Hooke's Law

Question Paper 7

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Hooke's Law
Sub Topic	
Booklet	Question Paper 7

Time Allowed: **57 minutes**

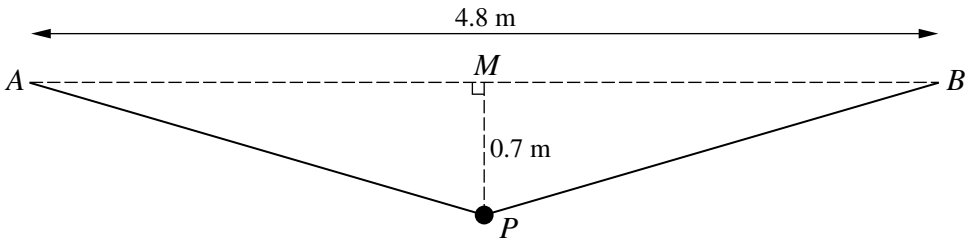
Score: **/47**

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 0.35 kg is attached to the mid-point of a light elastic string of natural length 4 m. The ends of the string are attached to fixed points A and B which are 4.8 m apart at the same horizontal level. P hangs in equilibrium at a point 0.7 m vertically below the mid-point M of AB (see diagram).

(i) Find the tension in the string and hence show that the modulus of elasticity of the string is 25 N. [4]

P is now held at rest at a point 1.8 m vertically below M, and is then released.

(ii) Find the speed with which P passes through M. [6]

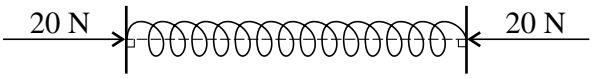
2 One end of a light elastic string of natural length 3 m and modulus of elasticity 24 N is attached to a fixed point O. A particle P of mass 0.4 kg is attached to the other end of the string. P is projected vertically downwards from O with initial speed $2\,\text{m s}^{-1}$. When the extension of the string is x m the speed of P is $v\,\text{m s}^{-1}$.

(i) Show that $v^2 = 64 + 20x - 20x^2$. [4]

(ii) Find the greatest speed of the particle. [3]

(iii) Calculate the greatest tension in the string. [4]

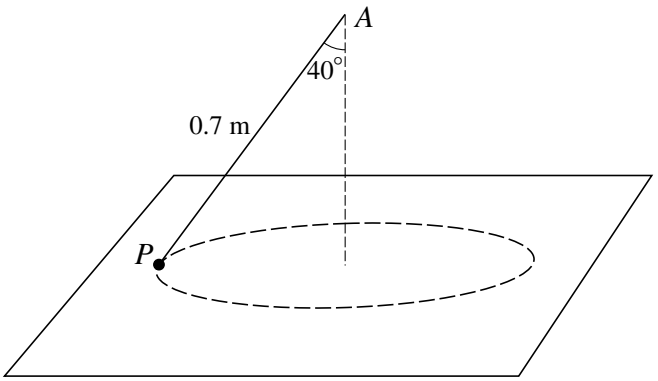
3



A light elastic spring of natural length 0.25 m and modulus of elasticity 100 N is held horizontally between two parallel plates. The axis of the spring is at right angles to each of the plates. The horizontal force exerted on the spring by each of the plates is 20 N (see diagram). Find the amount by which the spring is compressed and hence write down the distance between the plates. [3]

4 A particle of mass 0.2 kg is attached to one end of a light elastic string of natural length 0.6 m and modulus of elasticity 4 N. The other end of the string is attached to a fixed point O. The particle is held at a point which is $(0.6 + x)$ m vertically below O. The particle is released from rest. In the subsequent motion the speed of the particle is 3 m s^{-1} when the string becomes slack. By considering energy, find the value of x. [5]

5



One end of a light inextensible string of length 0.7 m is attached to a fixed point A. The other end of the string is attached to a particle P of mass 0.25 kg. The particle P moves in a circle on a smooth horizontal table with constant speed 1.5 m s^{-1}. The string is taut and makes an angle of 40° with the vertical (see diagram). Find

(i) the tension in the string, [3]

(ii) the force exerted on P by the table. [3]

P now moves in the same horizontal circle with constant angular speed ω rad s^{-1}.

(iii) Find the maximum value of ω for which P remains on the table. [5]

6 One end of a light elastic string of natural length 3 m and modulus of elasticity $15m$ N is attached to a fixed point O. A particle P of mass m kg is attached to the other end of the string. P is released from rest at O and moves vertically downwards. When the extension of the string is x m the velocity of P is v m s^{-1}.

(i) Show that $v^2 = 5(12 + 4x - x^2)$. [4]

(ii) Find the magnitude of the acceleration of P when it is at its lowest point, and state the direction of this acceleration. [3]