Answer on the question #68054, Chemistry / Physical Chemistry

Question:
b) 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−1.

Answer:
Matter wave is the synonym of de Broglie wave. It is the concept of quantum mechanics that explains the wave-like behavior of matter, in particular elementary particles, electrons, neutrons and molecules. The energy of such a wave (and also its wavelength) is related to the mass and velocity of particle:

$$\lambda = \frac{h}{mv},$$

where λ is the wavelength, m and v are the mass and the velocity of a particle and h is the Planck's constant. Then, the wavelength associated with a body of mass 1.5 kg with a velocity of 100 m/s is:

$$\lambda = \frac{h}{mv} = \frac{6.626 \cdot 10^{-34}(m^2 kg\ s^{-1})}{1.5\ (kg) \cdot 100(m\ s^{-1})} = 4.42 \cdot 10^{-36}(m)$$

Phase denotes the particular point in the cycle of a waveform, measured as an angle in degrees. Let's consider the equation of the harmonic wavefunction:

$$\psi(x,t) = A\sin(kx - \omega t + \varepsilon).$$

In this equation, k is the propagation number, ω is the angular temporal frequency and ε is the initial phase angle. The argument of the sine function is called the phase.

When two waves are propagating in the same direction and with the same frequency, we can compare their phase. If ε is the same, the waves called in phase, if not, the waves are called out of phase. When the difference in ε is 180°, the waves are called completely out of phase. The illustration below shows two waves in phase (top panel), out of phase (bottom panel) and completely out of phase (middle panel).

Answer provided by www.AssignmentExpert.com