**Lecture 3. /B**

***Calculation of X-ray wavelengths & frequency***

If electrons are accelerated to a velocity **v** by a potential difference **V** and then allowed to collide with a metal target, the maximum frequency of the X-rays emitted is given by the equation:

***½ mv2= eV = hf***

**Therefore**:

**X ray frequency (f) = eV/h**

↨↨  
*This mathematical formula shows that the maximum frequency is directly proportional to the accelerating voltage*.

**Example problem**  
***Q/Calculate the minimum wavelength of X-rays emitted when electrons accelerated through 30 kV strike a target.***

**Answer is:-**  
**f** = [1.6 x 10-19 x 3 x 104]/ 6.63 x 10-34 = 7.2x1018 Hz  
  
Therefore the wavelength

**** (= c/f) is 0.41 x 10-10 m = 0.04 1 nm (compared with some 600 nm for yellow light)

**(Quizzes examination No. 1) Q1/ Calculate the: - 1-maximum energy & 2- minimum wavelength**

**for an x-ray beam generated at 100 kVp.**

**Answer /**

The maximum energy (keV) numerically equals the maximum tube voltage (kVp).  
Because the maximum tube voltage is 100 kVp, the maximum energy of the photons is 100 keV:

λ min= {1.24}/{100 kVp}

*λmin*=0.0124 *nm*

**Q2/**

**Find the**

**(a) maximum frequency**

**(b) Minimum wavelength of X-rays produced by 30 kV electrons**.

**The Solutions**

(**a**).

Potential of the electrons, V=30kV=3×104V

Hence, energy of the electrons, E=3×104eV

Where,

e = Charge on an electron = 1.6×10−19C

Maximum frequency produced by the X-rays is ν

The energy of the electrons is given by the relation is E=hν

Where,

h = Planck’s constant = 6.626×10−34Js

ν=E/h=7.24×1018Hz

(**b**).

 Energy of a electron, E=30×103eV

Let Maximum frequency produced by the X-rays be ν

ν=E/h=1.6×10−19×3×104/6.626×10−34=7.24×1018Hz where h is the planck's constant.

The minimum wavelength produced by the X-rays is given as-

λ=c/ν=0.0414nm