Q1. The minimum energy required to eject an electron from a metal surface is called

A. Threshold energy
B. Binding energy
C. Work function
D. Ionization energy

Answer: C

Explanation: The work function is the minimum energy needed to remove an electron from the surface of a metal.

Q2. In the photoelectric effect, the number of photoelectrons emitted is directly proportional to

A. Frequency of incident light
B. Wavelength of light
C. Intensity of light
D. Angle of incidence

Answer: C

Explanation: The number of emitted photoelectrons increases with the intensity of light, not frequency.

Q3. Photoelectric effect supports the particle nature of light because

A. Light travels in a straight line
B. Light exerts pressure
C. The effect occurs instantaneously
D. Light interferes and diffracts

Answer: C

Explanation: Instantaneous emission of photoelectrons suggests that light transfers energy in discrete packets (photons).

Q4. A photon of energy 5 eV strikes a metal with work function 3 eV. What is the maximum kinetic energy of the emitted photoelectron?

A. 2 eV
B. 5 eV
C. 3 eV
D. 8 eV

Answer: A

Explanation: K.E. = hν − ϕ = 5 eV − 3 eV = 2 eV.

Q5. If the frequency of light is below the threshold frequency, then

A. Electrons are emitted with less energy
B. Electrons are emitted after a time delay
C. No photoelectrons are emitted
D. Emission depends on intensity

Answer: C

Explanation: Below the threshold frequency, photons do not have enough energy to eject electrons.

Q6. Einstein's photoelectric equation is

A. K.E. = hν − ϕ
B. K.E. = ϕ − hν
C. K.E. = hν + ϕ
D. K.E. = hc/λ

Answer: A

Explanation: According to Einstein, the energy of a photon goes into work function + kinetic energy.

Q7. Threshold frequency is defined as the

A. Maximum frequency needed for emission
B. Minimum frequency needed for emission
C. Frequency where electrons are accelerated
D. Frequency where light gets absorbed

Answer: B

Explanation: It is the minimum frequency of light that can cause photoelectric emission.

Q8. A metal has a work function of 2 eV. What is its threshold wavelength?
(Given: $h = 6.63\times10^{-34}$ J·s, $c = 3\times10^{8}$ m/s, 1 eV = 1.6×10^{-19} J)

A. 620 nm
B. 540 nm
C. 700 nm
D. 6200 nm

Answer: A

Explanation:
$\lambda = hc/E = (6.63\times10^{-34} \times 3\times10^{8}) / (2 \times 1.6\times10^{-19}) \approx 620$ nm.

Q9. Stopping potential is the potential at which

A. Emission starts
B. Acceleration of electrons starts
C. Maximum photoelectrons are emitted
D. Fastest photoelectrons are stopped

Answer: D

Explanation: Stopping potential is the reverse voltage needed to stop the most energetic photoelectrons.

Q10. If stopping potential is 3 V, the maximum kinetic energy of emitted electrons is

A. 0 eV
B. 1.5 eV
C. 3 eV
D. 6 eV

Answer: C

Explanation: K.E. = eV = 1 × 3 = 3 eV.

Q11. The de Broglie wavelength of a particle is given by

A. h/v
B. h/m
C. h/mv
D. mv/h

Answer: C

Explanation: de Broglie wavelength is $\lambda = h / (mv)$, where m is mass and v is velocity.

Q12. If the velocity of an electron is doubled, its de Broglie wavelength becomes

A. Half
B. Double
C. Four times
D. One-fourth

Answer: A

Explanation: $\lambda \propto 1/v$, so doubling velocity makes wavelength half.

Q13. An electron and a proton have the same kinetic energy. Who has a longer de Broglie wavelength?

A. Proton
B. Electron
C. Both equal
D. Cannot say

Answer: B

Explanation: At same kinetic energy, lighter particles (electron) have longer wavelength.

Q14. The wave nature of electrons was confirmed by

A. Millikan’s oil drop experiment

B. Davisson-Germer experiment
C. Photoelectric effect
D. Rutherford's scattering

Answer: B

Explanation: The Davisson-Germer experiment showed electron diffraction—proof of wave nature.

Q15. According to de Broglie, matter shows

A. Only wave nature
B. Only particle nature
C. Both wave and particle nature
D. Neither wave nor particle nature

Answer: C

Explanation: Matter has dual nature — it behaves as both wave and particle.

Q16. The kinetic energy of photoelectrons emitted by a metal surface depends on

A. Intensity of incident light
B. Frequency of incident light
C. Number of incident photons
D. Angle of incidence

Answer: B

Explanation: Kinetic energy depends on the frequency (or energy) of photons, not on intensity.

