Concept Items

21.1 Planck and Quantum Nature of Light 1.

What aspect of the blackbody spectrum forced Planck to propose quantization of energy levels in atoms and molecules?

a. Radiation occurs at a particular frequency that does not change with the energy supplied.
b. Certain radiation occurs at a particular frequency that changes with the energy supplied.
c. Maximum radiation would occur at a particular frequency that does not change with the energy supplied.
d. Maximum radiation would occur at a particular frequency that changes with the energy supplied.

2.

Two lasers shine red light at 650 nm. One laser is twice as bright as the other. Explain this difference using photons and photon energy.

a. The brighter laser emits twice the number of photons and more energy per photon.
b. The brighter laser emits twice the number of photons and less energy per photon.
c. Both lasers emit equal numbers of photons and equivalent amounts of energy per photon.
d. The brighter laser emits twice the number of photons but both lasers emit equivalent amounts of energy per photon.

3.

Consider four stars in the night sky: red, yellow, orange, and blue. The photons of which star will carry the greatest amount of energy?

a. blue
b. orange
c. red
d. yellow

4.

A lightbulb is wired to a variable resistor. What will happen to the color spectrum emitted by the bulb as the resistance of the circuit is increased?

a. The bulb will emit greener light.
b. The bulb will emit bluer light.
c. The bulb will emit more ultraviolet light.
d. The bulb will emit redder light.

21.2 Einstein and the Photoelectric Effect 5.

Light is projected onto a semi-conductive surface. However, no electrons are ejected. What will happen when the light intensity is increased?

a. An increase in light intensity decreases the number of photons. However, no electrons are ejected.
b. An increase in Increase in light intensity increases the number of photons, so electrons with higher kinetic energy are ejected.
c. An increase in light intensity increases the number of photons, so electrons will be ejected.
d. An increase in light intensity increases the number of photons. However, no electrons are ejected.

6.

True or false—The concept of a work function (or binding energy) is permissible under the classical wave model.

a. false
b. true

7.

Can a single microwave photon cause cell damage?

a. No, there is not enough energy associated with a single microwave photon to result in cell damage.
b. No, there is zero energy associated with a single microwave photon, so it does not result in cell damage.
c. Yes, a single microwave photon causes cell damage because it does not have high energy.
d. Yes, a single microwave photon causes cell damage because it has enough energy.

21.3 The Dual Nature of Light 8.

Why don't we feel the momentum of sunlight when we are on the beach?

a. The momentum of a singular photon is incredibly small.
b. The momentum is not felt because very few photons strike us at any time, and not all have momentum.
c. The momentum of a singular photon is large, but very few photons strike us at any time.
d. A large number of photons strike us at any time, and so their combined momentum is incredibly large.

9.

If a beam of helium atoms is projected through two slits and onto a screen, will an interference pattern emerge?

a. No, an interference pattern will not emerge because helium atoms will strike a variety of locations on the screen.
b. No, an interference pattern will not emerge because helium atoms will strike at certain locations on the screen.
c. Yes, an interference pattern will emerge because helium atoms will strike a variety of locations on the screen.
d. Yes, an interference pattern will emerge because helium atoms will strike at certain locations on the screen.