2.3.2 Photons

Electromagnetic radiation comes in small packets called photons. A photon has a certain amount of energy related to its frequency:

videos

$$E = hf$$

where h is the Plank constant (=6.63 x 10^{-34}Js)

(1) What is the energy of a photon with a frequency f = 5 x 10^{14}Hz?

All photons travel at the speed of light. In a vacuum, this is *3.00 x 10^{8}ms^{-1}*.

The wave equation is given by:

$$c = f\lambda$$

where c=the speed of light, f=frequency (in hertz), λ=wavelength (in metres)

(2) Rearrange this equation to find an expression for frequency.

(3) Substitute for f in the equation E=hf.

(4) What is the energy of a photon with a wavelength of 500nm (500 x 10^{-9}m)?

The particle nature of light

A light source will emit photons of light. The total energy of the light emitted will depend on the number *n* of photons released:

$$E_{total} = nhf = nh\frac{c}{\lambda}$$

The power (in watts) of the light source will be the energy released per second.

$$P = \frac{nhf}{t} = \left(\frac{n}{t}\right)hf$$

where t is the time

(5) *Work out the number of photons emitted per second $\left(\frac{n}{t}\right)$ for a 100W light bulb, assuming that it is emitting photons with wavelength of 550nm (and 100% efficient!).*