

Uniform Motion in a Circle

Question Paper 7

Level	International A Level
Subject	Maths
Exam Board	CIE
Topic	Uniform Motion in a Circle
Sub Topic	
Booklet	Question Paper 7

Time Allowed: 52 minutes

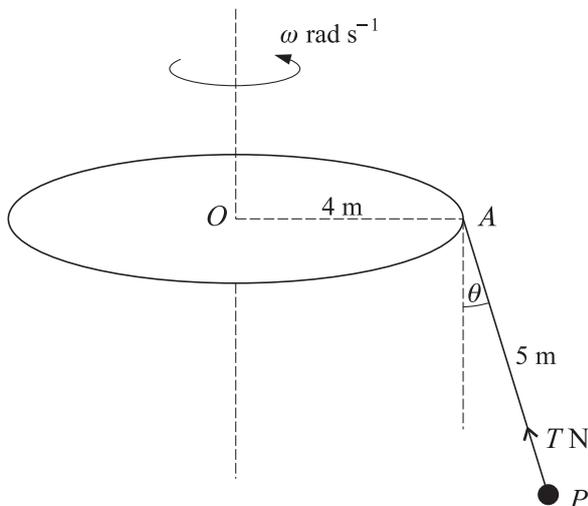
Score: /43

Percentage: /100

Grade Boundaries:

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

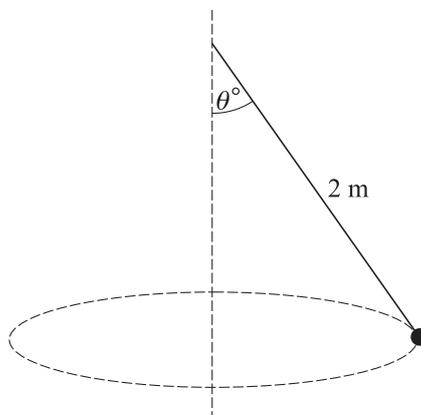
1



A horizontal circular disc of radius 4 m is free to rotate about a vertical axis through its centre O . One end of a light inextensible rope of length 5 m is attached to a point A of the circumference of the disc, and an object P of mass 24 kg is attached to the other end of the rope. When the disc rotates with constant angular speed $\omega \text{ rad s}^{-1}$, the rope makes an angle of θ radians with the vertical and the tension in the rope is $T \text{ N}$ (see diagram). You may assume that the rope is always in the same vertical plane as the radius OA of the disc.

- (i) Given that $\cos \theta = \frac{24}{25}$, find the value of ω . [5]
- (ii) Given instead that the speed of P is twice the speed of the point A , find
 - (a) the value of T , [3]
 - (b) the speed of P . [2]

2



A particle of mass 0.15 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 magnitude of the acceleration of the particle is 7 m s^{-2} . The string makes an angle of θ° with the downward vertical, as shown in the diagram. Find

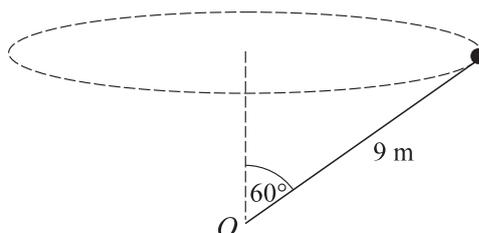
- (i) the value of θ to the nearest whole number, [3]
- (ii) the tension in the string, [1]
- (iii) the speed of the particle. [2]

3 A horizontal turntable rotates with constant angular speed $\omega \text{ rad s}^{-1}$ about its centre O . A particle P of mass 0.08 kg is placed on the turntable. The particle moves with the turntable and no sliding takes place.

- (i) It is given that $\omega = 3$ and that the particle is about to slide on the turntable when $OP = 0.5 \text{ m}$. Find the coefficient of friction between the particle and the turntable. [3]
- (ii) Given instead that the particle is about to slide when its speed is 1.2 m s^{-1} , find ω . [5]

- 4 A railway engine of mass 50 000 kg travels at a constant speed of 25 m s^{-1} on a horizontal circular track of radius 1250 m. Find the magnitude of the horizontal force on the engine. [3]

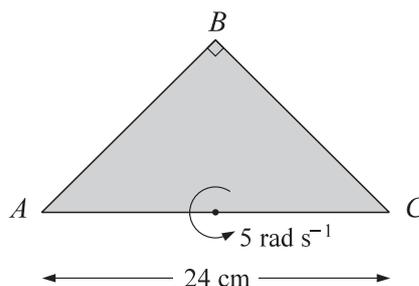
5



A toy aircraft of mass 0.5 kg is attached to one end of a light inextensible string of length 9 m . The other end of the string is attached to a fixed point O . The aircraft moves with constant speed in a horizontal circle. The string is taut, and makes an angle of 60° with the upward vertical at O (see diagram). In a simplified model of the motion, the aircraft is treated as a particle and the force of the air on the aircraft is taken to act vertically upwards with magnitude 8 N . Find

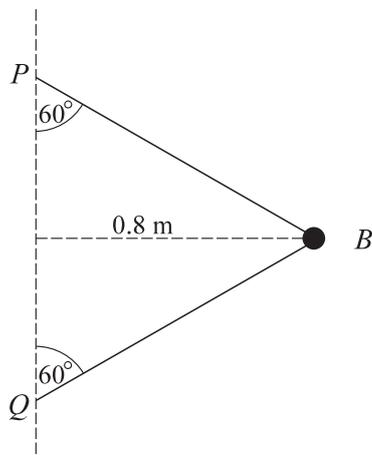
- (i) the tension in the string, [3]
 (ii) the speed of the aircraft. [4]

6



A uniform isosceles triangular lamina ABC is right-angled at B . The length of AC is 24 cm . The lamina rotates in a horizontal plane, about a vertical axis through the mid-point of AC , with angular speed 5 rad s^{-1} (see diagram). Find the speed with which the centre of mass of the lamina is moving. [3]

7



A small ball B of mass 0.5 kg is attached to points P and Q on a fixed vertical axis by two light inextensible strings of equal length. Both of the strings are taut and each is inclined at 60° to the vertical, as shown in the diagram. The ball moves with constant speed 4 m s^{-1} in a horizontal circle of radius 0.8 m . Find the tension in the string PB . [6]