Answer on the Question #66796, Chemistry / General chemistry

what is matter wave? what do you understand by in phase and out phase waves? Calculate the wavelength associated with a body of mass 1.5 kg moving with a velocity of 100 m/s.

Solution:

Wave is an oscillation which lead to transfer of energy though a medium. The waves can be a mechanical (sound) and electromagnetic, for instance, visible light. In common waves consist of oscillations or vibrations around almost fixed locations.

Phase is the position of a point in time (an instant) on a wave cycle. One can note that phase can also be an expression of relative displacement between two corresponding features (peak or zero crossing) of two waves with the same frequency.

Two waves that have the same frequency and phase are in phase. Two waves that have the same frequency but different phases are out of phase with each other.

Calculation of the wavelength can be performed with Brogle equation:

1) kinetic energy:

$$E = \frac{1}{2}mv^2 = \frac{1}{2} \cdot 1.5 \ kg \ \cdot (100m/s)^2 = 7500 \ \frac{kg \cdot m^2}{s^2} = 7500 \ J$$

2) wavelength (the Broglie equation):

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

where h is the Planck's constant and p is the moment of the body.

$$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2Em}} = \frac{6.626 \cdot 10^{-34} J \cdot s}{\sqrt{2 \cdot 7500 J \cdot kg}} = 4.4 \cdot 10^{-36} m$$

Answer: the wavelength is $4.4 \cdot 10^{-36}$ m.