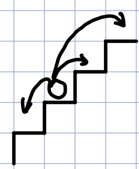
Quantized : only specific values

Ex : mass, energy, charge

($E=mc^2$) (+, -, neutral)

Fixed location, ball could be at (1, 2, 3)

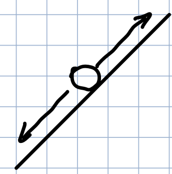


stairs

Continuous : Any or all values

Ex : time, temp.

Ball could be anywhere

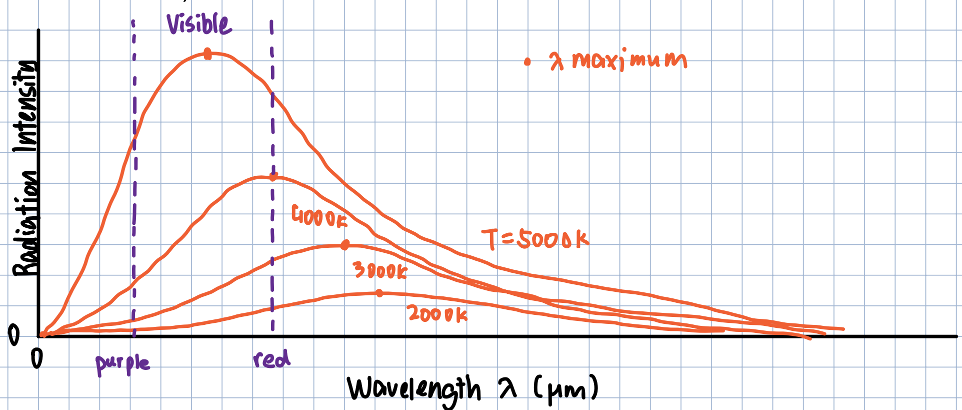


(1, 1.23, 2.47, etc)

ramp

Blackbody Radiation Definition:

A hypothetical object that reflects no light, it only absorbs light. Any emitted light comes from that absorbed light (energy). Anything that produces heat is emitting blackbody radiation (ex. humans emit infrared radiation)



Max Planck realized that energy is released in discrete packets, known as quanta. The energy released is proportional to frequency also $\frac{1}{\lambda}$ $v=f\lambda$

$J=(J\cdot S)(\frac{1}{S})$

$E \propto f$

$E=hf$

Planck's constant 6.63×10^{-34} J·S

Ex: Calculate the energy in joules and electron volts (ev) of

a) a quantum of blue light with f=6.67x10^14 Hz

b) a quantum of red light with lambda = 635nm

a)

$$E = hf$$

$$= (6.63\times10^{-34}\,J\cdot s)(6.67\times10^{14}\,\tfrac{1}{s})$$

$$= 4.42\times10^{-19}\,J \times \frac{1ev}{1.6\times10^{-19}\,J}$$

$$= 2.76ev$$

b)

$$E = hf$$

$$= h\frac{v}{\lambda}$$

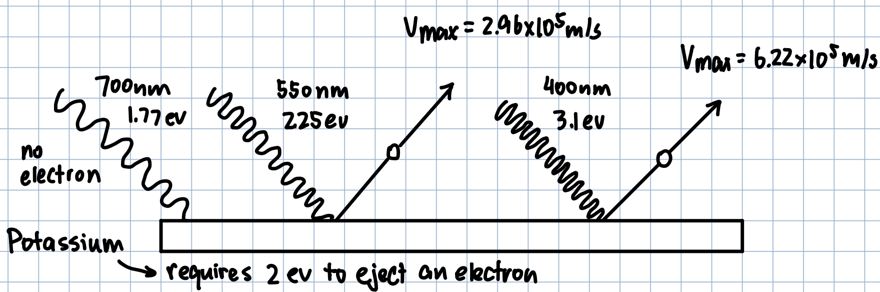
$$= \frac{(6.63\times10^{-34})(3\times10^{8})}{635\times10^{-9}}$$

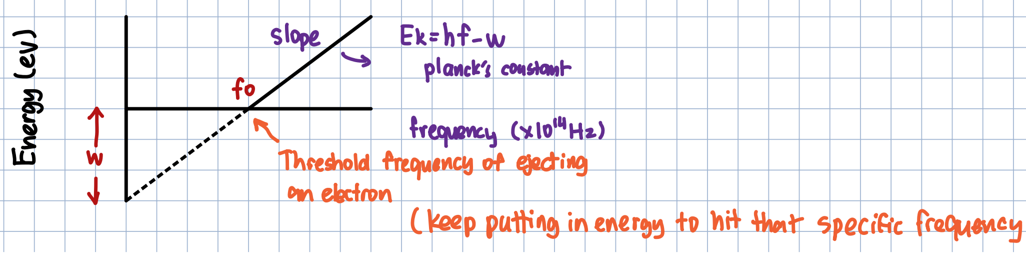
$$= 3.13\times10^{-9}\,J$$

$$= 1.96\,ev$$

The photoelectric effect is the emission of electrons when electromagnetic radiation, such as light, hits a material. However there is a threshold frequency that must be met in order for this to occur. Any additional energy (frequency) will dictate to the kinetic energy of the particle

$$E_{photon} = hv$$





$$\Delta V = \frac{\Delta E}{q} \qquad \frac{J}{C} = \text{Volts}$$

Ex:

Orange light with a wavelength of 600nm is directed at a metallic surface with a work function (W) of 1.6eV.

Calculate:

a) max kinetic energy in joules of the emitted electrons

b) maximum speed

c) the cutoff necessary to stop electrons

$\lambda = 6\times10^{-9}\,m$

$W = 1.6\,eV$

a)

$$E_k = hf - W$$

$$= h\frac{v}{\lambda} - W$$

$$= 6.63\times10^{-34}\left(\frac{3\times10^{8}}{600\times10^{-9}}\right) - \left(1.6\,eV \times \frac{1.6\times10^{-19}\,J}{1\,eV}\right)$$

$$E_k = 7.55\times10^{-20}\,J$$

b)

$m_e = 9.1\times10^{-31}\,kg$

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

$$7.55\times10^{-20} = \frac{1}{2}(9.1\times10^{-31})v^2$$

$$v = \sqrt{\frac{7.55\times10^{-20}}{\frac{1}{2}(9.1\times10^{-31})}}$$

$$v = 4.07\times10^{5}\,m/s$$

c)

charge

cut off potential

$$E_k = eV_0$$

V not

$$V_0 = \frac{E_k}{e} = \frac{7.55\times10^{-20}\,J}{1.6\times10^{-19}\,C}$$

coulombs

$$= 0.47\,V$$

Straight conductor/wire

$$B = \mu_0 \frac{I}{2\pi r}$$

Coil

number of coils

current

$$B = \mu_0\left(\frac{NI}{L}\right)$$

Length of coil

permeability of free space: $\boxed{}$

constant