Heisenberg uncertainity principle (HUP)

- According to HUP it is impossible to determine the exact value of conjugate pair simultaneously minimum product of uncertainity indetermination is $\left(\frac{h}{4\pi}\right)$.
- this conjugate pair (dependent pair) for a moving particle is position and momentum therefore According to Heisenberg uncertainity.

$$\Delta x \times \Delta p \geq \frac{h}{4\pi}$$

$$\geq \left(\frac{\hbar}{2}\right) \qquad \left\{\hbar = \frac{h}{2\pi}\right\}$$

$$\hbar = \frac{h}{2\pi} = 1.096 \times 10^{-34}$$

$$\simeq 10^{-34} \text{ JS.}$$

$\Delta x \rightarrow$ uncertainity in position

$\Delta p \rightarrow$ ——— momentum.

$$\boxed{p = mv}$$

$$\downarrow$$

$$\boxed{\Delta p = m\Delta v}$$

if velocity is not higher than velocity of light then mass remain constant

Now,

$$\Delta x \times m \times \Delta v \geq \frac{h}{4\pi}$$

$$\Delta x \times m \times \Delta v \geq \frac{\hbar}{2}$$

$$\boxed{(\Delta x \cdot \Delta v) \geq \frac{\hbar}{2m}}$$

what is Heisenberg uncertainity principle, by using this derive the relationship. $\Delta E \cdot \Delta t \geq \frac{h}{4\pi}$ where

$\Delta E \Rightarrow$ uncertainity in Energy

$\Delta t \Rightarrow$ ——— in time

$\because \quad E = \frac{P^2}{2m}$

taking derivative.

$$\Delta E = \frac{2P \cdot \Delta P}{2m}$$

$$\Delta E = \left(\frac{P}{m}\right) \cdot \Delta P$$

but according to mass velocity relationship

$$P = mv$$

$$\Delta P = m \cdot \Delta v$$

$$\Delta E = \left(\frac{mv}{m}\right) \cdot \Delta P$$

$$\boxed{\Delta E = v \cdot \Delta P}$$