

Advanced Solar System Astrophysics

Solar System Basics · Answer Key · 10 Questions

1. Which region of the solar system is characterized by a vast, disc-shaped population of icy bodies, remnants from the formation of the solar system, and is considered the source of short-period comets?

- A) The Oort Cloud
- B) The Kuiper Belt**
- C) The Asteroid Belt
- D) The Scattered Disc

2. The Roche limit for a celestial body is the minimum distance at which a second celestial body, held together by its own gravity, can approach the first without being torn apart by the tidal forces. For a rigid satellite, this limit is approximately 1.26 times the radius of the primary. What is the approximate Roche limit for a fluid satellite around Earth, relative to Earth's radius?

- A) 0.85 R_{earth}
- B) 1.26 R_{earth}
- C) 2.44 R_{earth}
- D) 3.9 R_{earth}**

3. The terrestrial planets in our solar system exhibit significant differences in their atmospheric composition. Which of the following statements most accurately describes the dominant atmospheric component for each of the terrestrial planets (Mercury, Venus, Earth, Mars) in order?

- A) Nitrogen, Carbon Dioxide, Oxygen, Carbon Dioxide**
- B) Carbon Dioxide, Nitrogen, Oxygen, Carbon Dioxide
- C) Helium, Argon, Nitrogen, Nitrogen
- D) Hydrogen, Methane, Oxygen, Carbon Dioxide

4. What is the primary mechanism responsible for the observed difference in the rate of rotation between the inner and outer planets of our solar system, considering their formation from the solar nebula?

- A) The conservation of angular momentum during accretion, with larger masses accumulating more momentum.**
- B) Differential gravitational forces from the Sun on larger bodies, causing them to spin down.
- C) The impact of smaller planetesimals during the later stages of formation, imparting varying angular momenta.
- D) The outward migration of gas giants, which dragged surrounding material and altered rotation.

5. The process of core accretion is the dominant theory for the formation of the giant planets. Which factor is considered the most critical for enabling the rapid accumulation of massive hydrogen and helium envelopes by the gas giants (Jupiter and Saturn)?

- A) The presence of large quantities of metallic hydrogen in the early solar nebula.
- B) The temperature gradient in the protoplanetary disk, allowing ice giants to form closer to the Sun.
- C) The ability to accumulate a solid core mass of approximately 10 Earth masses before the protoplanetary disk dissipated.**
- D) Strong magnetic fields in the protoplanetary disk that attracted gaseous material.

6. Io, a moon of Jupiter, is volcanically active to an extreme degree. What is the primary energy source driving this intense geological activity?

- A) Radiogenic decay within its core.
- B) Tidal heating caused by Jupiter's immense gravity and the gravitational influence of other Galilean moons.**
- C) Residual heat from its formation.
- D) Accretion of micrometeorites.

7. The composition of Saturn's rings is primarily what substance, organized into countless individual particles ranging in size from dust grains to boulders?

- A) Silicate rock
- B) Frozen methane and ammonia
- C) Water ice**
- D) Metallic iron

8. The planet Uranus has an unusual axial tilt of approximately 98 degrees. This extreme tilt is widely believed to be the result of what celestial event?

- A) A close encounter with a rogue planet during the early solar system.
- B) The cumulative gravitational pull of all the other planets over billions of years.
- C) A massive impact with a protoplanet-sized object early in its history.**
- D) Instability in its orbit due to resonance with Neptune.

9. The 'Great Dark Spot' observed on Neptune by the Voyager 2 spacecraft was a large anticyclonic storm. What is the primary reason for the generally clearer and less cloudy appearance of Neptune compared to Jupiter and Saturn?

- A) Neptune's lower internal heat flux.**
- B) A thicker atmospheric layer of hydrogen.
- C) Less solar radiation reaching Neptune.
- D) A higher concentration of metallic hydrogen in its core.

10. The existence of the Kuiper Belt is strongly supported by observations of which population of objects?

A) Long-period comets originating from the Oort Cloud.

B) Short-period comets, many of which have orbital periods less than 200 years.

C) Asteroids with highly elliptical orbits.

D) Near-Earth Objects (NEOs) with orbits that cross Earth's path.