4.2 Circular Motion

MCQ

1 ✓ | 1 mark

A website states: "The radius of the orbit of the Moon around the Earth is increasing by a small amount each year, however the time period of the orbit remains constant."

Which row of the table is correct if the statement is true?

	Angular velocity of Moon	Speed of Moon
A	constant	constant
B	constant	increasing
C	increasing	constant
D	increasing	increasing

Structured Questions

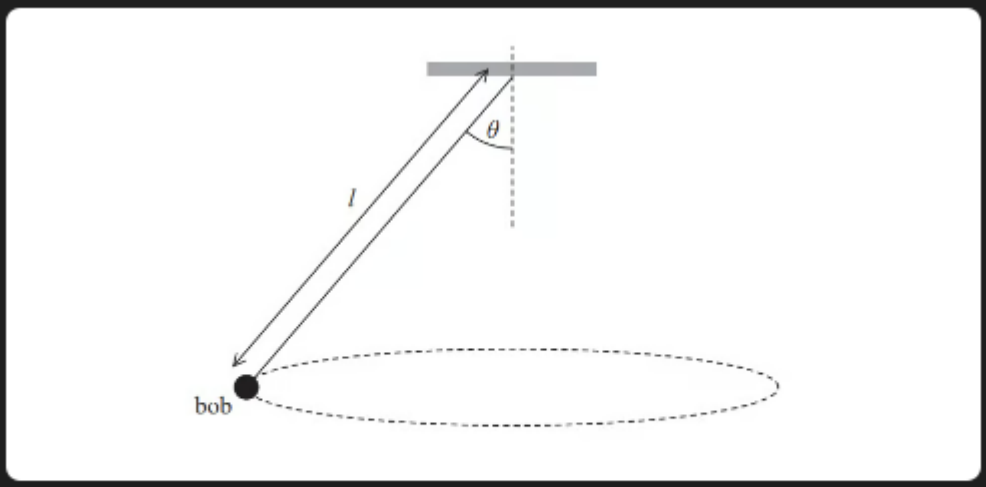
Medium

1a

2 marks

18th century clocks sometimes used a conical pendulum to measure regular periods of time.

A conical pendulum consists of a bob of mass m fixed to the end of a wire of length l as shown. The bob is set to follow a circular path in the horizontal plane. The wire makes an angle θ with the vertical.



Add to the diagram to show the two forces acting on the bob.

1b

7 marks

i) Derive the following equation for the angular velocity ω of the bob.

$$\omega = \sqrt{\frac{g}{l \cos \theta}}$$

(4)

ii) A clock requires the period of the bob to be 5.0 s.

$l = 6.4\,\text{m}$
$\theta = 13.9°$

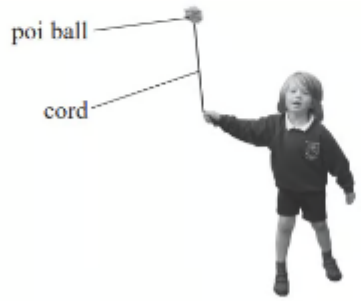
Deduce whether this arrangement leads to the required period.

(3)

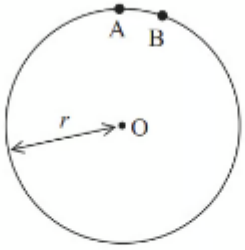
2a

5 marks

A poi ball is a ball attached to a person's hand by a cord. A child makes the poi ball undergo circular motion in a vertical plane as shown in the photograph.



The poi ball moves clockwise in a circle of radius *r*, centre O, with a constant speed *v*.
The diagram shows two positions, A and B, of the poi ball.



Derive the equation for centripetal acceleration $a = \frac{v^2}{r}$ by considering the velocity of the poi ball at these two positions.

Your answer should include a vector diagram.

2b

3 marks

The poi ball completes 1.3 revolutions per second.

Calculate the acceleration of the poi ball.

radius of circular motion = 0.58 m

Acceleration = ...

2c

4 marks

The child comments that as the ball goes round the circle with a constant speed, the size of the force on his hand changes.

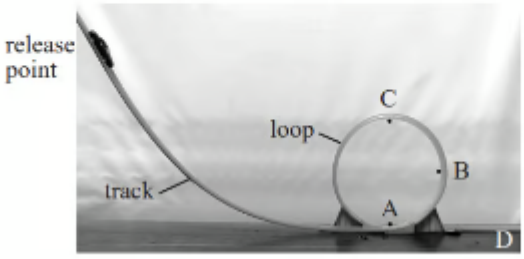
Discuss whether this comment is correct.

Hard

1

6 marks

The photograph shows a track for a toy car. The car moves down the track towards a circular loop. The loop starts at point A.



If the release point of the car is high enough, the car moves fast enough to pass point C and complete the loop, continuing to the end of the track at point D.

If the release point is too low, the car falls off the track between point B and point C.

Deduce whether a car released from a vertical height of 25 cm above point A will complete the loop and reach point D. You should assume that friction is negligible.

vertical height of point C above point A = 22 cm
mass of toy car = 33 g

(6)