**Name:** _____ **Date:** _____

# Answer Key: Stellar Dynamics 12th Grade Orbital Quiz

Calculate orbital mechanics and analyze axial precession through diverse problem sets designed to bridge Newtonian physics with observational astronomy.

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**1. Which astronomical phenomenon, occurring over a ~26,000-year cycle, is responsible for the gradual shift in the positions of constellations relative to the equinoxes?**

**Answer:** B) Axial precession

Axial precession, caused by the gravitational tug of the Sun and Moon on Earth's equatorial bulge, makes the Earth's axis trace a cone, changing the 'North Star' over millennia.

**2. The _____ limit refers to the minimum distance from a planet where a moon can remain intact without being shredded by tidal forces.**

**Answer:** C) Roche

The Roche limit is a critical concept in celestial mechanics explaining why planetary rings (like Saturn's) exist where moons cannot form or survive.

**3. During perihelion, the Earth is at its furthest point from the Sun, resulting in lower orbital velocities according to Kepler's Second Law.**

**Answer:** B) False

False. Perihelion is the point of closest approach. According to Kepler’s Second Law, the Earth travels faster when it is closer to the Sun.

**4. Milankovitch cycles are used to model long-term climate changes on Earth. Which component of these cycles refers specifically to the shape of Earth's orbit around the sun?**

**Answer:** C) Eccentricity

Eccentricity measures how much an elliptical orbit deviates from a perfect circle, impacting the total variation in solar radiation received annually.

**5. The _____ point L1 is a position in space between the Earth and the Sun where gravitational forces allow an object to remain nearly stationary relative to them.**

**Answer:** A) Lagrange

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Lagrange points are equilibrium points for small-mass objects under the influence of two massive orbiting bodies.

**6. The sidereal day is approximately 4 minutes shorter than the solar day because the Earth must rotate slightly more than 360 degrees to realign with the Sun.**

**Answer:** A) True

True. Because Earth moves in its orbit while rotating, it takes extra time (4 minutes) to face the Sun again compared to distant stars.

**7. What specifically causes the 'Analemma'—the figure-eight curve representing the Sun's position in the sky—when photographed at the same time throughout the year?**

**Answer:** C) Axial tilt and orbital eccentricity

The vertical component is caused by Earth's tilt (seasons), while the horizontal component is caused by Earth's varying orbital speed (eccentricity).

**8. When the Moon is at _____, its furthest point from Earth, it appears smaller and can result in an annular solar eclipse rather than a total one.**

**Answer:** B) Apogee

Apogee is the point in a satellite's orbit farthest from Earth; if an eclipse occurs then, the Moon's angular diameter is too small to cover the Sun.

**9. The Barycenter of the Earth-Moon system is located deep within the Earth's mantle, rather than at the exact geometric center of the Earth.**

**Answer:** A) True

True. The barycenter (center of mass) is about 4,670 km from Earth's center. Both bodies orbit this point, which is technically inside the Earth.

**10. Which force is primarily responsible for the 'Tidal Bulge' found on the side of Earth opposite to the Moon?**

**Answer:** B) Inertia (Centrifugal effect) from the system's rotation

While gravity pulls water toward the Moon on one side, inertia/centrifugal force creates the second bulge on the opposite side as Earth rotates around the barycenter.