Class 12 Physics · Chapter 11: Dual Nature of Radiation and Matter

Worksheet · 20 marks · about 40 minutes · based on NCERT

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1. Very intense light of frequency below the threshold frequency of a metal falls on it for a long time. The photoelectrons emitted [1]

(a) are few, but of large kinetic energy
(b) are none at all
(c) are many, but of small kinetic energy
(d) appear only after a time that depends on the intensity

2. Which statement about photons is not correct? [1]

(a) A photon is deflected by a magnetic field.
(b) A photon of frequency v has energy hv.
(c) In vacuum every photon travels at speed c.
(d) The number of photons may change in a collision with a particle.

3. An uncharged zinc plate, mounted on an electroscope, is exposed to ultraviolet light. The plate [1]

(a) becomes negatively charged
(b) becomes positively charged
(c) stays uncharged
(d) first gains and then loses positive charge

4. Light of frequency above the threshold, but of very low intensity, falls on a clean metal surface. Photoelectric emission begins [1]

(a) within about 10^{-9} s or less
(b) after a few seconds
(c) after several minutes, as energy builds up
(d) only after hours, unless the intensity is raised

5. The light on a photosensitive surface is changed to one of higher frequency, its intensity kept the same. Compared with before, [1]

(a) the stopping potential is the same and the saturation current is larger
(b) both the stopping potential and the saturation current are larger
(c) the stopping potential is smaller in magnitude and the saturation current is the same
(d) the stopping potential is larger in magnitude and the saturation current is the same

6. Ultraviolet light of wavelength 300 nm falls on two metal plates, X of work function 2.3 eV and Y of work function 4.5 eV. Which plate emits photoelectrons, and with what maximum kinetic energy? What is the longest wavelength that would eject electrons from the other plate? ($h = 6.63 \times 10^{-34}$ J s, $e = 1.6 \times 10^{-19}$ C, $c = 3 \times 10^{8}$ m s^{-1}) [2]

7. On the wave picture of light, how long would one expect an electron to take to escape from a metal under very dim light? How does this compare with what is observed? [2]

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8. A red lamp (wavelength 700 nm) and a violet lamp (wavelength 400 nm) each emit light energy at the same rate of 1.0 W. Which lamp emits more photons per second? Find the ratio of the two numbers. [2]

9. Write Einstein's photoelectric equation. Use it to explain (i) why there is a threshold frequency, and (ii) why the maximum kinetic energy of photoelectrons does not depend on the intensity of light. [3]

10. Light of frequency v_1 falling on a metal gives a stopping potential of 1.0 V. Light of frequency $1.5v_1$ on the same metal gives a stopping potential of 2.5 V. Find (a) the work function of the metal in eV, (b) v_1, and (c) the threshold frequency. ($h = 6.63 \times 10^{-34}$ J s, $e = 1.6 \times 10^{-19}$ C) [3]

11. (a) What did J. J. Thomson measure for cathode ray particles, and why did his result suggest that these particles are universal? (b) Millikan found the elementary charge to be 1.602×10^{-19} C. Taking $e/m = 1.76 \times 10^{11}$ C kg^{-1}, find the mass of the electron. [3]