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each MCQ = 1 mark  
1.5 mark each answer

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question 31 =

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

- 1) What is the purpose of adaptive optics? 1) \_\_\_\_\_
- A) to improve the angular resolution of telescopes in space
  - B) to increase the collecting area of telescopes on the ground
  - C) to eliminate the distorting effects of atmospheric turbulence for telescopes on the ground
  - D) to allow several small telescopes to work together like a single larger telescope
  - E) to increase the magnification of telescopes on the ground
- 2) What causes stars to twinkle? 2) \_\_\_\_\_
- A) It is intrinsic to the stars—their brightness varies as they expand and contract.
  - B) the inability of the human eye to see faint objects
  - C) variable absorption by interstellar gas along the line of sight to the star
  - D) variations in the absorption of the atmosphere
  - E) bending of light rays by turbulent layers in the atmosphere
- 3) What does *temperature* measure? 3) \_\_\_\_\_
- A) the average mass of particles in a substance
  - B) the total number of particles in a substance
  - C) the average size of particles in a substance
  - D) the total potential energy of particles in a substance
  - E) the average kinetic energy of particles in a substance
- 4) We can learn a lot about the properties of a star by studying its spectrum. All of the following statements are true except one. Which one? 4) \_\_\_\_\_
- A) The total amount of light in the spectrum tells us the star's radius.
  - B) We can identify chemical elements present in the star by recognizing patterns of spectral lines that correspond to particular chemicals.
  - C) The peak of the star's thermal emission tells us its temperature: Hotter stars peak at shorter (bluer) wavelengths.
  - D) We can look at Doppler shifts of spectral lines to determine the star's speed toward or away from us.
- 5) The most metal-rich terrestrial planet is 5) \_\_\_\_\_
- A) Venus.
  - B) Mercury.
  - C) Earth.
  - D) Mars.
  - E) the Moon.

- 6) Without telescopes or other aid, we can look up and see the Moon in the night sky because it 6) \_\_\_\_\_  
A) emits thermal radiation.  
B) glows through radioactive decay.  
C) reflects visible light.  
D) emits visible light.  
E) reflects infrared light.
- 7) In what part of the electromagnetic spectrum do the biggest telescopes on Earth operate? 7) \_\_\_\_\_  
A) infrared  
B) visible  
C) ultraviolet  
D) radio  
E) X-ray
- 8) The *frequency* of a wave is 8) \_\_\_\_\_  
A) measured in cycles per second.  
B) equal to the speed of the wave divided by the wavelength of the wave.  
C) measured in hertz (Hz).  
D) the number of peaks passing by any point each second.  
E) all of the above
- 9) Which of the following is *not* a characteristic of the inner planets? 9) \_\_\_\_\_  
A) Their orbits are relatively closely spaced.  
B) They have very few, if any, satellites.  
C) They all have substantial atmospheres.  
D) They all have solid, rocky surfaces.  
E) They are relatively smaller than the outer planets.
- 10) How much electrical charge does an atom with 6 protons, 6 neutrons, and 5 electrons have? 10) \_\_\_\_\_  
A) a total charge of +17  
B) a negative charge of -5  
C) a positive charge of +1  
D) a positive charge of +7  
E) none of the above
- 11) Where does nuclear fusion occur in the Sun? 11) \_\_\_\_\_  
A) anywhere below the surface  
B) on the surface  
C) in its core  
D) just above the visible surface  
E) all of the above
- 12) Which of the following is not a conserved quantity? 12) \_\_\_\_\_  
A) radiation  
B) momentum  
C) angular momentum  
D) energy
- 13) Suppose the angular separation of two stars is smaller than the angular resolution

of your 13) eyes.  
How will the stars appear to your eyes?

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- A) You will see two distinct stars.
- B) You will see only the larger of the two stars, not the smaller one.
- C) You will not be able to see these two stars at all.
- D) The two stars will appear to be touching, looking rather like a small dumbbell.
- E) The two stars will look like a single point of light.

14) The allowed shapes for orbits under the force of gravity are 14) \_\_\_\_\_

- A) ellipses, spirals, and parabolas.
- B) ellipses, parabolas, and hyperbolas.
- C) ellipses and spirals.
- D) spirals, circles, and squares.
- E) ellipses only.

15) Which of the following statements best describes the two principal advantages of telescopes over eyes? 15) \_\_\_\_\_

- A) Telescopes can see farther without image distortion and can record more accurate colors.
- B) Telescopes can collect far more light with far better angular resolution.
- C) Telescopes have much more magnification and better angular resolution.
- D) Telescopes collect more light and are unaffected by twinkling.
- E) Telescopes can collect far more light with far greater magnification.

