Question 10. Two particles A_1 and A_2 of masses m_1 , m_2 ($m_1 > m_2$) have the same de-Broglie wavelength. Then,

(a) their momenta are the same (b) their energies are the same

(c) energy of A_1 is less than the energy of A_2

(d) energy of A_1 is more than the energy of A_2

Ans-(a),(c)

We know that de-Broglie wavelength $\lambda = \frac{h}{mv}$

where, $mv = p$ (momentum) of the particle

$\Rightarrow$ But we can express wavelength $\lambda = \frac{h}{p} \Rightarrow p = \frac{h}{\lambda}$
Here, h is Planck constant.

Hence, $p \propto \frac{1}{\lambda} \Rightarrow \frac{p_1}{p_2} = \frac{\lambda_2}{\lambda_1}$

But particles have the same de-Broglie wavelength. $(\lambda_1 = \lambda_2) = \lambda$.

Then, $\frac{p_1}{p_2} = \frac{\lambda}{\lambda} = 1 \Rightarrow p_1 = p_2$

Thus, their momenta is same.

Also, $E = \frac{1}{2}mv^2 = \frac{1}{2}mv^2\frac{m}{m}$

$= \frac{1}{2}\frac{m^2v^2}{m} = \frac{1}{2}\frac{p^2}{m}$

As p is constant, $E \propto \frac{1}{m}$

$\therefore \quad \frac{E_1}{E_2} = \frac{m_2}{m_1} < 1 \Rightarrow E_1 < E_2$