Chapter 15 Quantum Theory

15.1 Questions About Light Quanta

1) In the equation E = hf, the f stands for
   A) wave frequency as defined for sound, radio, and light waves.
   B) the smaller wavelengths of visible light.
   C) frequency characteristic of quantum phenomena.
   D) none of these

   Answer: A
   Diff: 1
   Topic: Light Quanta

2) The ratio of the energy of a photon to its frequency is
   A) pi.
   B) Planck's constant.
   C) the photon's speed.
   D) the photon's wavelength.
   E) not known.

   Answer: B
   Diff: 1
   Topic: Light Quanta

3) Which has less energy per photon?
   A) red light
   B) blue light
   C) Both have the same energy.

   Answer: A
   Diff: 1
   Topic: Light Quanta

4) Which has more energy per photon?
   A) red light
   B) blue light
   C) Both have the same energy.

   Answer: B
   Diff: 1
   Topic: Light Quanta

5) Which of the following photons has the greatest energy?
   A) infrared
   B) red light
   C) green light
   D) blue light
   E) ultraviolet

   Answer: E
   Diff: 1
   Topic: Light Quanta

6) As a solid is gradually heated, the first color to glow is
A) red.
B) yellow.
C) white.
D) blue.

Answer: A
Diff: 1
Topic: Light Quanta

7) The photoelectric effect best demonstrates the
A) wave nature of light.
B) particle nature of light.
C) both of these
D) none of these

Answer: B
Diff: 1
Topic: Light Quanta

8) In the photoelectric effect, the brighter the illuminating light on a photosensitive surface, the greater the
A) number of ejected electrons.
B) velocity of ejected electrons.
C) both of these
D) neither of these

Answer: A
Diff: 1
Topic: Light Quanta

9) In the photoelectric effect, the greater the frequency of the illuminating light, the greater the
A) number of ejected electrons.
B) maximum velocity of ejected electrons.
C) both of these
D) neither of these

Answer: B
Diff: 1
Topic: Light Quanta

10) A lump of energy associated with light is called a
A) quantum.
B) photon.
C) both of these
D) neither of these

Answer: C
Diff: 1
Topic: Light Quanta

17) Quantum uncertainties are most predominant for simultaneously measuring the speed and location of
A) a baseball.
B) a spitball.
C) an electron.

Answer: C
Diff: 1
Topic: Light Quanta

18) The uncertainty principle applies not only to momentum and position, but also to energy and time. This statement is
A) true.
B) false.

Answer: A
Diff: 1
Topic: Light Quanta

19) According to the uncertainty principle, the more we know about a particle's momentum, the less we know about its
A) kinetic energy.
B) mass
C) speed.
D) location.
E) none of these

Answer: D
Diff: 1
Topic: Light Quanta

20) According to quantum physics, looking at a star through a telescope
A) affects the processes occurring in the star.
B) has no effect on the processes occurring in the star.

Answer: B
Diff: 1
Topic: Light Quanta

21) In the relationship E = hf for a photon emitted from an atom, the symbol E is used to represent the energy
A) of the emitted photon.
B) difference between atomic energy states producing the photon.
C) both of these
D) neither of these

Answer: C
Diff: 2
Topic: Light Quanta

27) When a clean surface of potassium metal is exposed to blue light, electrons are emitted. If the intensity of the blue light is increased, which of the following will also increase?
A) the number of electrons ejected per second
B) the maximum kinetic energy of the ejected electrons
C) the threshold frequency of the ejected electrons
D) the time lag between the absorption of blue light and the start of emission of the electrons
E) none of these

Answer: A
Diff: 2
Topic: Light Quanta

15.2 Questions About Light Emission

1) To say that energy levels in an atom are discrete is to say the energy levels are well defined and
A) separate from one another.
B) separated from one another by the same energy increments.
C) continuous.
D) private.

Answer: A
Diff: 1
Topic: Light Emission

2) Electrons with the greater potential energies with respect to the atomic nucleus are
A) inner electrons.
B) outer electrons.
C) both the same, actually

Answer: B
Diff: 1
Topic: Light Emission

3) An excited atom is an atom
A) that has excess vibration.
B) that has one or more displaced electrons.
C) with more protons than electrons.
D) that is frantic.

