Quiz.

1. Which has more energy per photon?
   a) red light
   b) blue light
   c) Both have the same energy.

2. A "piece" of energy associated with light is called a
   a) quantum.
   b) photon.
   c) both of these
   d) neither of these

3. Light behaves primarily as a particle when it
   a) travels from one place to another.
   b) interacts with matter.

4. In the double-slit experiment with electrons, the electrons arrive at the screen in a
   a) particle-like way with a pattern that is particle-like.
   b) particle-like way with a pattern that is wave-like.
   c) wave-like way with a pattern that is particle-like.
   d) wave-like way with a pattern that is wave-like.

5. 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.

6. To study the energy of photoelectrons we measure
   a) the potential difference required to stop them.
   b) the distance they travel in a given time.
   c) the time they take to go a given distance.
   d) their temperature.

7. According to the uncertainty principle, the more we know about a particle's position, the less we know about its
   a) speed
   b) momentum
   c) kinetic energy
   d) all of these
   e) none of these

8. Which of the following has the longer wavelength?
   a) a low-energy electron
   b) a high-energy electron
   c) Both have the same wavelength.

9. In the photoelectric effect, electrons ejected from bound states in the photosensitive material have

a) less kinetic energy than the absorbed photon's energy.
b) more kinetic energy than the absorbed photon's energy.
c) kinetic energy equal to the absorbed photon's energy.
d) all of these
e) none of these

Answer Key.

1. b)

Blue light has a shorter wavelength and, therefore, higher frequency and higher energy than red light.

2. c)

Light is quantized, and each "piece" or quantum of light is called a photon.

3. b)

Light generally behaves as a wave when it is traveling through space and as a particle when it interacts with matter.

4. b)

Electrons undergoing the double-slit experiment travel in waves and hit the screen as particles, which is why we are able to detect their pattern when we do not observe their path.

5. b)

As long as we do not give or extract energy from the system we are observing, then our observation will not affect its behavior. For macroscopic entities (especially for those as large as a star) the amount of energy we may exchange with it while observing it is far too little to have any effect on it.

6. a)

This potential difference is also called the stopping potential.

7. d)

While the equation states that the more we know about the particle's position the less we know about its momentum, we also know the speed if we know the momentum, and we also know the energy. The speed of a particle is used to calculate both momentum and energy.

8. a)

This is similar to the first question. Longer wavelengths correspond to lower frequencies and, therefore, lower energies.

9. a)

Some of the photon's energy (the work function) goes into freeing the electron from the metal.