

Name _____

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

- 1) Newton's second law of motion tells us that the net force applied to an object equals its _____ 1) _____
A) mass times energy.
B) mass times acceleration.
C) mass times velocity.
D) energy times acceleration.
E) momentum times velocity.
- 2) The *frequency* of a wave is _____ 2) _____
A) measured in cycles per second.
B) the number of peaks passing by any point each second.
C) equal to the speed of the wave divided by the wavelength of the wave.
D) measured in hertz (Hz).
E) all of the above
- 3) Which of the following statements correctly describes the *law of conservation of energy*? _____ 3) _____
A) The fact that you can fuse hydrogen into helium to produce energy means that helium can be turned into hydrogen to produce energy.
B) An object always has the same amount of energy.
C) The total quantity of energy in the universe never changes.
D) It is not really possible for an object to gain or lose potential energy, because energy cannot be destroyed.
E) Energy can change between many different forms, such as potential, kinetic, and thermal, but it is ultimately destroyed.
- 4) *Thermal radiation* is defined as _____ 4) _____
A) radiation in the infrared part of the spectrum.
B) radiation produced by a hot object.
C) radiation that depends only on the emitting object's temperature.
D) radiation that is felt as heat.
E) radiation in the form of emission lines from an object.
- 5) A skater can spin faster by pulling her arms closer to her body or spin slower by spreading her arms out from her body. This is due to _____ 5) _____
A) conservation of angular momentum.
B) Newton's third law.
C) the law of gravity.
D) conservation of energy.
E) conservation of momentum.

- 6) What is *granulation* in the Sun? 6) _____
A) another name for the way sunspots look on the surface of the Sun
B) elements in the Sun other than hydrogen and helium
C) lumps of denser material in the Sun
D) dust particles in the Sun that haven't been turned into plasma
E) the bubbling pattern on the photosphere produced by the underlying convection
- 7) An atom in an *excited state* contains more of what type of energy than the same atom in the *ground state*? 7) _____
A) thermal energy
B) mass-energy
C) gravitational potential energy
D) kinetic energy
E) electric potential energy
- 8) As long as an object is not gaining or losing mass, a net force on the object will cause a change in 8) _____
A) direction.
B) velocity.
C) weight.
D) speed.
E) acceleration.
- 9) If a material is highly *opaque*, then it 9) _____
A) emits most light.
B) reflects most light.
C) absorbs most light.
D) scatters most light.
E) transmits most light.
- 10) According to the *universal law of gravitation*, the force due to gravity is 10) _____
A) inversely proportional to the distance between objects.
B) directly proportional to the distance between objects.
C) inversely proportional to the square of the distance between objects.
D) directly proportional to the square of the distance between objects.
E) not dependent on the distance between objects.
- 11) The fact that the *Voyager* spacecraft continue to speed out of the solar system, even though its rockets have no fuel, is an example of 11) _____
A) Newton's third law of motion.
B) the universal law of gravitation.
C) Newton's second law of motion.
D) Newton's first law of motion.
E) none of the above.
- 12) At extremely high temperatures (e.g., millions of degrees), which of the following best describes the phase of matter? 12) _____
A) a plasma consisting of positively charged ions and free electrons
B) a plasma consisting of rapidly moving, neutral atoms
C) a gas consisting of individual, neutral atoms, but no molecules
D) a gas of rapidly moving molecules
E) none of the above (At these extremely high temperatures, matter cannot exist.)

- 13) The overall fusion reaction by which the Sun currently produces energy is 13) _____
A) $4 \text{ H} \Rightarrow 1 \text{ He} + \text{energy}$.
B) $4 \text{ H} \Rightarrow 4 \text{ He} + \text{energy}$.
C) $6 \text{ H} \Rightarrow 1 \text{ He} + \text{energy}$.
D) $3 \text{ He} \Rightarrow 1 \text{ C} + \text{energy}$.
E) $3 \text{ H} \Rightarrow 1 \text{ Li} + \text{energy}$.
- 14) What does *temperature* measure? 14) _____
A) the average kinetic energy 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 mass of particles in a substance
- 15) When an electron in an atom goes from a higher energy state to a lower energy state, the atom 15) _____
A) can absorb a photon of any frequency.
B) absorbs several photons of a specific frequency.
C) emits a photon of a specific frequency.
D) absorbs a photon of a specific frequency.
E) can emit a photon of any frequency.
- 16) Everything looks red through a red filter because 16) _____
A) the filter transmits red light and absorbs other colors.
B) the filter absorbs red light and emits other colors.
C) the filter reflects red light and transmits other colors.
D) the filter emits red light and absorbs other colors.
- 17) How does the Sun generate energy today? 17) _____
A) nuclear fusion
B) chemical reactions
C) gravitational contraction
D) nuclear fission
E) gradually expanding in size
- 18) Suppose you put two protons near each other. Because of the electromagnetic force, the two 18) _____
protons will
A) join together to form a nucleus.
B) collide.
C) attract each other.
D) repel each other.
E) remain stationary.
- 19) You observe a distant galaxy. You find that a spectral line normally found in the visible part of the 19) _____
spectrum is shifted toward the infrared. What do you conclude?
A) The galaxy is moving toward you.
B) The galaxy is moving away from you.
C) The galaxy has very weak gravity.
D) The composition of the galaxy is changing.
E) The galaxy is made purely of hydrogen.

