Uniform Motion in a Circle

Question Paper 5

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Uniform Motion in a Circle
Sub Topic	
Booklet	Question Paper 5

Time Allowed: **58 minutes**

Score: **/48**

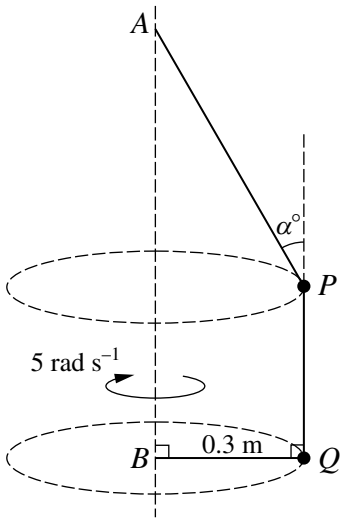
Percentage: **/100**

Grade Boundaries:

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

1 A horizontal circular disc rotates with constant angular speed 9 rad s^{-1} about its centre O. A particle of mass 0.05 kg is placed on the disc at a distance 0.4 m from O. The particle moves with the disc and no sliding takes place. Calculate the magnitude of the resultant force exerted on the particle by the disc. [3]

2

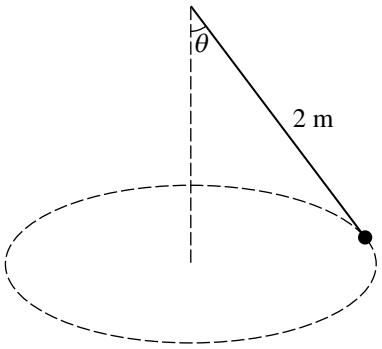


Particles P and Q have masses 0.8 kg and 0.4 kg respectively. P is attached to a fixed point A by a light inextensible string which is inclined at an angle α° to the vertical. Q is attached to a fixed point B, which is vertically below A, by a light inextensible string of length 0.3 m. The string BQ is horizontal. P and Q are joined to each other by a light inextensible string which is vertical. The particles rotate in horizontal circles of radius 0.3 m about the axis through A and B with constant angular speed 5 rad s^{-1} (see diagram).

(i) By considering the motion of Q, find the tensions in the strings PQ and BQ. [3]

(ii) Find the tension in the string AP and the value of α. [5]

3

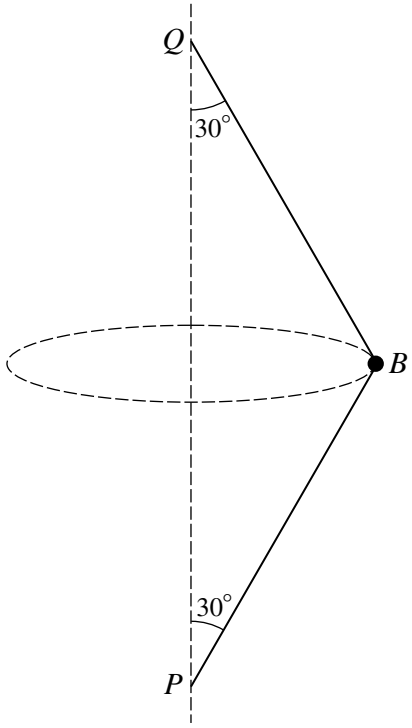


A particle of mass 0.24 kg is attached to one end of a light inextensible string of length 2 m. The other end of the string is attached to a fixed point. The particle moves with constant speed in a horizontal circle. The string makes an angle θ with the vertical (see diagram), and the tension in the string is T N. The acceleration of the particle has magnitude 7.5 m s^{-2}.

(i) Show that $\tan\theta = 0.75$ and find the value of T. [4]

(ii) Find the speed of the particle. [2]

4



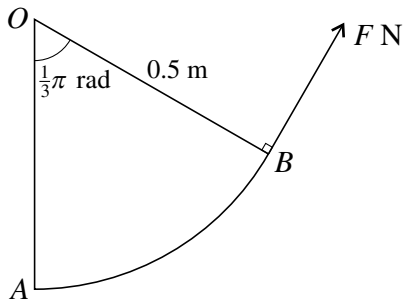
A small ball B of mass 0.4 kg is attached to fixed points P and Q on a vertical axis by two light inextensible strings of equal length. Both strings are taut and each is inclined at 30° to the vertical. The ball moves in a horizontal circle (see diagram).

(i) It is given that when the ball moves with speed 6 m s^{-1} the tension in the string QB is three times the tension in the string PB. Calculate the radius of the circle. [4]

The ball now moves along this circular path with the minimum possible speed.

(ii) State the tension in the string PB in this case, and find the speed of the ball. [4]

5

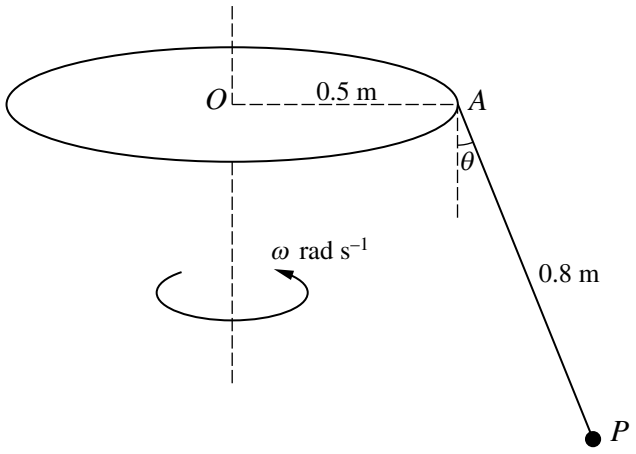


A uniform lamina AOB is in the shape of a sector of a circle with centre O and radius 0.5 m, and has angle $AOB = \frac{1}{3}\pi$ radians and weight 3 N. The lamina is freely hinged at O to a fixed point and is held in equilibrium with AO vertical by a force of magnitude F N acting at B. The direction of this force is at right angles to OB (see diagram). Find

(i) the value of F, [4]

(ii) the magnitude of the force acting on the lamina at O. [4]

6



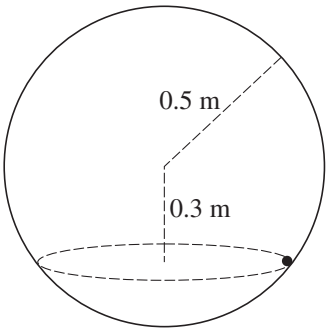
A horizontal disc of radius 0.5 m is rotating with constant angular speed ω rad s^{-1} about a fixed vertical axis through its centre O. One end of a light inextensible string of length 0.8 m is attached to a point A of the circumference of the disc. A particle P of mass 0.4 kg is attached to the other end of the string. The string is taut and the system rotates so that the string is always in the same vertical plane as the radius OA of the disc. The string makes a constant angle θ with the vertical (see diagram). The speed of P is 1.6 times the speed of A.

(i) Show that $\sin\theta = \frac{3}{8}$. [3]

(ii) Find the tension in the string. [2]

(iii) Find the value of ω. [3]

7



A particle of mass 0.12 kg is moving on the smooth inside surface of a fixed hollow sphere of radius 0.5 m. The particle moves in a horizontal circle whose centre is 0.3 m below the centre of the sphere (see diagram).

(i) Show that the force exerted by the sphere on the particle has magnitude 2 N. [2]

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

(iii) Find the time taken for the particle to complete one revolution. [2]