Answer: B
Diff: 1
Topic: Light Emission

4) Light is emitted when an electron
A) is boosted to a higher energy level.
B) makes a transition to a lower energy level.
C) neither of these

Answer: B
Diff: 1
Topic: Light Emission

15) The greater proportion of energy immediately converted to heat rather than light occurs in
A) a fluorescent lamp.
B) an incandescent lamp.
C) both the same

Answer: B
Diff: 1
Topic: Light Emission

16) Discrete spectral lines occur when excitation takes place in a
A) solid.
B) liquid.
C) gas.
D) superconductor.
E) all of these

Answer: C
Diff: 1
Topic: Light Emission

17) Light frequency from an incandescent lamp depends on the
A) amount of electrical energy transformed.
B) rate of atomic and molecular vibrations.
C) voltage applied to the lamp.
D) electrical resistance of the lamp.
E) transparency of glass.

Answer: B
Diff: 1
Topic: Light Emission

18) Isolated bells ring clear, while bells crammed in a box have a muffled ring. If the sound of isolated bells is analogous to light from a gas discharge tube, then sound from the box crammed with bells is analogous to light from
A) a laser.
B) a fluorescent lamp.
C) an incandescent lamp.
D) a phosphorescent source.
E) none of these

Answer: C
Diff: 1
Topic: Light Emission

19) An atom that emits a certain frequency of light is
A) not likely to absorb that same frequency.
B) an absorber of the same frequency.

Answer: B
Diff: 1
Topic: Light Emission

20) The dark lines in the sun's spectrum represent light that is
A) absorbed by the sun's atmosphere.
B) emitted by the sun.
C) not emitted by the sun.

Answer: A
Diff: 1
Topic: Light Emission

21) Spectral lines take the shape of vertical lines because
A) the light is vertically polarized.
B) they are simply images of a vertical slit.
C) the energy levels in the atom are parallel to one another.
D) all of these
E) none of these

Answer: B
Diff: 1
Topic: Light Emission

22) Helium was first discovered in the
A) laboratory.
B) upper atmosphere.
C) sun.
D) island of Helios, in Greece.
E) byproducts of nuclear fusion.

Answer: C
Diff: 1
Topic: Light Emission

23) Astronomers can tell whether a star is approaching or receding from earth by
A) its temperature.
B) its change in temperature.
C) its absorption spectra.
D) the Doppler effect.
E) all of these

Answer: D
Diff: 1
Topic: Light Emission

24) Atoms can be excited by
A) thermal agitation.
B) electron impact.
C) photon impact.
D) all of these
E) none of these

Answer: D
Diff: 1
Topic: Light Emission

30) Light from a laser is
A) monochromatic.
B) in phase.
C) coherent.
D) all of these
E) none of these

Answer: D
Diff: 1
Topic: Light Emission

31) Green light emitted by excited mercury vapor corresponds to a particular energy transition in the mercury atom. A more energetic transition might emit
A) red light.
B) blue light.
C) either red or blue light.
D) white light.

Answer: B
Diff: 2
Topic: Light Emission

32) If the energy levels in the neon atom were not discrete, neon signs would glow
A) red.
B) white.
C) blue.

Answer: B
Diff: 2
Topic: Light Emission

33) If light in a spectroscope were passed through a star-shaped opening instead of a thin slit, spectral lines would appear as
A) lines, but with poorer resolution.
B) stars.
C) blobs of no definite shape.

Answer: B
Diff: 2
Topic: Light Emission

34) If light in a spectroscope passed through round holes instead of slits, spectral lines would appear
A) as thicker lines.
B) round.
C) dimmer.

Answer: B
Diff: 2
Topic: Light Emission

35) The fact that iron absorption lines occur in the solar spectrum directly indicates that there is iron in the solar
A) atmosphere.
B) surface.
C) interior.

Answer: A
Diff: 2
Topic: Light Emission

36) A certain object emits infrared waves. If it were to emit light waves instead, its temperature would have to be
A) higher.
B) lower.
C) the same, temperature doesn't make any difference.

Answer: A
Diff: 2
Topic: Light Emission

37) Which of the following continually emits electromagnetic radiation?
A) insects
B) radio antennas
C) red-hot coals
D) all of these
E) none of these

Answer: D
Diff: 2
Topic: Light Emission

15.3 Questions About the Atom and the Quantum

1) 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

Answer: A
Diff: 1
Topic: Atom and Quantum

2) An excited hydrogen atom is capable of emitting radiation of
A) a single frequency.
B) 3 frequencies.
C) many more than 3 frequencies.

Answer: C
Diff: 1
Topic: Atom and Quantum