2021 Ph H1 Q17

Section: Particles and Waves

Topic: Wave-Particle Duality

Question Summary

An experiment to demonstrate the photoelectric effect is set up with a gold-leaf electroscope. Which row in the table shows the correct charge on the metal plate and the type of radiation most likely to cause emission?

Worked Solution

Photoelectric effect: electrons emitted when incident photons have energy ≥ work function.

Energy of a photon $E = hf = hc/\lambda$.

Ultraviolet photons have higher energy than visible or infrared → can cause emission.

Metal plate must be negatively charged to observe photoelectron emission (repels emitted electrons to electroscope).

Therefore correct combination: negative plate, ultraviolet radiation.

Final Answer

E — Negative, Ultraviolet

Revision Tips

• Photoelectric effect requires high-frequency (short λ) light.

• Threshold frequency is unique to the material.

• Ultraviolet has enough energy; visible (green/red) or infrared do not.

• Plate must be negative to store electrons and show emission on electroscope.