

**Short Answer: Answer each question briefly. You do not need to write in full sentences.**

1. What are Kepler's 3 Laws of Planetary Motion?
2. What are the requirements for a satellite to get into and stay in orbit?
3. Name one use of a satellite.
4. In what direction does the gravitational field surrounding a mass point?
5. Are we closer to the Sun in the summer or winter?
6. Are astronauts orbiting the earth in the ISS actually weightless? Explain.
7. Sketch a drawing of Earth's gravitational field.

**Problem Solving: Solve each problem. Show all work and box all final answers.**

8. Find the acceleration due to gravity on the surface of the following planets:

a. Sun

b. Jupiter

9. Engineers are planning to place the International Space Station (ISS) into orbit at an altitude of 450 km above Earth's surface. What would be the orbital speed and period of the satellite?

10. Earth's gravitational field is 7.83 N/kg at the altitude of a space shuttle. At this altitude, what is the size of the force of attraction between an astronaut with a mass of 45 kg and Earth? How does this compare to the space shuttle's force of attraction on the surface of Earth?

11. The moon's mass is  $7.34 \times 10^{22}$  kg, and its orbital radius around Earth is  $3.8 \times 10^8$  m. Calculate the gravitational force of attraction between Earth and the Moon. Then, find Earth's gravitational field at the Moon.
12. Two satellites are in orbit around a planet. One satellite has an orbital radius of  $8 \times 10^6$  m. The period of rotation for this satellite is  $1 \times 10^6$  s. The other satellite has an orbital radius of  $2 \times 10^7$  m. What is this satellite's period of rotation?
13. If a meteorite hit Earth and moved it  $2.41 \times 10^{10}$  m closer to Venus, how many days would there be in an Earth year?