Q17. A light of wavelength 400 nm is incident on a metal with work function 2.5 eV. Find the maximum kinetic energy of emitted electrons.
(Given: $h = 6.63\times10^{-34}$ J·s, $c = 3\times10^{8}$ m/s, 1 eV = 1.6×10^{-19} J)

A. 1.1 eV
B. 2.1 eV
C. 3.5 eV
D. 0.6 eV

Answer: A

Explanation:
Energy of photon = hc/λ
= $(6.63\times10^{-34} \times 3\times10^{8}) / (400\times10^{-9}) \approx 4.97\times10^{-19}$ J ≈ 3.1 eV
K.E. = 3.1 eV − 2.0 eV = 1.1 eV

Q18. Which graph best represents the photoelectric current vs intensity of light for a fixed frequency?

A. Straight line passing through origin
B. Parabola
C. Horizontal line
D. Step function

Answer: A

Explanation: Photoelectric current ∝ intensity when frequency is above threshold.

Q19. For a certain metal, threshold wavelength is 500 nm. What is the work function of the metal?
($h = 6.63\times10^{-34}$ J·s, $c = 3\times10^{8}$ m/s, 1 eV = 1.6×10^{-19} J)

A. 2.5 eV
B. 3.2 eV
C. 4.0 eV
D. 2.0 eV

Answer: A

Explanation:
$\phi = hc/\lambda$
= $(6.63\times10^{-34} \times 3\times10^{8}) / (500\times10^{-9}) = 3.98\times10^{-19}$ J ≈ 2.5 eV

Q20. The stopping potential is zero when

A. Frequency = threshold frequency
B. Frequency > threshold frequency
C. Intensity = zero

D. Angle of incidence = 90°

Answer: A

Explanation: When photon energy = work function, electrons are just ejected with zero kinetic energy.

Q21. In photoelectric effect, if intensity is increased but frequency is below threshold, then

A. Electrons are emitted faster
B. More electrons are emitted
C. Electrons are not emitted
D. Electrons are emitted with more K.E.

Answer: C

Explanation: Below threshold frequency, no electrons are emitted—regardless of intensity.

Q22. An electron is accelerated through 150 V. What is its de Broglie wavelength?
($h = 6.63\times10^{-34}$ J·s, $m = 9.11\times10^{-31}$ kg, $e = 1.6\times10^{-19}$ C)

A. 1.0×10^{-10} m
B. 1.0×10^{-9} m
C. 1.0×10^{-11} m
D. 3.2×10^{-10} m

Answer: D

Explanation:
K.E. = eV = $1.6\times10^{-19} \times 150$
$\lambda = h / \sqrt{(2meV)} \approx 3.2 \times 10^{-10}$ m

Q23. Which of the following supports the particle nature of light?

A. Diffraction
B. Interference
C. Polarisation
D. Photoelectric effect

Answer: D

Explanation: Photoelectric effect involves photons interacting like particles with electrons.

Q24. The wavelength of light emitted by an electron accelerated through 100 V is closest to

A. 0.123 nm
B. 10 nm
C. 100 nm
D. 1 μm

Answer: A

Explanation:
K.E. = eV = 100 eV
$\lambda \approx h / \sqrt{(2meV)} \approx 1.23 / \sqrt{(100)} \approx 0.123$ nm

Q25. If the mass of a particle is doubled, its de Broglie wavelength becomes

A. Same
B. Double
C. Half
D. Four times

Answer: C

Explanation: $\lambda = h / mv \rightarrow$ doubling mass halves the wavelength.

Q26. Which experiment confirmed wave nature of electrons?

A. Photoelectric effect
B. Davisson-Germer experiment
C. Millikan's oil drop
D. Rutherford's α-scattering

Answer: B

Explanation: Davisson and Germer showed diffraction of electrons from crystal surfaces.

Q27. Which physical quantity of photons is responsible for energy transfer to electrons?

A. Amplitude
B. Phase
C. Frequency
D. Intensity

Answer: C

Explanation: Energy of a photon = hν → frequency determines energy.

Q28. The graph of stopping potential vs frequency is

A. Linear
B. Parabolic
C. Hyperbolic
D. Exponential

Answer: A

Explanation: $V_o = (h/e)\nu - (\phi/e)$, which is a straight-line equation.

Q29. A particle has kinetic energy 1 eV. Its de Broglie wavelength is

A. Inversely proportional to energy
B. Directly proportional to energy
C. Inversely proportional to square of energy
D. Independent of energy

Answer: A

Explanation: $\lambda = h / \sqrt{(2mK.E)} \rightarrow \lambda \propto 1/\sqrt{K.E}$

Q30. When light of frequency $2\nu_o$ (twice threshold frequency) is used on a metal with work function ϕ, the maximum kinetic energy is

A. ϕ
B. 2ϕ
C. hv_o
D. hv_o

Answer: D

Explanation:
K.E. = $h(2v_o) - \phi = hv_o$ (since $\phi = hv_o$)

Q31. A beam of light of intensity I is incident on a metal surface. If the intensity is doubled, the number of photoelectrons emitted per second will

A. Remain the same
B. Double
C. Become half
D. Four times

Answer: B

Explanation: Photoelectron current is directly proportional to the intensity of incident light, provided frequency is above threshold.

