Year 13 Science: Circular motion and gravity

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A 0.050 kg ball on a string moves in a horizontal circle of radius 0.40 m, taking 0.50 s per revolution. Find the tension, ignoring gravity.

2. A bend of radius 120 m is banked at 12.0°. At what speed is no friction needed?

3. A roller coaster loop has radius 12.0 m at the top. What is the slowest the car can go at the top and still follow the track?

4. An 80.0 kg astronaut weighs 785 N on the Earth's surface. What is the gravitational force on her one Earth radius above the surface?

Exam-style question: an Earth observation satellite

A satellite that images New Zealand's forests orbits 700 km above the Earth's surface in a circular orbit. Earth's mass is 5.97×10^{24} kg, its radius 6.37×10^{6} m, and $G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}.

5. Show that the gravitational field strength at the satellite's height is 7.97 N kg^{-1}.

6. Calculate the satellite's orbital speed.

7. Calculate its orbital period in minutes.

8. Explain why the satellite keeps a constant speed without using its engines, even though a force acts on it the whole time.

Fix the mistake

9. Correct this statement: "The free-body diagram shows weight, tension and a centripetal force."

10. Correct this statement: "For a satellite 700 km up, $F = GMm \div (7.00 \times 10^{5})^2$."

11. Correct this statement: "Astronauts in orbit are weightless because there is no gravity up there."

12. Correct this statement: "A heavier satellite must go faster to stay in the same orbit."