

## Astronomy 4 Test #3 Practice

### Multiple Choice

Choose the *ONE* best answer for each question.

1. Which of the following things makes Saturn's moon Titan unique amongst all of the moon in the solar system?
  - a. It has a rocky surface.
  - b. It orbits Saturn in the opposite direction from Saturn's other moons.
  - c. It has a thick atmosphere.
  - d. It has flows of molten lava on its surface.
  
2. How were the rings of Uranus discovered?
  - a. Astronomers used radar signals from the Earth and bounced them off of the rings, receiving the reflected waves with radio telescopes.
  - b. Astronomers saw a star appear to momentarily get dimmer as it passed behind each of the rings.
  - c. They were among the first features discovered with the telescope in the 1600s.
  - d. Astronomers could see them silhouetted in front of Uranus when they observed Uranus with large telescopes.
  
3. Which of the following statements best describes what's weird about the orbit of Triton, the large moon of Neptune?
  - a. Its orbit is more elliptical than those of most moons.
  - b. It orbits closer to Neptune than any other moon orbits its 'parent' planet.
  - c. It orbit Neptune in the opposite direction that most moons orbit their 'parent' planets.
  - d. Its orbit is not very close to the plane of the ecliptic; it passes over the north and south poles of Neptune.

4. What's the biggest difference -besides overall size and mass - between the Earth and Jupiter?
  - a. The Earth's solid surface has much more atmosphere on top of it than is the case for Jupiter.
  - b. Jupiter is composed mostly of liquid metallic hydrogen, while the Earth is mostly silicate rock, and iron.
  - c. Jupiter has much more of its surface area covered by oceans.
  - d. The Earth is mostly hydrogen and helium, while Jupiter is a good example of a 'Jovian' planet, made mostly of rock and metal.
  
5. Mercury, Venus, Mars, Jupiter, and Saturn are sometimes referred to as the 'classical' planets. Why isn't Uranus in this list?
  - a. The cultures of the early, pre-telescopic observers all had room for only 5 planets in their religious and mythological interpretations of the sky.
  - b. The strange, highly tilted rotational axis of Uranus made it seem too strange to consider a planet like the others.
  - c. It's far enough from the Sun that, even though it's barely visible to the eye from time to time, it wasn't noticed by the pre-telescopic astronomers.
  - d. Uranus doesn't show any apparent 'retrograde motion' in the sky, so it wasn't considered a planet like the others.
  
6. In 1877, Mars was at opposition as seen from the Earth, and the Italian astronomer Schiaparelli described seeing 'canali' (singular: 'canale') on its surface. This wasn't translated into other languages (such as English) correctly. What was the result?
  - a. People thought he meant 'canals', which would imply that there are intelligent, canal-building Martians on the surface.
  - b. Astronomers reading translations of his report thought he meant that the surface of Mars is broken into large, channel-like valleys and ridges due to fracturing of its crust.
  - c. The study of Mars was set back for many years, because Schiaparelli hadn't seen evidence of active volcanic activity.
  - d. Other astronomers were highly impressed with the resolving power of his telescope, and basically left the study of Mars entirely up to him for decades.

7. Imagine that you build a large spacecraft and fly to Jupiter. Once you go into orbit around Jupiter, you set off in a small landing pod (the same one you used to land on Mars, during your trip to Jupiter), and you try to land on Jupiter. Which of the following scenarios best describes what will happen?
  - a. You won't actually go down through an atmosphere, since the solid surface of Jupiter is directly exposed to the vacuum of space.
  - b. You'll eventually land on the surface, but by the time you do so, there will be almost no sunlight reaching the ground, you'll be so deep.
  - c. It won't be possible to land on the surface, because the rotation rate of Jupiter is too high for your landing pod to be able to land there.
  - d. You'll sink deeper and deeper into the atmosphere, until it slowly gets dense enough to be liquid.
  
8. Which of these things provides the best example of evidence for rainfall (or possibly snowfall) on Mars at some time in the distant past?
  - a. The presence of a great deal of frozen water below the surface, in Mars's soil.
  - b. The 'valley networks', which resemble branching valleys on the Earth.
  - c. The 'outflow channels', which resemble the pathways of floods that are seen in parts of the Pacific Northwest of the U.S..
  - d. The large canyons on the Martian surface, such as the Valles Marineris.
  
