

Answer on Question #48949 – Chemistry – Inorganic Chemistry

Question:

Calculate the frequency of the radiation required to eject photoelectrons to a velocity of $9 \times 10^5 \text{ MS}^{-1}$ from sodium metal surface, having a threshold frequency of $4.61 \times 10^{14} \text{ Hz}$ (mass of photoelectron = $9.109 \times 10^{-31} \text{ kg}$)

Solution:

According to Einstein's equation energy of photon (irradiation energy) is given by

$h\nu = m \times v^2/2 + A$, where ν – the irradiation frequency, v – the velocity of photo electrons, A – the work function and $h = 6.62606957 \times 10^{-34} \text{ J s}$.

The work function can be calculated using the threshold frequency (ν_0) when $V = 0$:

$$A = h\nu_0$$

$$\text{Thus, } \nu = (m \times v^2/2 + h\nu_0)/h$$

$$\begin{aligned} \nu &= (9.109 \times 10^{-31} \text{ kg} \times 40.5 \times 10^{10} \text{ m}^2/\text{s}^2) / (6.62606957 \times 10^{-34} \text{ J s}) + 4.61 \times 10^{14} \text{ Hz} = \\ &= 5.56762 \times 10^{14} \text{ Hz} + 4.61 \times 10^{14} \text{ Hz} = 10.17762 \text{ Hz} \end{aligned}$$

Answer: 10.17762 Hz