2023 Ph H1 Q14

Section: Particles and Waves

Topic: Wave – Particle Duality / Photoelectric Effect

Brief summary of the question

Radiation of frequency f = 9.0×10^14 Hz strikes a clean, negatively charged metal. Work function ϕ = 6.1×10^-19 J. There is no photoemission — explain why.

Worked solution

Photon energy: E = h f = (6.63×10^-34)(9.0×10^14) = 5.97×10^-19 J.

Compare with work function: E < ϕ (5.97×10^-19 < 6.1×10^-19).

Therefore the frequency is below the threshold for this metal; photons lack sufficient energy to liberate electrons.

Final answer

C — frequency is less than the threshold frequency of the metal.

Revision tips

- **No emission if h f < ϕ, regardless of intensity.**
- **Higher work function ⇒ higher threshold frequency.**
- **A negative plate makes emission harder, but here photon energy is already too low.**