3.3 Further Mechanics: Circular Motion: 10-minute Pack

AQA 7367 · Calculator allowed · about 10 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

Formulae and modelling assumptions used in this worksheet

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Unless a question states otherwise, take g = 9.8 m/s^2 and model each object as a particle. Strings are light and inextensible; rods are light and rigid; all surfaces, tracks, hemispheres and hinges are smooth (frictionless) unless friction is explicitly stated. For a particle moving on a circle of radius r with angular speed omega, the linear speed is v = r*omega, and the magnitude of the centripetal (radial) acceleration, directed towards the centre of the circle, is a = v^2/r = r*omega^2. For a conical pendulum and for a vehicle on a banked track, resolve the forces vertically and horizontally (or perpendicular and parallel to the surface) to form simultaneous equations linking the tension or normal reaction to the speed. For vertical circular motion, combine Newton's second law in the radial direction with conservation of energy; the critical condition for a particle on a string, or moving on the inside of a smooth circular track or the outside of a smooth sphere, occurs where the tension or normal reaction is zero, whereas a particle threaded on a rigid rod can maintain circular motion even when its speed is instantaneously zero.

1 A small ball of mass 0.2 kg lies on a smooth horizontal table and is attached to a fixed point on the table by a light inextensible string of length 0.5 m. The ball moves in a horizontal circle of radius 0.5 m at a constant speed of 3 m/s.

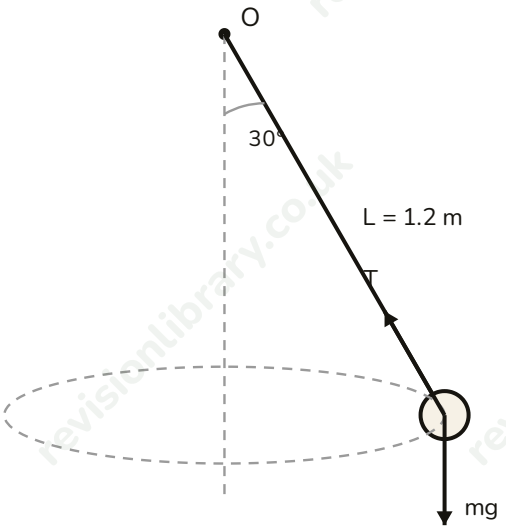
(a) Find the angular speed of the ball. **(2)**

(b) Find the tension in the string. **(2)**

(Total for Question 1 is 4 marks)

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2 During a practical, Sofia sets up a conical pendulum using a string of length 1.2 m, with the string making a constant angle of 30 degrees with the vertical. She measures the time for one complete revolution and records a period of 1.6 seconds. Verify whether Sofia's recorded period is consistent with the given length and angle.



(Total for Question 2 is 4 marks)

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Mark scheme · 3.3 Further Mechanics: Circular Motion: 10-minute Pack

Question 1

(a) uses $\omega = v/r$	**M1**
(a) $\omega = 6$ rad/s, cao	**A1**
(a) Answer: $\omega = 6$ rad/s	
(b) uses $T = m*v^2/r$	**M1**
(b) $T = 3.6$ N, cao	**A1**
(b) Answer: $T = 3.6$ N	

Question 2

uses the conical pendulum result $\omega^2 = g/(L*\cos(\theta))$ with $L = 1.2$ and $\theta = 30$ degrees	**M1**
substitutes values correctly and finds the corresponding period, period $= 2*\pi/\omega$	**M1**
period $= 2.05$ s, awrt	**A1**
compares this calculated period with the recorded value of 1.6 s and correctly concludes that Sofia's measurements are not consistent with a half-angle of 30 degrees, since 2.05 s does not equal 1.6 s, oe	**A1**

Answer: The theoretical period for a half-angle of 30 degrees is awrt 2.05 s, which does not match Sofia's recorded period of 1.6 s, so the measurements are not consistent.

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