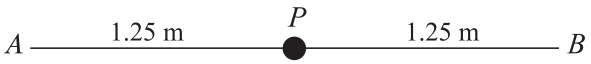
(ii) Find the greatest distance of P from A in the subsequent motion. [3]

4 One end of a light elastic string, of natural length 0.5 m and modulus of elasticity 140 N, is attached to a fixed point O. A particle of mass 0.8 kg is attached to the other end of the string. The particle is released from rest at O. By considering the energy of the system, find

(i) the speed of the particle when the extension of the string is 0.1 m, [4]

(ii) the extension of the string when the particle is at its lowest point. [4]

5



A and B are fixed points on a smooth horizontal table. The distance AB is 2.5 m. An elastic string of natural length 0.6 m and modulus of elasticity 24 N has one end attached to the table at A, and the other end attached to a particle P of mass 0.95 kg. Another elastic string of natural length 0.9 m and modulus of elasticity 18 N has one end attached to the table at B, and the other end attached to P. The particle P is held at rest at the mid-point of AB (see diagram).

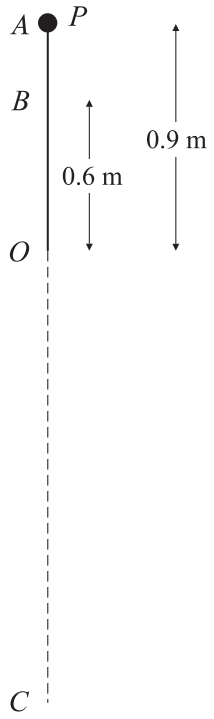
(i) Find the tensions in the strings. [3]

The particle is released from rest.

(ii) Find the acceleration of P immediately after its release. [2]

(iii) P reaches its maximum speed at the point C. Find the distance AC. [4]

6



The diagram shows a light elastic string of natural length 0.6 m and modulus of elasticity 5 N with one end attached to a fixed point O. A particle P of mass 0.2 kg is attached to the other end of the string. P is held at the point A, which is 0.9 m vertically above O. The particle is released from rest and travels vertically downwards through O to the point C, where it starts to move upwards. B is the point of the line AC where the string first becomes slack.

(i) Find the speed of P at B. [4]

(ii) The extension of the string when P is at C is x m.

(a) Show that $x^2 - 0.48x - 0.81 = 0$. [3]

(b) Hence find the distance AC. [2]