Q6. The wavelength of a photon needed to remove a proton from a nucleus which is bound to the nucleus with 1 MeV energy is nearly

a) 1.2 nm (b) 1.2 x 10^{-3} nm
(c) 1.2 x 10^{-6} nm (d). 1.2 x 10 nm
Solution: **(b)**

Key concept: According to Einstein's quantum theory light propagates in the bundles (packets or quanta) of energy, each bundle being called a photon and possessing energy. Energy of photon is given by

$E = h\nu = \dfrac{hc}{\lambda}$; where c = Speed of light, h = Planck's constant = 6.6×10^{-34} J-sec, ν = Frequency in Hz, λ = the minimum wavelength of the photon required to eject the proton from nucleus.

In electron volt, $E(eV) = \dfrac{hc}{e\lambda} = \dfrac{12375}{\lambda(\text{Å})} \approx \dfrac{12400}{\lambda(\text{Å})}$

According to the problem,
Energy of a photon, E = 1 MeV or 10^6 eV
Now, hc = 1240 eV nm

Now, $E = \dfrac{hc}{\lambda}$

$$\Rightarrow \quad \lambda = \frac{hc}{E} = \frac{1240}{10^6}\,\text{nm}$$

$$= 1.24 \times 10^{-3}\,\text{nm}$$