

Hooke's Law

Question Paper 3

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Hooke's Law
Sub Topic	
Booklet	Question Paper 3

Time Allowed: 58 minutes

Score: /48

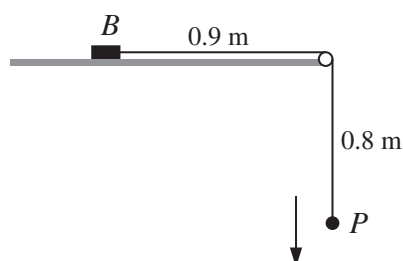
Percentage: /100

Grade Boundaries:

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

- 1 A particle P of mass 0.2 kg is attached to one end of a light elastic string of natural length 1.6 m and modulus of elasticity 18 N . The other end of the string is attached to a fixed point O which is 1.6 m above a smooth horizontal surface. P is placed on the surface vertically below O and then projected horizontally. P moves with initial speed 1.5 m s^{-1} in a straight line on the surface. Show that, when $OP = 1.8 \text{ m}$,
- (i) P is at instantaneous rest, [3]
 - (ii) P is on the point of losing contact with the surface. [4]

2



A block B of mass 3 kg is attached to one end of a light elastic string of modulus of elasticity 70 N and natural length 1.4 m . The other end of the string is attached to a particle P of mass 0.3 kg . B is at rest 0.9 m from the edge of a horizontal table and the string passes over a small smooth pulley at the edge of the table. P is released from rest at a point next to the pulley and falls vertically. At the first instant when P is 0.8 m below the pulley and descending, B is in limiting equilibrium with the part of the string attached to B horizontal (see diagram).

- (i) Calculate the speed of P when B is first in limiting equilibrium. [5]
 - (ii) Find the coefficient of friction between B and the table. [3]
- 3 A particle P of mass 0.3 kg is attached to one end of a light elastic string of natural length 0.6 m and modulus of elasticity 45 N . The other end of the string is attached to a fixed point O . The particle P is released from rest at O and falls vertically. Find the extension of the string when P is at its lowest position. [4]

- 4 One end of a light elastic string S_1 of modulus of elasticity 20 N and natural length 0.5 m is attached to a fixed point O . The other end of S_1 is attached to a particle P of mass 0.4 kg. P hangs in equilibrium vertically below O .

(i) Find the distance OP . [2]

The opposite ends of a light inextensible string S_2 of length l m are now attached to O and P respectively. The elastic string S_1 remains attached to O and P . The particle P hangs in equilibrium vertically below O .

(ii) Find the tension in the inextensible string S_2 for each of the following cases:

(a) $l < 0.5$;

(b) $l > 0.6$;

(c) $l = 0.54$.

[4]

In the case $l = 0.54$, the inextensible string S_2 suddenly breaks and P begins to descend vertically.

(iii) Calculate the greatest speed of P in the subsequent motion. [3]

- 5 A light elastic string has natural length 3 m and modulus of elasticity 45 N. A particle P of weight 6 N is attached to the mid-point of the string. The ends of the string are attached to fixed points A and B which lie in the same vertical line with A above B and $AB = 4$ m. The particle P is released from rest at the point 1.5 m vertically below A .

(i) Calculate the distance P moves after its release before first coming to instantaneous rest at a point vertically above B . (You may assume that at this point the part of the string joining P to B is slack.) [4]

(ii) Show that the greatest speed of P occurs when it is 2.1 m below A , and calculate this greatest speed. [5]

(iii) Calculate the greatest magnitude of the acceleration of P . [3]

- 6 A light elastic string has natural length 4 m and modulus of elasticity 60 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 in the same vertical line with A at a distance of 6 m above B . P is projected vertically upwards from the point 2 m vertically above B . In the subsequent motion, P comes to instantaneous rest at a distance of 2 m below A .
- (i) Calculate the speed of projection of P . [2]
- (ii) Calculate the distance of P from A at an instant when P has its greatest kinetic energy, and calculate this kinetic energy. [6]