Circular Motion

Further mechanics · 4 questions · step-by-step answers at the end

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USEFUL EQUATIONS

$\omega = 2\pi / T \quad v = r\omega \quad a = v^2 / r = r\omega^2 \quad F = mv^2 / r = mr\omega^2$

Questions

Show your working in the space under each question.

1. A satellite orbits once every 90 minutes. Find its angular velocity.

2. A 900 kg car takes a level bend of radius 50 m at 15 m s^{-1}. Find the centripetal force and say what provides it.

3. What is the minimum speed at the top of a vertical circle of radius 0.90 m for water to stay in a bucket?

4. At what speed does a car lose contact with the road at the top of a hump-back bridge of radius 40 m?

Step-by-step answers

Circular Motion

1. $\omega = 2\pi/(5400) = \mathbf{1.16 \times 10^{-3}\ rad\ s^{-1}}$.

2. 1. $F = mv^2/r = 900 \times 15^2/50$.

2. $F = \mathbf{4050\ N}$, toward the centre of the bend.

3. It is provided by **friction** between the tyres and the road.

Answer: 4.05 kN, from friction

3. $v = \sqrt{(gr)} = \sqrt{(9.81 \times 0.90)} = \mathbf{3.0\ m\ s^{-1}}$.

4. $v = \sqrt{(gr)} = \sqrt{(9.81 \times 40)} = \mathbf{20\ m\ s^{-1}}$.