Energy of a wave: $E = h\upsilon$; $E = Energy\ of\ wave\ (J)$,

$$h = 6.63\times10^{-34} J\cdot\sec,\ \upsilon = frequency\ \left(\tfrac{1}{\sec}\right)$$

Speed of light: $c = \lambda\upsilon$; $c = 3.00\times10^{8}\, m\cdot\sec^{-1}$, $\lambda = wavelength\ (m)$, $\upsilon = frequency\ \left(\tfrac{1}{\sec}\right)$

Energy of electron: $E_n = \dfrac{-2.178\times10^{-18} J}{n^2}$; E_n = energy (J), n = principle quantum number (no unit)

Wavelength of light: $\lambda = \dfrac{h}{mv}$, $\boldsymbol{m}$ = mass of the photon (kg), $\boldsymbol{v}$ = velocity (meter per second),

$$h = 6.63\times10^{-34}\left(kg\cdot\tfrac{m^2}{\sec^2} \right)\cdot\sec$$

1) Calculate the wavelength of a photon with a frequency of 1.25 x 10^{16} Hz. (2.40 x 10^{-8} m)

$C = \lambda\upsilon$

$\lambda = \dfrac{c}{\upsilon} = \dfrac{3.00\times10^{8}\ m\ (sec)}{1.25\times10^{16}\ sec} = \boxed{2.40\times10^{-8}\ m}$

2) Calculate the energy of an electron that is in the fourth energy level. (-1.36 x 10^{-19} J)

$E_n = \dfrac{-2.178\times10^{-18} J}{n^2} = \dfrac{-2.178\times10^{-18} J}{(4)^2} = \boxed{-1.36\times10^{-19} J}$

3) Calculate the mass of a photon with a wavelength of 730 nm and traveling at 2.92 x 10^{8} m sec^{-1} (the photon is moving through a sample of nitrogen gas which is why it is not moving at the speed of light). (3.11 x 10^{-36} kg)

$730nm \left| \dfrac{1m}{10^9\ nm} \right. = 7.30\times10^{-7} m$

$\lambda = \dfrac{h}{mv}$; $m = \dfrac{h}{\lambda v} = \dfrac{(6.63\times10^{-34}\ kg\cdot m^2\cdot sec)\ sec}{(7.30\times10^{-7} m)\ sec^2\ (2.92\times10^{8} m)} = \boxed{3.11\times10^{-36}\ kg}$

4) Calculate the energy of the photon discussed in the previous question. (2.65 x 10^{-19} J)

$C = \lambda\upsilon$

$\upsilon = \dfrac{c}{\lambda} = \dfrac{3.00\times10^{8} m}{7.30\times10^{-7} m\ sec} = 4.11\times10^{14}\ \frac{1}{sec}$

$E = h\upsilon = (6.63\times10^{-34} J\cdot sec)\left(4.11\times10^{14}\ \frac{1}{sec}\right) = \boxed{2.72\times10^{-19} J}$