Astro 4 F 2010 E2 sample

Multiple Choice

Identify the choice that best completes the statement or answers the question.

1. How does Venus's atmosphere make the surface of the planet so hot?
   a. The atmosphere is extremely transparent to infrared (heat) radiation. This allows heat from the Sun to reach the surface very easily. This, in turn, allows the Sun to heat up the surface of the planet to a very high temperature.
   b. The thick clouds of Venus trap heat below them. Over time, the surface of the planet gets progressively hotter and hotter.
   c. The carbon dioxide in the atmosphere allows sunlight to get in, but doesn't allow infrared (i.e. heat) radiation to get out, thus making the surface hotter.
   d. The atmosphere is heated by eruptions from Venus's abundant volcanoes, and spreads this heat around the planet, causing the surface to get hotter and hotter.

2. Isaac Newton discovered that the gravitational pull between two objects gets weaker with distance, in such as way that he called it an `inverse square' relationship. Which of the following would be the best example of what he meant by that?
   a. If I could move several times farther from the Earth than I am now, the Earth's gravitational pull would seem about 50% weaker to me.
   b. All objects in the universe exert an equally strong gravitational pull on each other, regardless of the distances between them.
   c. The closer a planet gets to the Sun, the weaker the Sun's gravitational pull on that planet.
   d. If I'm near the Earth, and I move twice as far away, I'll only feel 1/4 as strong of a gravitational pull from the Earth.

3. Which of the following types of rock would you be most likely to find in the lunar highlands?
   a. Granite, a light-colored rock similar to the rock of the Sierra Nevada.
   b. Andesite, a greyish-colored rock similar to the rock that makes up volcanoes like Mt. Shasta.
   c. Basalt, a dark volcanic rock made of solidifed lava.
   d. Anorthosite, a light-colored rock made of minerals rich in calcium and aluminum.

4. Think about a ray of light that is reaching your eye from a distant star. If something about the star changed, and caused the waves of light in that ray to have a higher **frequency** (in other words, more waves per second were hitting your eye than before), what would change about the light's **wavelength**?
   a. The wavelength would get shorter, the light would look bluer.
   b. The wavelength would get shorter; the light would look redder.
   c. The wavelength would get longer; the light would look redder.
   d. The wavelength would stay the same; the light's color would also stay the same.

5. Which of the following statements about the rotation of Venus and the rotation of the Earth is most accurate??
   a. If you were looking down on the north poles of both planets, they would appear to rotate in opposite directions.
   b. Venus's rotational axis is tilted about 60 degrees compared to the Earth's.
   c. If you were looking down on the north poles of both planets, they would appear to rotate in the same direction.
   d. The rotation period (i.e. the length of a day) on each planet is about the same - about 24 hours for each planet.

6. Why would it be hazardous to go skydiving through the clouds of Venus?
   a. Venus's clouds are so high above its surface that the planet's gravitational pull is too weak to pull you down to the surface, and you'd just float away into space.
   b. Venus's clouds are very close to its surface, so when you got down through the clouds, there wouldn't be enough time to deploy your parachute and slow down.
   c. Venus's clouds are made of sulfuric acid, similar to the acid in a car battery.
   d. Venus doesn't have any clouds, that's why it's described as an `airless' body similar to the Moon and Mercury.

7. Let's say that on a clear spring evening, you're spending a few enjoyable hours looking at the Moon through a telescope. How could you tell the lunar **maria** from the lunar **highlands**, just by looking at the surface of the moon through your telescope?
   a. The color difference between the two types of terrain is very slight, but the maria can be recognized by the fact that they have slightly larger craters than the highlands.
   b. The highlands are made of dark-colored material, whereas the maria are noted for their very light color.
   c. The maria are smooth, dark-colored plains, as opposed to the highlands, which are lighter-colored, more heavily-cratered regions.
   d. The highlands have a lot of craters on them, but the maria have even more craters.

8. Twenty years before the first astronauts landed on the Moon, an amateur astronomer and businessman named Ralph Baldwin predicted that the lunar maria would turn out to be much younger than the lunar highlands, because the highlands are much more heavily cratered. When samples of both types of terrain were finally collected by the Apollo astronauts, how did the samples confirm (or deny) Baldwin's hypothesis?
   a. Radiometric dating of both types of rocks showed that the basalt lavas of the maria were several hundred million years younger than the anorthosite rock of the highlands.
   b. Radiometric dating of both types of rocks showed that Baldwin was wrong, and that the two types of terrain are essentially the same age.
   c. Radiometric dating of both types of rocks showed that the anorthosite of the maria was several hundred million years younger than the basalt lava flows that make up the lunar highlands.
   d. Radiometric dating of both types of rocks showed that in fact, the highlands are much younger than the maria, having been thrust upward through the maria just a few hundred million years ago.