9. Titan, Saturn's largest moon, has lakes made of liquid methane. Which of the following is the best reason why the Earth doesn't have lakes like this?
  - a. The temperature at the surface of the Earth is much too warm for methane to be a liquid.
  - b. The carbon dioxide in the Earth's atmosphere makes it impossible for methane to exist on the Earth.
  - c. The ultraviolet light reaching the Earth's surface breaks down methane too quickly for it to collect in lakes.
  - d. There is very little methane at the surface of the Earth; most of it is deep in the Earth's mantle.

10. How does Jupiter's moon Io tell us that Jupiter must be very massive, even though the outer part of Jupiter is made of gas?
  - a. Io orbits Jupiter at about the same radius as the orbit of the Earth's moon, but it orbits much faster, so Jupiter's gravity must be much stronger than the Earth's.
  - b. In order for Io to be as massive as it is, the collision that formed the Galilean moons must have ejected a lot of material from Jupiter, but since Jupiter is still so big, it must have a very high mass.
  - c. Since Io's orbit was 'circularized' by tidal forces from Jupiter, Jupiter must be extremely massive in order to create those forces.
  - d. The Io flux tube is something that only a massive object like Jupiter could produce.
  
11. In 1989, the Voyager 2 spacecraft took images of Neptune's large moon, Triton. These images are thought to give us a preview of which \*other\* solar system body, which we won't see until a probe reaches it in 2015?
  - a. Mercury
  - b. Mimas
  - c. Eris
  - d. Pluto
  
12. Jupiter's magnetic field makes a giant electric current with its moon Io, called the 'Io flux tube'. At the places where this huge loop of electricity touches Jupiter, what effects does it have?
  - a. The atmosphere is thinner in these areas, due to heating by the electric current.
  - b. The atmosphere becomes much more turbulent in those areas.
  - c. In these areas, Jupiter's rotation is much faster.
  - d. There are large auroras, like the Earth's, but much more powerful.
  
13. Which of the following statements comparing Mars's seasons with the Earth's seasons is the most accurate?
  - a. The rotational axis of Mars is not tilted at all with respect to its orbital plane, so Mars has almost no seasons.
  - b. Mars has four seasons like the Earth, and since the Martian year is thus divided into four parts, each of those seasons is the same length as an Earth season.
  - c. Mars has seasons like the Earth, because its axis is tilted, but each season is longer than on the Earth.
  - d. Since Mars takes less time to orbit the Sun, each season on Mars is shorter than a season on the Earth, even though Mars's axis is also tilted like the Earth's.

14. Which of the following is a good description of a major difference between the Earth's moon and Jupiter's moon Europa?
- The density of Europa is much higher than that of the Earth's moon, because it has a much larger iron core than the Earth's moon.
  - Europa is much larger than the Earth's moon.
  - Europa may have a subsurface ocean, while our moon is very dry.
  - Europa is not spherical, because it's too small for gravity to have formed it into a sphere.
15. The planet Uranus takes about 17 hours to rotate once on its axis. When the Voyager 2 spacecraft flew past Uranus in 1986, Uranus's south pole was pointed at the Sun. Imagine that you were on Uranus at that time (well, at least hovering high in its atmosphere in a balloon, suspended over the same part of Uranus at all times.) The part of Uranus that you were hovering over was a point a little ways south of the equator. How would the Sun have appeared at that time?
- It would have been just above the horizon, going around in a circle.
  - It would have been nearly overhead at all times.
  - It would have been invisible, far below the horizon.
  - It would have been above the horizon for about 8.5 hours, and below the horizon for about 8.5 hours.
16. Why are the rings of Saturn, Jupiter, and the other outer planets all within a certain distance (called the *Roche Limit*) of their host planets?
- This is the zone where large asteroids collide when approaching these planets, and the rings form from these collisions.
  - Moons get broken up by tidal forces outside this limit, and their broken pieces drift inside it, forming the rings.
  - Within this limit, tidal forces will break up any large body into many smaller bodies, thus forming a ring of small particles.
  - Beyond this limit, the gravity of the planet is too weak for anything to orbit it.
17. Io, one of the Galilean moons of Jupiter, is a great example of the effect that tidal forces can have in heating the inside of an astronomical body. If you could orbit over Io's surface and examine it, which of these things would you see that show the effects of this process?
- A very heavily cratered surface
  - Lakes of liquid methane
  - An icy surface with cracks that suggest a subsurface ocean
  - A large number of volcanoes

