Quiz Questions

Q1: Which of the following quantities determines whether photoelectrons are emitted from a metal surface when light shines on it?
A. The intensity of the light
B. The angle of incidence
C. The frequency of the light
D. The distance from the source

Q2: If the intensity of monochromatic light is increased, what effect does this have on the photoelectrons emitted?
A. They are emitted with greater speed
B. More electrons are emitted per second
C. The threshold frequency increases
D. The work function of the metal decreases

Q3: Which of the following is the best evidence for the particle nature of light?
A. Reflection of light from a mirror
B. Refraction of light through glass
C. The photoelectric effect
D. Interference of light waves

Q4: Why is there a threshold frequency in the photoelectric effect?
A. Below this frequency, light is absorbed by the metal
B. Below this frequency, photons do not have enough energy to overcome the work function
C. Above this frequency, light behaves like a wave
D. Above this frequency, electrons are repelled by the surface

Q5: A metal has a work function of 2.2 eV. What is the minimum frequency of light required to emit photoelectrons? (Planck constant h = 6.63 x 10^-34 J·s, 1 eV = 1.60 x 10^-19 J)
A. 3.3 x 10^14 Hz
B. 5.3 x 10^14 Hz
C. 8.2 x 10^14 Hz
D. 1.2 x 10^15 Hz

Q6: Why does the photoelectric effect not occur when very intense red light shines on a clean zinc plate?
A. Red light has low intensity
B. Zinc is not a good conductor
C. Photons of red light have energy below the work function of zinc
D. Electrons are too tightly bound in zinc

Q7: Light of frequency 6.0 x 10^14 Hz is incident on a metal surface with a work function of 2.0 eV. What is the maximum kinetic energy of the emitted photoelectrons? (h = 6.63 x 10^-34 J·s)

A. 0.49 eV
B. 1.23 eV
C. 2.47 eV
D. 3.98 eV

Q8: In an experiment, electrons are emitted from a metal surface with a maximum speed of 7.5 x 10^5 m/s. Calculate the photon energy if the work function of the metal is 2.2 eV. (mass of electron = 9.11 x 10^-31 kg, 1 eV = 1.60 x 10^-19 J)
A. 3.5 eV
B. 2.2 eV
C. 5.0 eV
D. 4.0 eV

Q9: A metal surface requires photons of wavelength no greater than 400 nm to emit photoelectrons. What is the minimum energy in eV that a photon must have to cause emission? (h = 6.63 x 10^-34 J·s, c = 3.00 x 10^8 m/s, 1 eV = 1.60 x 10^-19 J)
A. 3.1 eV
B. 2.5 eV
C. 4.0 eV
D. 3.5 eV

Q10: A metal surface is illuminated by photons of energy 3.5 eV. The maximum kinetic energy of the emitted electrons is 1.0 eV. What is the work function of the metal?
A. 2.5 eV
B. 3.5 eV
C. 1.0 eV
D. 4.5 eV

Q11: A photocell is illuminated with light of frequency 8.0 x 10^14 Hz. The stopping potential is measured to be 1.5 V. What is the work function of the metal in eV? (h = 6.63 x 10^-34 J·s, 1 eV = 1.60 x 10^-19 J)
A. 1.8 eV
B. 2.8 eV
C. 3.8 eV
D. 4.8 eV

Q12: How can Planck's constant be determined using the photoelectric effect?
A. By plotting current against frequency
B. By measuring stopping potential for different frequencies and plotting KE vs frequency
C. By using a double-slit interference setup
D. By measuring light intensity and wavelength

Q13: The stopping potential in a photoelectric experiment is 2.0 V. What is the maximum kinetic energy of the emitted electrons?
A. 2.0 J

B. 2.0 eV
C. 1.0 eV
D. 0.5 J

Q14: Light with frequency 1.2 x 10^15 Hz shines on a metal surface with a work function of 3.5 eV. What is the speed of the emitted photoelectrons? (h = 6.63 x 10^-34 J·s, m = 9.11 x 10^-31 kg, 1 eV = 1.60 x 10^-19 J)
A. 1.0 x 10^6 m/s
B. 1.3 x 10^6 m/s
C. 8.5 x 10^5 m/s
D. 6.0 x 10^5 m/s

Q15: Planck’s constant is determined in a lab by plotting maximum kinetic energy (in eV) against frequency (in Hz). The gradient of the graph is found to be 4.1 x 10^-15 eV·s. What is the value of Planck’s constant in J·s? (1 eV = 1.60 x 10^-19 J)
A. 2.3 x 10^-33 J·s
B. 4.1 x 10^-34 J·s
C. 6.6 x 10^-34 J·s
D. 5.5 x 10^-33 J·s

Q16: In a ripple tank experiment, water waves pass from a deeper to a shallower region. What happens to the wavelength and speed of the waves?
A. Both wavelength and speed increase
B. Wavelength increases but speed decreases
C. Wavelength and speed both decrease
D. Speed increases but wavelength stays the same

Q17: Which of the following is a correct unit for wave speed?
A. m
B. Hz
C. m/s
D. s/m

Q18: A wave on a string has a frequency of 50 Hz and a wavelength of 0.4 m. What is its speed?
A. 20 m/s
B. 25 m/s
C. 10 m/s
D. 200 m/s

Q19: What is the phase difference between two points separated by half a wavelength?
A. 0°
B. 90°
C. 180°
D. 360°

Q20: Why are X-rays not significantly diffracted when passing through slits or gaps of typical size?