9. Let's say that you could measure the speed of a planet as it revolves around the Sun. Which of the following statements about that speed is most accurate?
   a. Kepler's Laws tell us that the planet will be moving at a constant speed at all points on an elliptical orbit.
   b. The conservation of momentum will cause the planet to slow down to a relatively low speed when it makes its closest approach to the Sun.
   c. When the planet makes its closest approach to the Sun, the conservation of momentum means that it will have its maximum speed.
   d. When the planet reaches its farthest point from the Sun, it will be traveling at its fastest speed, due to the conservation of angular momentum.

10. Which of the following is the best description of why the Moon always keeps one side turned toward the Earth?
   a. The Earth's gravitational attraction produced tidal bulges in the Moon's shape, and as the Moon `rotated through' these bulges, friction inside the Moon's rocks drained the Moon's rotational energy.
   b. The Moon doesn't keep one side turned toward the Earth; if you observe it carefully all night long, you can see it slowly rotate, and the other side becomes visible during the wee hours of the morning.
   c. The Moon raises tidal bulges in the Earth's rocks and oceans, and the gravitational pull from these bulges has slowed down the Moon's rotation.
   d. When the Moon formed out of debris that was blasted from the Earth in a `giant impact' event, it accreted in such a way that it was not rotating relative to the Earth.

11. Let's say that you're an amateur astronomer who has just gotten in to the hobby. Your friends' telescopes have larger apertures than yours, and you're jealous. If you had a telescope with a larger aperture, which of the following would be something that your new telescope could do that the old one couldn't?
   a. It would have a lower magnification than your old telescope, so that you wouldn't be so annoyingly `zoomed-in' on everything.
   b. It would be able to reduce the effects of the Earth's turbulent atmosphere, so that your views of celestial objects would not be blurred by `poor seeing'.
   c. It would gather less light than your old telescope, thus keeping bright objects like the Moon from looking uncomfortably bright.
   d. It could resolve smaller details, such as smaller craters on the Moon's surface, or `tighter' double stars.

12. Let's say that you're standing on Mercury, and it's noontime - the Sun appears at its highest point in the sky. If you wait one whole Mercurian day, for the Sun to once again appear at its highest point, how long will you have to wait?
    a. Two Mercurian weeks.
    b. Two Mercurian years.
    c. One Earth day.
    d. Two Earth years.

13. After many futile attempts to determine the rotation period of Mercury by observing it with **optical** telescopes, which of the following things told **radio** astronomers that Mercury's rotation is probably NOT tidally `locked' to its period of revolution around the Sun?
    a. The temperatures on Mercury were exactly the same everywhere, which would not be expected on an airless planet with one side permanently exposed to the Sun.
    b. In a bizarre twist, which is still not explained, the side of Mercury facing away from the Sun is the hottest side of the planet.
    c. The side of Mercury facing towards the Sun was somewhat warmer than would be expected if it always faced the Sun.
    d. The side of Mercury facing away from the Sun was somewhat warmer than would be expected if it never had sunlight on it.

14. Which of the following things has been observed on the surface of Mercury, giving evidence that the planet (or at least its outer parts) has shrunk slightly?
    a. Lobate scarps, showing places where one part of Mercury's outermost layer has slid up and over another part.
    b. Multi-ring basins, which are produced by contraction of Mercury's outer layers.
    c. Graben, which are long, trough-like depressions showing evidence for stretching of Mercury's outer layers.
    d. Lobate scarpes, showing places where stretching of Mercury's outermost layer has cracked it.

15. Which of the following is NOT a reason why astronomical observatories are often built on mountaintops?
    a. Being on top of a high mountain means that you are somewhat closer to the objects your are studying, particularly objects like the Moon.
    b. By getting above some of the Earth's atmosphere, it is possible to look at astronomical object using wavelengths of light that would otherwise be blocked by the atmosphere.
    c. Depending on weather conditions, being on top of the mountain means that you may be above fog or clouds some of the time.
    d. By getting above some of the Earth's atmosphere, there are fewer problems with atmospheric turbulence causing poor `seeing'.

16. Which of the following is a good description of a type of surface feature on Venus, which is similar to a type of surface feature produced by plate tectonics on Earth?
    a. Venus shows folded mountain ranges, such as those north and west of Lakshmi Planum. These are somewhat similar to the folded mountains of Earth, which are produced in places where plates move toward each other.
    b. Venus has impact craters scattered randomly over its surface, which is also a sign of plate tectonics on the Earth.
    c. There are circular features on Venus called `coronae' that are almost identical to the circular coronae on Earth. These circular features on Earth are one of the main features made by plate-tectonic processes.
    d. Venus has large areas of flat plains, which appear to have been produced by vast outpourings of lava that flooded the plains.

