

MODERN PHYSICS DAY 1: THE PHOTOELECTRIC EFFECT

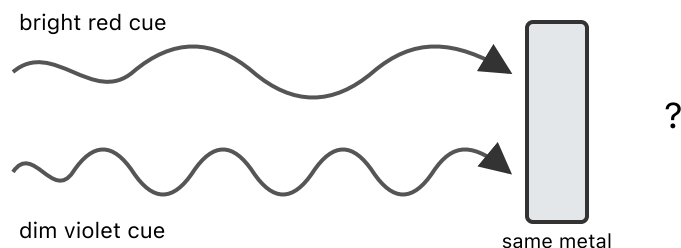
CED 15.5 · Skill 3.C · FRQ: Qualitative/Quantitative Translation

PREDICT

The same metal is illuminated first by a bright red source and then by a dim violet source. Which observation would best test whether color or brightness sets the maximum electron energy?

- A. count electrons only B. measure K_{Emax} for each color C. measure plate temperature**
D. compare beam width

The sources are a prediction cue. Use the simulation or supplied result for the observation.

BEFORE THE EVIDENCE IS REVEALED**Question for the model**

What property of the light sets whether electrons are ejected, how energetic they can be, and how many leave each second?

NOTES / REASONING

ONE PHOTON, ONE ENERGY ACCOUNT

$$E_{\gamma} = hf \quad KE_{max} = hf - \phi$$

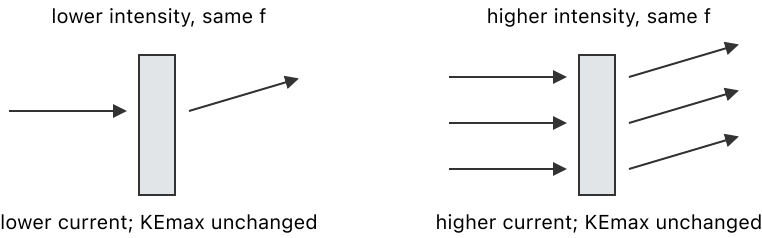
The work function ϕ is the minimum energy required to remove an electron from the metal. If $hf < \phi$, no electrons are ejected, regardless of intensity.

$$f_0 = \frac{\phi}{h}$$

WE DO A metal has $\phi = 2.40 \text{ eV}$. Light of frequency $7.50 \times 10^{14} \text{ Hz}$ strikes it. Find the photon energy and KE_{max} . Use $h = 4.14 \times 10^{-15} \text{ eV} \cdot \text{s}$.

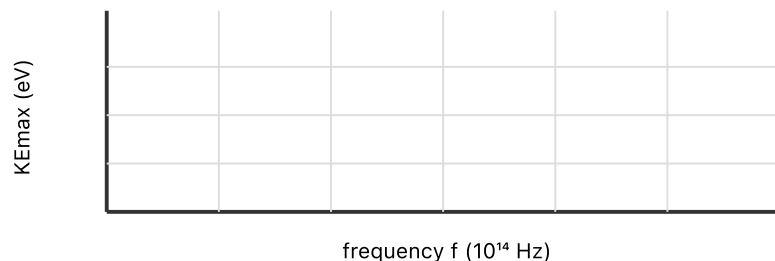
FREQUENCY VERSUS INTENSITY

HOLD COLOR FIXED WHILE INTENSITY CHANGES



Change	Electron rate / current	K_{Emax} / stopping voltage
Increase intensity at fixed $f > f_0$		
Increase frequency at fixed intensity		
Increase intensity while $f < f_0$		

Complete the table, then write one sentence that distinguishes energy per photon from photons per second.

TRANSLATE EVIDENCE TO A GRAPH**SKETCH KEMAX AS FREQUENCY INCREASES**

1. Mark the threshold frequency, draw the above-threshold line, and label its slope and extrapolated vertical intercept.

2. Find the threshold frequency for $\phi = 2.40 \text{ eV}$. Carry units through the division.

3. Above threshold, $KE_{max} = 0.705 \text{ eV}$. Find the stopping voltage.

4. A student doubles intensity and predicts a steeper KEmax-versus-frequency line. Use the model to evaluate the claim.