

When a laser is pointed at a zinc metal surface ($\Phi = 7.85 \times 10^{-13} \mu\text{J}$), an electron is ejected with a velocity of $1.44 \times 10^5 \text{ mm/ms}$. What is the wavelength of light that is emitted by the laser? Report your answer in nm.

Ok, let's think about this problem in pieces:

1. Consider the equation $E_{\text{photon}} = \Phi + E_k$

a. Which variable is explicitly told to you in the problem? Is it in SI units? If not, convert it.

b. Can you determine either of the other variables from the information you are given and the extra info below? If so, calculate that value. Make sure you are careful with units (when in doubt, use SI units).

$$E_{\text{photon}} = h\nu = \frac{hc}{\lambda}$$

$$h = 6.626 \times 10^{-34} \text{ Js}$$

$$c = 2.998 \times 10^8 \text{ ms}^{-1}$$

$$E_k = \frac{1}{2}mv^2$$

$$m_{\text{electron}} = 9.109 \times 10^{-31} \text{ kg}$$

$$c = \lambda\nu$$

c. Now put it all together and solve for the 3rd term in the equation $E_{\text{photon}} = \Phi + E_k$

d. Is this the answer that you need? If not, use the information given above to solve for the variable that you want. Make sure to note that the problem is asking for the answer in a specific unit.

2. Now try it yourself. Determine the velocity of an electron that is ejected from a Uranium surface when 145 nm light is directed at that surface. The threshold energy of Uranium is 3.6 eV (note that 1 eV = 1.602×10^{-19} J).

3. The threshold energy of carbon is 4.81 eV while aluminum is 4.08 eV. Using your understanding of Coulomb's Law, explain why it takes less energy to release an electron from aluminum.

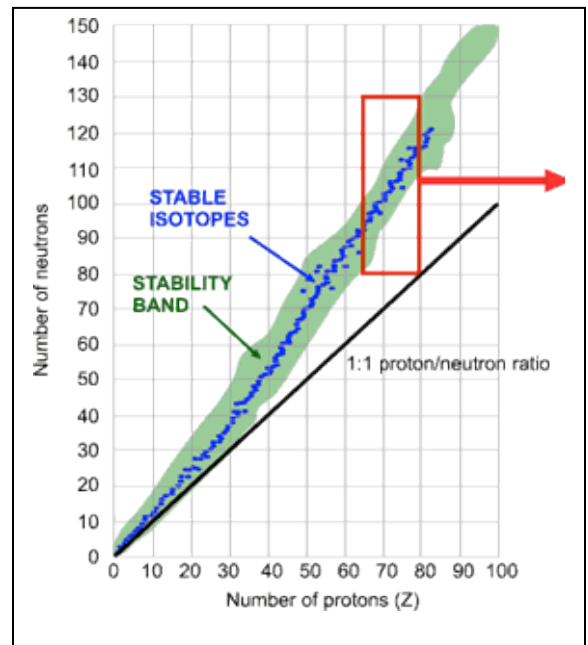
$$E_p = c \frac{q_1 q_2}{r} \text{ where } c \text{ is a constant}$$

4. Determine the frequency of a photon required to release an electron from carbon.

5. The image to the right shows the relationship between the number of neutrons and protons for stable nuclei.
- As stable nuclei get larger, do the number of protons increase more quickly or slowly than the number of neutrons?

What would the graph look like if the opposite were true?

- Using your understanding of Coulomb's law, propose a reason that one subatomic particle needs to be more abundant than the other as nuclei get larger.



6. Two stable isotopes of lithium exist. Lithium-6 has an exact mass of 6.015 amu and lithium-7 has an exact mass of 7.016 amu.
- What is the average mass of lithium?
 - Is this number closer to the mass of ${}^6\text{Li}$ or ${}^7\text{Li}$? Based on this, which isotope do you think is more abundant?
 - Calculate the natural abundance of each isotope.