16) Which planet, other than Earth, has visible water ice on it? 16) \_\_\_\_\_

- A) the Moon
- B) Mercury
- C) Jupiter
- D) Venus
- E) Mars

17) At which lunar phase(s) are tides least pronounced (e.g., the lowest high tides)? 17) \_\_\_\_\_

- A) full Moon
- B) new Moon
- C) first quarter
- D) both new and full Moons
- E) both first and third quarters

18) What are the main constituents of the jovian planets? 18) \_\_\_\_\_

- A) hydrogen and helium
- B) ammonia and methane
- C) nitrogen and methane

- D) ammonia and water
- E) rocky minerals and water, as on Earth

- 19) When white light passes through a cool cloud of gas, we see \_\_\_\_\_  
A) an absorption line spectrum.  
B) infrared light.  
C) an emission line spectrum.  
D) visible light.  
E) thermal radiation.
- 20) Which planet has a ring system? \_\_\_\_\_  
A) Saturn  
B) Uranus  
C) Neptune  
D) Jupiter  
E) all of the above
- 21) *Thermal radiation* is defined as \_\_\_\_\_  
A) radiation in the infrared part of the spectrum.  
B) radiation that is felt as heat.  
C) radiation that depends only on the emitting object's temperature.  
D) radiation in the form of emission lines from an object.  
E) radiation produced by a hot object.
- 22) Which of the following is not a pattern of motion in our solar system? \_\_\_\_\_  
A) Large planets all have many moons orbiting them.  
B) Planets all rotate in the same direction.  
C) Planets all orbit the same direction as the Sun's spin.  
D) Planets all orbit in the same direction.
- 23) From laboratory measurements, we know that a particular spectral line formed by hydrogen appears at a wavelength of 486.1 nanometers (nm). The spectrum of a particular star shows the same hydrogen line appearing at a wavelength of 485.9 nm. What can we conclude? \_\_\_\_\_  
A) The star is moving away from us.  
B) The "star" actually is a planet.  
C) The star is getting colder.  
D) The star is getting hotter.  
E) The star is moving toward us.
- 24) Where are most of the known asteroids found? \_\_\_\_\_  
A) between the orbits of the terrestrial planets  
B) between the orbits of Mars and Jupiter  
C) in the Oort cloud  
D) between the orbits of the jovian planets  
E) in the Kuiper belt
- 25) Which of the following statements is *not* an observed pattern of motion in our solar system? \_\_\_\_\_  
A) Most planets rotate in the same direction in which they orbit.  
B) Most planets orbit at the same speed.  
C) Most planetary orbits lie nearly in the same plane.

- D) All planets orbit the Sun in the same direction.
- E) Almost all moons orbit their planet in the same direction as the planet's rotation.

26) Suppose you heat up an oven and boil a pot of water. Which of the following explains why you would be burned by sticking your hand briefly in the pot but not by sticking your hand briefly in the oven? 26) \_\_\_\_\_

- A) The water has a higher heat content than the oven.
- B) The oven has a higher temperature than the water.
- C) The molecules in the water are moving faster than the molecules in the oven.
- D) The water has a higher temperature than the oven.
- E) The oven has a higher heat content than the water.

27) We can see each other in the classroom right now because we 27) \_\_\_\_\_

- A) emit visible light.
- B) reflect visible light.
- C) emit infrared light.
- D) emit thermal radiation.
- E) reflect infrared light.

28) According to the *universal law of gravitation*, the force due to gravity is 28) \_\_\_\_\_

- A) not dependent on the distance between objects.
- B) directly proportional to the square of the distance between objects.
- C) inversely proportional to the square of the distance between objects.
- D) directly proportional to the distance between objects.
- E) inversely proportional to the distance between objects.

29) Suppose you see two stars: a blue star and a red star. Which of the following can you conclude about the two stars? Assume that no Doppler shifts are involved. (*Hint*: Think about the laws of thermal radiation.) 29) \_\_\_\_\_

- A) The blue star is farther away than the red star.
- B) The red star is more massive than the blue star.
- C) The blue star has a hotter surface temperature than the red star.
- D) The blue star is more massive than the red star.
- E) The red star has a hotter surface temperature than the blue star.

30) Which of the following is furthest from the Sun? 30) \_\_\_\_\_

- A) Neptune
- B) an asteroid in the asteroid belt
- C) a comet in the Oort cloud
- D) Pluto
- E) a comet in the Kuiper belt

### SHORT ANSWER QUESTION

31) The most common isotope of oxygen has atomic number 8 and atomic weight 16. Another isotope has two extra neutrons. What are a) the atomic number and b) atomic weight of this isotope? 31) \_\_\_\_\_

- 1) C
- 2) E
- 3) E
- 4) A
- 5) B
- 6) C
- 7) D
- 8) E
- 9) C
- 10) C
- 11) C
- 12) A
- 13) E
- 14) B
- 15) B
- 16) E
- 17) E
- 18) A
- 19) A
- 20) E
- 21) C
- 22) B
- 23) E
- 24) B
- 25) B
- 26) A
- 27) B
- 28) C
- 29) C
- 30) C
- 31) The atomic number would still be 8 because the number of protons wouldn't change, but the atomic weight would increase to 18.