

Hooke's Law

Question Paper 5

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Hooke's Law
Sub Topic	
Booklet	Question Paper 5

Time Allowed: 52 minutes

Score: /43

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 0.4 m and modulus of elasticity 20 N is attached to a fixed point O . The other end of the string is attached to a particle P of mass 0.25 kg. P hangs in equilibrium below O .

(i) Calculate the distance OP . [2]

The particle P is raised, and is released from rest at O .

(ii) Calculate the speed of P when it passes through the equilibrium position. [3]

(iii) Calculate the greatest value of the distance OP in the subsequent motion. [3]

- 2 A smooth bead B of mass 0.3 kg is threaded on a light inextensible string of length 0.9 m. One end of the string is attached to a fixed point A , and the other end of the string is attached to a fixed point C which is vertically below A . The tension in the string is T N, and the bead rotates with angular speed ω rad s⁻¹ in a horizontal circle about the vertical axis through A and C .

(i) Given that B moves in a circle with centre C and radius 0.2 m, calculate ω , and hence find the kinetic energy of B . [5]

(ii) Given instead that angle $ABC = 90^\circ$, and that AB makes an angle $\tan^{-1}(\frac{1}{2})$ with the vertical, calculate T and ω . [6]

- 3 One end of a light elastic string of natural length 0.4 m and modulus of elasticity 20 N is attached to a particle P of mass 0.8 kg. The other end of the string is attached to a fixed point O at the top of a smooth plane inclined at 30° to the horizontal. The particle rests in equilibrium on the plane.

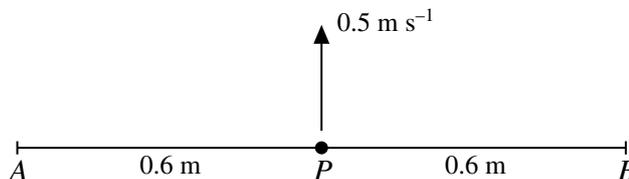
(i) Calculate the extension of the string. [2]

P is projected from its equilibrium position up the plane along a line of greatest slope. In the subsequent motion P just reaches O , and later just reaches the foot of the plane. Calculate

(ii) the speed of projection of P , [4]

(iii) the length of the line of greatest slope of the plane. [4]

4

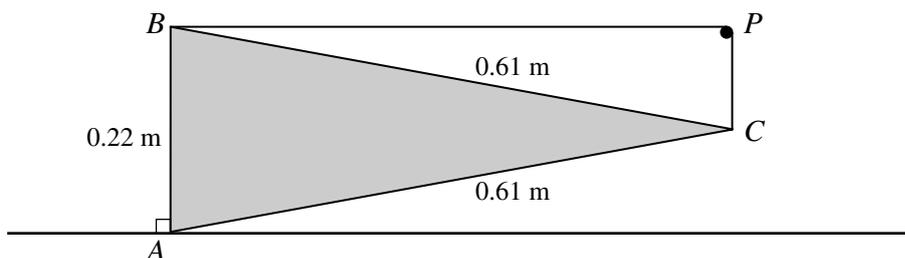


A light elastic string of natural length 1.2 m and modulus of elasticity 24 N is attached to fixed points A and B on a smooth horizontal surface, where $AB = 1.2$ m. A particle P is attached to the mid-point of the string. P is projected with speed 0.5 m s^{-1} along the surface in a direction perpendicular to AB (see diagram). P comes to instantaneous rest at a distance 0.25 m from AB .

(i) Show that the mass of P is 0.8 kg. [3]

(ii) Calculate the greatest deceleration of P . [3]

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ABC is a uniform triangular lamina of weight 19 N, with $AB = 0.22$ m and $AC = BC = 0.61$ m. The plane of the lamina is vertical. A rests on a rough horizontal surface, and AB is vertical. The equilibrium of the lamina is maintained by a light elastic string of natural length 0.7 m which passes over a small smooth peg P and is attached to B and C . The portion of the string attached to B is horizontal, and the portion of the string attached to C is vertical (see diagram).

(i) Show that the tension in the string is 10 N. [3]

(ii) Calculate the modulus of elasticity of the string. [2]

(iii) Find the magnitude and direction of the force exerted by the surface on the lamina at A . [3]