MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Approximately where is it currently high tide on Earth? 1) _____
   A) on the portion of Earth facing directly toward the Moon and on the portion of Earth facing directly away from the Moon
   B) anywhere that ocean water laps upon the shore
   C) only on the portion of the Earth facing directly toward the Moon
   D) wherever it is currently noon

2) Which of the following best describes the origin of ocean tides on Earth? 2) _____
   A) The Moon's gravity pulls harder on water than on land, because water is less dense than rock.
   B) Tides are caused by the difference in the force of gravity exerted by the Moon across the sphere of Earth.
   C) Tides are caused by the 23.5–degree tilt of the Earth's rotational axis to the ecliptic plane.
   D) Tides are caused on the side of the Earth nearest the Moon because the Moon's gravity attracts the water.

3) At which lunar phase(s) are tides most pronounced (for example, the highest high tides)? 3) _____
   A) third quarter Moon only
   B) new Moon only
   C) both first and third quarters
   D) both new and full Moons
   E) full Moon only

4) Which of the following best explains why the Moon's orbital period and rotation period are the same? 4) _____
   A) The Moon once rotated faster, but tidal friction slowed the rotation period until it matched the orbital period.
   B) The equality of the Moon's orbital and rotation periods is an extraordinary astronomical coincidence.
   C) The Moon was once closer to Earth, but the force of gravity got weaker as the Moon moved farther away.
   D) The law of conservation of angular momentum ensured that the Moon must have the same amount of rotational angular momentum as it has of orbital angular momentum.

5) Which of the following is *not* one of, nor a direct consequence of, Kepler's Laws? 5) _____
   A) More distant planets orbit the Sun at slower speeds.
   B) The force of attraction between any two objects decreases with the square of the distance between their centers.
   C) As a planet moves around its orbit, it sweeps out equal areas in equal times.
   D) A planet or comet in a noncircular orbit travels faster when it is nearer to the Sun and slower when it is farther from the Sun.
   E) The orbit of each planet about the Sun is an ellipse with the Sun at one focus.

6) Suppose the Sun were suddenly to shrink in size but that its mass remained the same. According to the law of conservation of angular momentum, what would happen? 6) _____
A) The Sun's rate of rotation would slow.
B) The Sun's angular size in our sky would stay the same.
C) The Sun would rotate faster than it does now.
D) This could never happen, because it is impossible for an object to shrink in size without an outside torque.

7) Earth is farthest from the Sun in July and closest to the Sun in January. During which Northern Hemisphere season is Earth moving fastest in its orbit? 7) _____
A) Summer B) Winter C) Fall D) Spring

8) According to Kepler's third law ($p^2 = a^3$), how does a planet's mass affect its orbit around the Sun? 8) _____
A) More massive planets orbit the Sun at higher average speed.
B) A more massive planet must have a larger semimajor axis.
C) A planet's mass has no effect on its orbit around the Sun.
D) More massive planets must have more circular orbits.

9) All the following statements are true. Which one follows directly from Kepler's third law ($p^2 = a^3$)? 9) _____
A) Venus has a thicker atmosphere than Mercury.
B) Venus takes longer to rotate than it does to orbit the Sun.
C) Venus is more massive than Mercury.
D) Venus orbits the Sun at a slower average speed than Mercury.

10) Suppose a comet orbits the Sun on a highly eccentric orbit with an average (semimajor axis) distance of 1 AU. How long does it take to complete each orbit, and how do we know? 10) _____
A) Each orbit should take about 2 years, because the eccentricity is so large.
B) It depends on the eccentricity of the orbit, as described by Kepler's second law.
C) One year, which we know from Kepler's third law.
D) It depends on the eccentricity of the orbit, as described by Kepler's first law.

11) Suppose that the Sun shrank in size but that its mass remained the same. What would happen to Earth's orbit? 11) _____
A) The size of Earth's orbit would shrink, and it would take less than one year to orbit the Sun.
B) Earth's orbit would expand, and it would take more than one year to orbit the Sun.
C) Earth's orbit would be unaffected.
D) Earth would change from a bound orbit to an unbound orbit and fly off into interstellar space.

12) Neptune circles the Sun at a distance of 4.50×10^{12} m once every 164 years. Saturn circles the Sun at a distance of 1.43×10^{12} m. What is the orbital period of Saturn? 12) _____
A) 121 yr B) 304 yr C) 29.4 yr D) 109 h E) 88.6 yr

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

13) The International Space Station is orbiting at an altitude of about 370 km above the earth's surface. The mass of the earth is 5.97×10^{24} kg, the radius of the earth is 6.38×10^{6} m, and $G = 6.67 \times 10^{-11}$ N • m^2/kg^2. Assuming a circular orbit,
(a) what is the period of the International Space Station's orbit?
(b) what is the speed of the International Space Station in its orbit?

13) _____