Photoelectric Effect

mp|851

$\lambda = 571\,nm$

$c = \lambda f$

$1\,eV = 1.6 \times 10^{-19}\,J$

Cesium ($W = 2.14\,eV$) ($3.42 \times 10^{-19}\,J$)

a) $E_{k(max)} = ?$

b) $V_0 = ?$

c) $f_0 = ?$

a)
$$E_{k(max)} = hf - W$$
$$E_{k(max)} = \frac{hc}{\lambda} - W$$
$$E_{k(max)} = \frac{(6.626 \times 10^{-34}\,J{\cdot}s)(3.00 \times 10^{8}\,m/s)}{(571 \times 10^{-9}\,m)} - 3.42 \times 10^{-19}\,J$$
$$E_{k(max)} = 5.73 \times 10^{-21}\,J$$
$$E_{k(max)} = 0.0358\,eV$$

b) stopping potential:
$$E_{k(max)} = eV_0$$
$$V_0 = \frac{E_{k(max)}}{e}$$
$$V_0 = \frac{5.73 \times 10^{-21}\,J}{1.6 \times 10^{-19}\,C}$$
$$V_0 = 0.0358\,V$$

Note that the stopping potential is the same numerical value as the $E_{k(max)}$ when expressed in eV.

Example: If the ~~stopping potential~~ were 3.2V, then the max KE is 3.2eV.
If the max KE is 2.4eV, the stopping potential is 2.4V.

c) threshold frequency:
$$W = hf_0$$
$$f_0 = \frac{W}{h}$$
$$f_0 = \frac{(2.14\,eV)(1.6 \times 10^{-19}\,J/eV)}{6.626 \times 10^{-34}\,J{\cdot}s}$$

minimum frequency → $f_0 = 5.17 \times 10^{14}\,Hz$

(universal wave equation)
$$c = \lambda f$$
$$\lambda = \frac{c}{f}$$
$$\lambda = \frac{3.00 \times 10^{8}\,m/s}{5.17 \times 10^{14}\,Hz}$$
$$\lambda = 5.81 \times 10^{-7}\,m$$
$$\lambda = 581\,nm$$

↑ maximum λ

← within the visible spectrum (400nm – 700nm)