A. They have too high a frequency
B. Their wavelength is much smaller than the gap
C. They travel at the speed of light
D. They are absorbed by most materials

Q21: A sound wave of frequency 340 Hz travels at 340 m/s. What is its wavelength?
A. 1.0 m
B. 0.5 m
C. 2.0 m
D. 3.4 m

Q22: Which of the following explains why red light diffracts more than blue light when passing through a narrow slit?
A. Red light has a higher frequency
B. Red light has a smaller amplitude
C. Red light has a longer wavelength
D. Red light travels more slowly

Q23: Which condition must be met for two waves to interfere constructively?
A. They must be of different frequencies
B. They must be 180° out of phase
C. They must have a phase difference of 0 or multiples of 360°
D. They must be travelling in opposite directions

Q24: Two coherent sources produce interference fringes in a double-slit experiment. What change would increase the fringe spacing?
A. Increase the distance between the slits
B. Use a source with shorter wavelength
C. Decrease the distance from the slits to the screen
D. Use light of a longer wavelength

Q25: Which of the following is an application of diffraction in everyday life?
A. Transmission of digital TV signals
B. Reflection of sound in a concert hall
C. Operation of a laser pointer
D. Focus of light by a magnifying glass

Answers & Explanations

Q1: Correct answer: C
Photoelectrons are only emitted if the frequency of the light is above the threshold frequency for the metal.

Q2: Correct answer: B
Increasing intensity means more photons strike the surface per second, so more electrons are emitted, but their energy is unchanged.

Q3: Correct answer: C
The photoelectric effect shows that light energy is delivered in discrete packets (photons), consistent with a particle model.

Q4: Correct answer: B
Each photon must have at least the work function energy to liberate an electron from the metal surface.

Q5: Correct answer: B
Threshold frequency f = work function / h = (2.2 x 1.60 x 10^-19) / (6.63 x 10^-34) ≈ 5.3 x 10^14 Hz.

Q6: Correct answer: C
The energy of red photons is too low to overcome the work function of zinc, so no photoelectrons are emitted regardless of intensity.

Q7: Correct answer: A
Photon energy E = hf = 6.63 x 10^-34 x 6.0 x 10^14 = 3.978 x 10^-19 J = 2.49 eV. KE = 2.49 - 2.0 = 0.49 eV.

Q8: Correct answer: A
KE = 0.5 x m x v^2 = 0.5 x 9.11 x 10^-31 x (7.5 x 10^5)^2 ≈ 2.56 x 10^-19 J = 1.60 eV. Photon energy = 2.2 + 1.6 = 3.8 eV.

Q9: Correct answer: A
E = hc / lambda = (6.63 x 10^-34 x 3.00 x 10^8) / (400 x 10^-9) ≈ 4.97 x 10^-19 J = 3.1 eV.

Q10: Correct answer: A
Work function = photon energy - kinetic energy = 3.5 eV - 1.0 eV = 2.5 eV.

Q11: Correct answer: C
Photon energy = hf = 6.63 x 10^-34 x 8.0 x 10^14 = 5.30 x 10^-19 J = 3.31 eV. Work function = 3.31 - 1.5 = 1.81 eV.

Q12: Correct answer: B
From Einstein’s equation KE = hf - work function, plotting KE against frequency gives a straight line with gradient equal to Planck's constant.

Q13: Correct answer: B
The stopping potential is the voltage required to stop the most energetic electrons. KE = eV = 2.0 eV.

Q14: Correct answer: B
Photon energy = hf = 7.96 x 10^-19 J = 4.98 eV. KE = 4.98 - 3.5 = 1.48 eV = 2.37 x 10^-19 J. v = sqrt(2KE/m) = sqrt(2 x 2.37 x 10^-19 / 9.11 x 10^-31) ≈ 1.3 x 10^6 m/s.

Q15: Correct answer: C
Convert eV·s to J·s: 4.1 x 10^-15 eV·s x 1.60 x 10^-19 J/eV = 6.56 x 10^-34 J·s ≈ 6.6 x 10^-34 J·s.

Q16: Correct answer: C
As waves enter shallower water, their speed decreases. Since frequency remains constant, the wavelength also decreases.

Q17: Correct answer: C
Wave speed is measured in metres per second (m/s).

Q18: Correct answer: A
Speed = frequency × wavelength = 50 × 0.4 = 20 m/s.

Q19: Correct answer: C
Half a wavelength corresponds to a phase difference of 180°.

Q20: Correct answer: B
Significant diffraction occurs when the gap is similar in size to the wavelength. X-rays have very small wavelengths.

Q21: Correct answer: A
Wavelength = speed / frequency = 340 / 340 = 1.0 m.

Q22: Correct answer: C
Diffraction is more pronounced for longer wavelengths; red has a longer wavelength than blue.

Q23: Correct answer: C
Constructive interference occurs when waves are in phase (0 or multiples of 360°).

Q24: Correct answer: D
Fringe spacing \(w =   rac{\lambda D}{a} \); increasing λ increases fringe spacing.

Q25: Correct answer: A
Diffraction allows TV and radio signals to bend around buildings and hills.