- 20) *Absolute zero* is 20) _____
- A) 0° Celsius.
 - B) 32° Fahrenheit.
 - C) 0° Fahrenheit.
 - D) 0° Kelvin.
 - E) 273° Celsius.
- 21) From the center outward, which of the following lists the "layers" of the Sun in the correct order? 21) _____
- A) core, corona, radiation zone, convection zone, photosphere, chromosphere
 - B) core, radiation zone, convection zone, photosphere, chromosphere, corona
 - C) core, convection zone, radiation zone, photosphere, chromosphere, corona
 - D) core, radiation zone, convection zone, corona, chromosphere, photosphere
 - E) core, convection zone, radiation zone, corona, chromosphere, photosphere
- 22) Which of the following *best* describes the origin of ocean tides on Earth? 22) _____
- A) The Moon's gravity pulls harder on water than on land, because water is less dense than rock.
 - B) Tides are caused on the side of Earth nearest the Moon because the Moon's gravity attracts the water.
 - C) Tides are caused primarily by the gravitational force of the Sun.
 - D) Tides are caused by the difference in the force of gravity exerted by the Moon across the sphere of the earth.
 - E) Tides are caused by the 23 1/2° tilt of the earth's rotational axis to the ecliptic plane.
- 23) Which of the following statements is *not* one of Newton's laws of motion? 23) _____
- A) In the absence of a net force, an object moves with constant velocity.
 - B) What goes up must come down.
 - C) For any force, there always is an equal and opposite reaction force.
 - D) The rate of change of momentum of an object is equal to the net force applied to the object.
 - E) All of the above are Newton's laws of motion.
- 24) The loss of an electron from a neutral helium atom results in 24) _____
- A) neutral deuterium.
 - B) ionized deuterium.
 - C) neutral hydrogen.
 - D) ionized helium.
 - E) ionized hydrogen.
- 25) How are wavelength, frequency, and energy related for photons of light? 25) _____
- A) Longer wavelength means higher frequency and lower energy.
 - B) Longer wavelength means higher frequency and higher energy.
 - C) Longer wavelength means lower frequency and higher energy.
 - D) Longer wavelength means lower frequency and lower energy.
 - E) There is no simple relationship because different photons travel at different speeds.

- 26) What do we mean when we say that the Sun is in *gravitational equilibrium*? 26) _____
- A) This is another way of stating that the Sun generates energy by nuclear fusion.
 - B) The hydrogen gas in the Sun is balanced so that it never rises upward or falls downward.
 - C) The Sun always has the same amount of mass, creating the same gravitational force.
 - D) The Sun maintains a steady temperature.
 - E) There is a balance within the Sun between the outward push of pressure and the inward pull of gravity.
- 27) If an object's velocity is doubled, its momentum is 27) _____
- A) dependent on its acceleration.
 - B) unchanged.
 - C) halved.
 - D) quadrupled.
 - E) doubled.
- 28) What happens to energy in the *convection zone* of the Sun? 28) _____
- A) Energy is transported outward by the rising of hot plasma and the sinking of cooler plasma.
 - B) Energy is consumed in the convection zone by the creation of electrons and positrons.
 - C) Energy is produced in the convection zone by nuclear fusion.
 - D) Energy slowly leaks outward through the diffusion of photons that repeatedly bounce off ions and electrons.
- 29) Consider an atom of gold in which the nucleus contains 79 protons and 118 neutrons. What is its atomic number and atomic weight? 29) _____
- A) The atomic number is 79, and the atomic weight is 118.
 - B) The atomic number is 118, and the atomic weight is 197.
 - C) The atomic number is 79, and the atomic weight is 197.
 - D) The atomic number is 118, and the atomic weight is 79.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

- 30) Define *atomic weight* (or *atomic mass*). 30) _____
- 31) Explain how we can use Newton's version of Kepler's third law to measure the total mass of two stars in a binary system. 31) _____
- 32) Briefly explain how the Sun became hot enough for nuclear fusion. 32) _____
- 33) Briefly explain how we can use spectral lines to determine an object's radial motion. Can we also learn the object's tangential motion (across our line of sight) from its spectral lines? 33) _____
- 34) An isotope of fluorine has 9 protons and 10 neutrons. What are the atomic number and atomic weight of this fluorine? If we added a proton to this fluorine nucleus, would the result still be fluorine? What if we added a neutron instead? Explain. 34) _____
- 35) State Newton's three laws of motion. 35) _____
- 36) Suppose a satellite is in a low-Earth orbit. Is it possible that the satellite will eventually fall to the ground? Why or why not? 36) _____

- 37) Briefly explain why spectral lines are useful in determining the chemical composition of their source. 37) _____
- 38) Give an example in which kinetic energy can be converted to thermal energy. 38) _____
- 39) State the two laws of thermal radiation. 39) _____
- 40) Imagine you are plunging into the Sun, starting from Earth. Briefly describe what you will see as you descend. 40) _____
- 41) Describe some of the early theories for why the Sun shines and why they are no longer accepted as viable. 41) _____
- 42) Explain what *synchronous rotation* is. What is it caused by? Give an example. 42) _____
- 43) Suppose you have a chunk of water ice. Describe what happens to it, in terms of phases, as you raise the temperature to millions of degrees. 43) _____
- 44) *Atomic number* refers to _____. 44) _____
- 45) Briefly explain how we can use spectral lines to determine an object's rotation rate. 45) _____
- 46) What is the solar thermostat? 46) _____