Q32. Which of the following cannot be explained by wave theory of light?

A. Photoelectric effect
B. Interference
C. Diffraction
D. Polarisation

Answer: A

Explanation: Wave theory cannot explain the instantaneous emission of photoelectrons or the presence of threshold frequency. This is explained only by particle nature.

Q33. The work function of a metal is 3.0 eV. If a light of 500 nm is incident on it, what will be the photoelectric current?
(Given: hc = 1240 eV·nm)

A. Zero
B. Depends on intensity
C. Infinite
D. Cannot be determined

Answer: A

Explanation:
Energy of incident photon = 1240 / 500 = 2.48 eV < 3.0 eV
Hence, no electrons will be emitted ⇒ current = 0

Q34. The de Broglie wavelength of an electron accelerated from rest by a potential difference V is

A. $\lambda = h / mv$
B. $\lambda = h / \sqrt{(2meV)}$
C. $\lambda = h / eV$
D. $\lambda = h / \sqrt{(eV)}$

Answer: B

Explanation: K.E. of electron = eV,
$\lambda = h / \sqrt{(2meV)}$, derived from de Broglie relation.

Q35. Which of the following is true for photon but not for electron?

A. Has energy
B. Has momentum
C. Has rest mass
D. Exhibits wave-like behavior

Answer: C

Explanation: Photon has no rest mass ($m_o = 0$), unlike electron which has definite rest mass.

Q36. A photon and an electron have the same de Broglie wavelength. Which one has higher energy?

A. Electron

B. Photon
C. Both have same
D. Cannot be determined

Answer: B

Explanation:
For same λ,
E_photon = hc/λ
E_electron = $p^2/2m$
But photon energy is greater than the kinetic energy of electron for same λ.

Q37. The stopping potential for photoelectrons from a surface is 2 V. What is the maximum kinetic energy of emitted photoelectrons?

A. 2 eV
B. 1 eV
C. 4 eV
D. 0.5 eV

Answer: A

Explanation: K.E_max = e × V_o = 1 × 2 = 2 eV

Q38. What is the de Broglie wavelength of a proton moving with the same speed as an electron?

A. Equal for both
B. Greater for proton
C. Greater for electron
D. Cannot be predicted

Answer: C

Explanation: λ = h / mv → for same v, heavier particle (proton) has smaller λ.

Q39. A particle has a wavelength of 2×10^{-10} m. If its mass is 1 kg, what is its momentum?

A. 2×10^{-10} kg·m/s

B. 3.3×10^{-34} kg·m/s
C. 3.3×10^{-24} kg·m/s
D. 3.3×10^{-27} kg·m/s

Answer: C

Explanation:
$p = h / \lambda = (6.63\times10^{-34}) / (2\times10^{-10}) = 3.315\times10^{-24}$ kg·m/s

Q40. Which of the following increases the photoelectric current?

A. Increasing frequency of incident light
B. Increasing intensity
C. Increasing threshold frequency
D. Increasing stopping potential

Answer: B

Explanation: More intensity means more photons → more electrons emitted → higher current.

Q41. The threshold frequency of a metal is 5×10^{14} Hz. If light of frequency 1×10^{15} Hz is incident, what is the maximum kinetic energy of emitted photoelectrons?
(Use $h = 6.63\times10^{-34}$ J·s, 1 eV = 1.6×10^{-19} J)

A. 1.38 eV
B. 2.07 eV
C. 0.83 eV
D. 3.13 eV

Answer: B

Explanation:
$K.E = h(v - v_o) = 6.63\times10^{-34} \times (5\times10^{14}) = 3.315\times10^{-19}$ J ≈ 2.07 eV

Q42. When the intensity of light is increased in photoelectric effect experiment (frequency > threshold),

A. Photoelectron energy increases
B. Number of electrons increases

C. Both increase
D. No change

Answer: B

Explanation: Kinetic energy depends on frequency, but more intensity means more photons → more electrons emitted.

Q43. Which of the following quantities is same for all photons of light?

A. Frequency
B. Speed
C. Wavelength
D. Energy

Answer: B

Explanation: All photons, regardless of energy or frequency, travel at speed of light in vacuum (3×10^8 m/s).

Q44. What is the nature of graph between kinetic energy of photoelectrons and frequency of light?

A. Straight line with positive slope
B. Parabola
C. Hyperbola
D. Constant

Answer: A

Explanation: K.E. = $h\nu - \phi$ → linear relation with slope h and y-intercept $-\phi$.

Q45. If light of intensity I and frequency v (above threshold) is incident, and I is doubled, what happens to stopping potential?

A. Doubles
B. Halves
C. Remains same
D. Becomes zero

Answer: C

Explanation: Stopping potential depends only on frequency (v), not intensity.