17. Imagine that you discover a new comet, and you find that it is traveling along a highly **eccentric** orbit. What does this mean?
    a. The orbit of the comet keeps it close to both the Sun and Earth.
    b. The comet's elliptical orbit is very `stretched out' compared to a circle.
    c. The distance of the comet from the Sun does not change very much as the comet goes around its orbit.
    d. The shape of the orbit is very close to a perfect circle.

18. In 1572, Tycho Brahe observed a ``new star'' in the sky, which appeared brighter than Venus for a period of weeks. He also noticed that it did not move relative to the other stars, and was thus probably not close to the Earth. Why was this a big deal for European astronomers at that time?
    a. According to Aristotle, whose writings dominated science at the time, everything farther away from the Earth than the Moon should be perfect and unchanging.
    b. ``New stars'' like this are frequently observed, but this particular star was somewhat brighter than similar ``new stars'', and thus it was more widely noticed.
    c. This particular ``new star'' was only noticed in Europe, even though careful records were also being kept in China and the Islamic world at that time. No one has yet explained why it couldn't be seen from East Asia and the Middle East.
    d. This ``new star'' didn't fit with the teachings of Aristotle, who had said that changes in the heavens should occur more frequently than we actually observe. In other words, there should be MORE such ``new stars''.

19. Which of the following is the best description of what it means to say that an object has gone into **orbit** around the Earth?
    a. It's like throwing the object horizontally from the top of a tall tower, so that when the object has fallen 1 foot, the curved surface of the Earth has `fallen away' by 1 foot, so the object never gets any closer to the Earth.
    b. It's like throwing the object horizontally from the top of a tall tower, so that the object gets far enough away from the Earth that it doesn't feel the Earth's gravitational pull any more.
    c. It's like throwing the object vertically upwards from the surface of the Earth, so that it goes far enough away from the Earth that the Earth's gravitational pull has gotten too weak to make the object fall down again.
    d. It's like throwing the object vertically upwards from the top of a tall tower, so that the Earth rotates under the object, keeping the object in orbit.

20. Scientists studying the Earth's oldest rocks, such as the 4.2-billion-year-old rocks in Canada that we saw in the `Birth of the Earth' film, have found what unexpected fact about the Earth during that part of its early history?
    a. The Earth had an intense greenhouse effect, which kept its surface extremely hot at that time, similar to modern-day Venus.
    b. The Earth's surface had water on it, only 300 million years after it formed.
    c. The Earth didn't have a surface yet, since it didn't form until 3.9 billion years ago.
    d. The Earth's surface was still a molten `magma ocean' at that time.

21. If a friend of yours were asking you how the solar system formed, which of the following would be the best way of describing the **solar nebula** to them?
    a. It was the atmosphere of a `gas giant' planet, from which the other planets formed.
    b. It was a cloud of comets around the Sun, similar to the Oort Cloud.
    c. It was a cloud of gas and dust.
    d. It was the debris left over from the `giant impact' that formed the Moon.

22. When we examine the Moon, Mercury, and other heavily cratered bodies in the Solar System, we notice that nearly all of the craters are circular. This seems strange, since we wouldn't expect the meteorites (whose impacts made the craters) to strike the surface from directly (i.e. vertically) above. Which of the following is the best explanation for why virtually all impact craters are circular?
    a. So-called impact craters aren't actually caused by impacts; they're volcanic craters. The volcanic explosions release energy equally in all directions, making circular craters.
    b. When the impacting meteorite hits the target, it releases its energy of motion so suddenly that it creates an outwardly-expanding explosion, rather than `gouging' or `digging' a hole in the target.
    c. Even if an object is approaching the surface of a planet or moon at an angle, the gravity from the `target' body will pull the object into a vertically-downward path before it hits.
    d. The interiors of many planets and Moons are hollow, and the impacting bodies punch round holes in the surfaces of these bodies.

Short Answer

23. Briefly describe the nebular theory for the origin of the Earth and the solar system. In particular, make sure to explain what a nebula is, how the Earth first formed, and why the earth has layers of different compositions today.

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Answer Section

MULTIPLE CHOICE

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

SHORT ANSWER

23. ANS:
About 4.5. billion years ago, a nebula (cloud of gas and dust) formed the solar system. The mutual gravitational attraction of all of the particles in the nebula caused it to contract, and different portions of it became the Sun and planets. As grains in the nebula collided and stuck together, they formed small bodies that collided in turn, making larger bodies like Earth, Mercury, Venus, the Sun, and the other planets. After this intital `assembly' (or accretion) of the Earth, the Earth was so hot that the denser materials could sink to form the core, and the less-dense materials could rise to form the mantle and the crust.