

Name \_\_\_\_\_

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

- 1) In the equation  $E = hf$ , the  $f$  stands for
  - A) frequency characteristic of quantum phenomena.
  - B) the smaller wavelengths of visible light.
  - C) wave frequency as defined for sound, radio, and light waves.
  - D) none of these
  
- 2) The ratio of the energy of a photon to its frequency is
  - A) the photon's speed.
  - B) Planck's constant.
  - C) the photon's wavelength.
  - D)  $\pi$  (pi).
  - E) not known.
  
- 3) Which has less energy per photon?
  - A) blue light
  - B) red light
  - C) Both have the same energy.
  
- 4) The photoelectric effect best demonstrates the
  - A) particle nature of light.
  - B) wave nature of light.
  - C) both of these
  - D) none of these
  
- 5) Light behaves primarily as a wave when it
  - A) travels from one place to another.
  - B) interacts with matter.
  
- 6) The uncertainty principle applies not only to momentum and position, but also to energy and time. This statement is
  - A) false.
  - B) true.
  
- 7) According to the uncertainty principle, the more we know about a particle's momentum, the less we know about its
  - A) speed.
  - B) location.
  - C) mass.
  - D) kinetic energy.
  - E) none of these

- 8) Which of the following is not quantized?
- A) radiation
  - B) number of people in a room
  - C) electric charge
  - D) energy
  - E) All are quantized.
- 9) According to quantum physics, measuring the velocity of a tiny particle with an electromagnet
- A) has no effect on the velocity of the particle.
  - B) affects the velocity of the particle.
- 10) In the photoelectric effect, electrons ejected from bound states in the photosensitive material have
- A) kinetic energy equal to the absorbed photon's energy.
  - B) less kinetic energy than the absorbed photon's energy.
  - C) more kinetic energy than the absorbed photon's energy.
- 11) Quantization of electron energy states in an atom is better understood in terms of the electron's
- A) wave nature.
  - B) particle nature.
  - C) neither of these
- 12) In the Bohr model of hydrogen, discrete radii and energy states result when an electron circles the atom in an integral number of
- A) diffraction patterns.
  - B) wave frequencies.
  - C) de Broglie wavelengths.
  - D) none of these
- 13) A beam of electrons has
- A) wave properties.
  - B) particle properties.
  - C) both of these
  - D) neither of these
- 14) When Rutherford had a stream of alpha particles hit a gold foil, most of the particles
- A) bounced back.
  - B) stopped.
  - C) spiraled.
  - D) went almost straight through.

- 15) According to Niels Bohr, an electron in an excited state could give off
- A) at most a single photon until the atom was excited again.
  - B) a continuous cascade of photons for a high-level transition.
  - C) several photons in a series of transitions to the ground state.
  - D) none of these
- 16) A nucleon is either
- A) a proton or a neutron.
  - B) a neutron or an electron.
  - C) a positron or an electron.
  - D) a proton or an electron.
- 17) The mass of an atomic nucleon is nearly
- A) two thousand times the mass of an electron.
  - B) four times the mass of an electron.
  - C) twice the mass of an electron.
  - D) a thousand times the mass of an electron.
- 18) Different isotopes of an element have different numbers of
- A) photons.
  - B) hadrons.
  - C) neutrons.
  - D) protons.
  - E) none of these
- 19) When an alpha particle is ejected from a nucleus, the nucleus then has less
- A) charge.
  - B) mass.
  - C) both of these
  - D) neither of these
- 20) When a beta particle is ejected from a nucleus, the nucleus then has a greater
- A) mass.
  - B) charge.
  - C) both of these
  - D) neither of these