18. A physicist once calculated that Saturn's rings can't be solid disks, because the forces associated with their rotation would tear them apart. Which of the following best describes what they're *really* made of?
- Clouds of gas, shaped into disks by their rotation
  - His calculations turned out to be incorrect, they really *are* solid disks.
  - Dark rock chunks, mostly from boulder- to house-sized
  - Particles of ice, ranging from dust-sized grains to house-sized blocks
19. What evidence suggests that Saturn's moon Enceladus might have a subsurface ocean (and thus possibly life), like Jupiter's moon Europa?
- The surface is highly deformed, showing strange, fold-like patterns called 'ovoids'.
  - The surface is covered with channels that appear to have been carved by liquid hydrocarbons, such as liquid methane.
  - Geysers of water that have been observed shooting out of its south polar region.
  - Extremely active volcanism, suggesting that strong tidal heating keeps its interior molten.
20. Which of the following statements best explains how the planet Neptune was discovered?
- It was first observed by the ancient Babylonians, and an astronomer who learned to read their language realized that it had been forgotten for centuries.
  - Unexplained irregularities in the orbit of Uranus allowed astronomers to use mathematical analysis to figure out where Neptune ought to appear in the sky.
  - A well-prepared amateur found it unexpectedly while searching the sky for new astronomical objects with his telescope.
  - Neptune was observed passing in front of the Sun, which clearly showed that there was at least one undiscovered planet in the solar system.

21. One can find deep canyons on both the Earth and Mars, such as the Earth's Grand Canyon and Mars's Valles Marineris. What is something that's fundamentally different about these two canyons?
  - a. The two canyons are nearly identical in appearance and geological history - there really isn't a significant difference between them.
  - b. The Valles Marineris is a much younger feature than the Grand Canyon. The Grand Canyon is older than most of the geological features on Mars.
  - c. The Grand Canyon was carved by flowing water, whereas the Valles Marineris was the result of faulting, which was due to stretching of the crust.
  - d. Unlike the Valles Marineris, the Grand Canyon is basically a large rift or crack on the side of a huge volcanic bulge.
  
22. Mars has two small moons, Phobos and Deimos. Which of the following statements about their origins is the most accurate, based on astronomers' current knowledge and theories?
  - a. Deimos may have been captured from the asteroid belt, but Phobos is probably made of material ejected from Mars during a large collision.
  - b. Both of Mars's moons probably formed like the Earth's moon, when a large impacting body collided with Mars and ejected a large volume of mantle material.
  - c. Phobos and Deimos are probably captured asteroids, based on their sizes and appearances.
  - d. Since Phobos and Deimos are both made of highly reflective ice, similar to the moons of Saturn, Uranus, and Neptune, they are probably captured objects from the outermost part of the solar system.

**Short Answer**

23. The planet Uranus is sometimes said to have the 'most extreme seasons in the Solar System'. Make a well-labeled drawing (or group of drawings) that shows why astronomers would say that. A good way to attack this problem would be to make a drawing of Uranus in its orbit around the Sun, showing it at various different positions in its orbit.

Make sure that you include the following things:

An accurate depiction of the relation of Uranus's rotational axis to its orbital plane

An explanation of why the seasons are so extreme.

An explanation of why the seasons are not the same length as Earth's.

An explanation of what is similar between Uranus's seasons and the Earth's.

An explanation of why Uranus's equator is not necessarily the warmest part of the planet.

