orbits - practice problems

1. A 40 kg rider is on a circular ride with radius 8 m. The ride has bright lights around the edge, but the circular motion depends on radius and speed. If the rider moves at 6 m/s, what centripetal force is required, and which direction does it point?

2. A car moves through a circular highway curve with radius 75 m at a speed of 15 m/s. The road sign gives an advisory speed, but use the given speed here. What is the car's centripetal acceleration?

3. A rotating space station design has radius 40 m, about the length of a large classroom hallway. How fast does the outer edge need to move to create an artificial gravity acceleration of 9.8 m/s^2?

4. The outer edge of the 40 m radius station moves at 19.8 m/s. How long does one rotation take?

5. A 1.8 m tall person stands with their feet on the outer edge of the same 40 m radius station. Their head is 38.2 m from the center. If one rotation takes 12.7 s, what acceleration does the person's head feel?

6. A 65 kg person in the rotating station has a head-level circular speed of 18.9 m/s at a radius of 38.2 m. What inward force would be needed if their whole mass were moving at that radius?

7. A small satellite is 100 km above the Moon's surface. Use the Moon's mass as 7.346 × 10 22 kg and radius as 1.737 × 10 6 m. What circular orbital speed is needed?

8. A 500 kg satellite orbits 300 km above a planet's surface. What is its orbital speed?

9. A satellite is 400 km above Earth's surface. Use Earth's mass as 5.972 × 10 24 kg and radius as 6.371 × 10 6 m. What circular orbital speed is needed?

10. A very low circular orbit around Mars has radius 3.390 × 10 6 m from Mars's center. Use Mars's mass as 6.417 × 10 23 kg. What orbital speed is needed?

11. A 100 kg satellite and a 400 kg satellite both orbit Earth at a radius of 1.00 × 10 7 m. First find the orbital speed, then find the centripetal force needed for each satellite. Use Earth's mass as 5.972 × 10 24 kg.

12. A satellite around Earth has a circular orbital speed of 6000 m/s. Use Earth's mass as 5.972 × 10 24 kg. What is the orbital radius, and what is the altitude above Earth's surface?

13. A GPS satellite has an orbital speed of about 3870 m/s. Use Earth's mass as 5.972 × 10 24 kg and Earth's radius as 6.371 × 10 6 m. Estimate its orbital radius and altitude.

14. Use the 400 km altitude Earth satellite from earlier. Its orbital radius is 6.771 × 10 6 m and its speed is 7670 m/s. How long does one orbit take?

15. Around the same planet, satellite B orbits at 4 times the orbital radius of satellite A. How does satellite B's circular orbital speed compare to satellite A's?

16. A satellite around Earth has orbital radius 4.22 × 10 7 m and speed 3070 m/s. If another circular orbit around Earth has one-fourth that radius, what speed would it need?

17. A 900 kg satellite is in a 400 km altitude circular orbit around Earth. Its orbital radius is 6.771 × 10 6 m and its speed is 7670 m/s. What centripetal force is required?

18. A satellite is at an orbital radius of 1.00 × 10 7 m from Earth's center and is moving at 5500 m/s. Use Earth's mass as 5.972 × 10 24 kg. Is that fast enough for a circular orbit at that radius?

19. A satellite orbits 800 km above the Moon's surface while mapping crater shadows. Its orbital radius is 2.537 × 10 6 m and its circular speed is 1390 m/s. Estimate the time for one orbit.