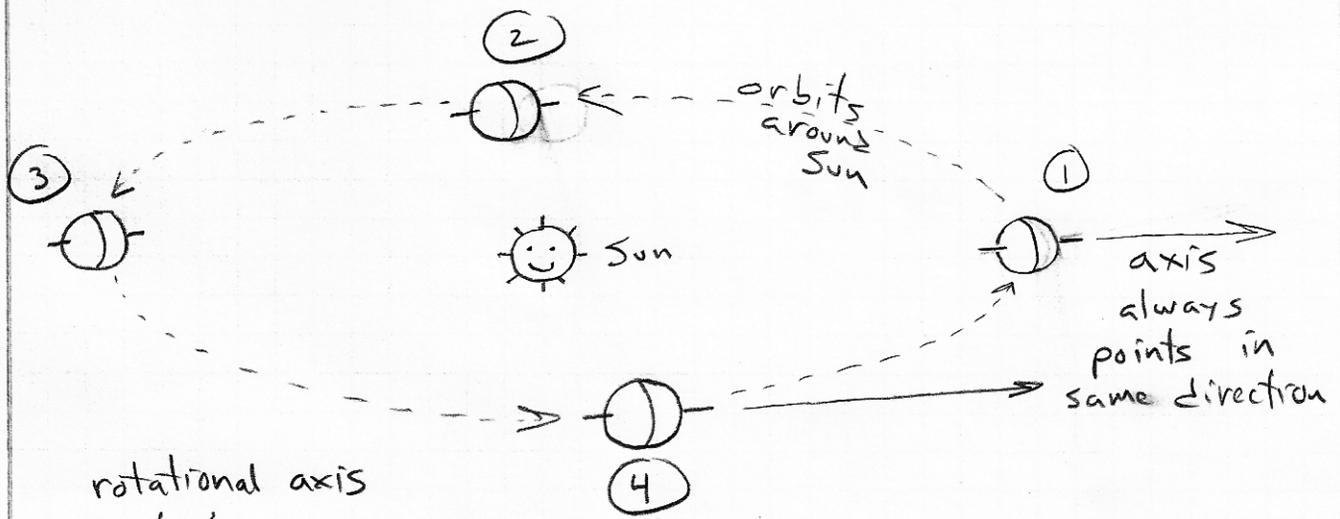
**Astronomy 4 Test #3 Practice  
Answer Section**

***MULTIPLE CHOICE***

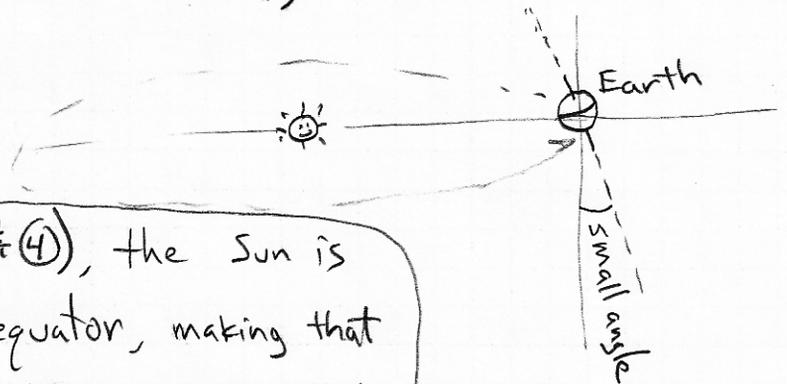
1. ANS: C
2. ANS: B
3. ANS: C
4. ANS: B
5. ANS: C
6. ANS: A
7. ANS: D
8. ANS: B
9. ANS: A
10. ANS: A
11. ANS: D
12. ANS: D
13. ANS: C
14. ANS: C
15. ANS: A
16. ANS: C
17. ANS: D
18. ANS: D
19. ANS: C
20. ANS: B
21. ANS: C
22. ANS: C

***SHORT ANSWER***

23. ANS:  
Answers will vary from student to student.



Uranus's rotational axis is tilted about  $90^\circ$  with respect to its orbital plane, unlike the Earth's, which is tilted much less:



At certain times (② & ④), the Sun is shining on Uranus's equator, making that the warmest planet, like on the Earth. However, at other times (① & ③), either the N or S pole is pointed at the Sun, making that pole the warmest place.

(they're both tilted, Uranus is just much more tilted.)

Uranus is farther from the Sun than the Earth, so its year is much longer than the Earth's. Since each season is about  $\frac{1}{4}$  of its year (as is also true of the Earth), a Uranus season is much longer than an Earth season.