c = speed of light = 3×10^{8} m/s

h = Plank's constant = 6.6×10^{-34}

PHYS 1403 Light Theory Example Problems

SAMPLE PROBLEMS THAT WILL BE WORKED OUT DURING THE LECTURE!

(1) Compute the wavelength (λ) of radio waves emitted by an AM radio station operating at 560 kHz (f).

use $c = \lambda f$ ---> $\lambda = \frac{c}{f} = \frac{3 \times 10^{8}\ m/s}{560{,}000\ Hz} =$ **535.71 m**

(2) What is the frequency of red light that has a wavelength of 760 nm?

use $c = \lambda f$ ---> $f = \frac{c}{\lambda} = \frac{3 \times 10^{8}\ m/s}{760 \times 10^{-9}\ m} =$ **3.95×10^{14} Hz**

(3) What is the energy of a photon with a frequency of 5×10^{14} Hz?

$E = hf = (6.6 \times 10^{-34})(5 \times 10^{14}) =$ **3.3×10^{-19} J**

(4) What is the energy of a photon with a wavelength of 760 nm?

$E = \frac{hc}{\lambda} = \frac{(6.6 \times 10^{-34})(3 \times 10^{8})}{760 \times 10^{-9}} =$ **2.6×10^{-19} J**

(5) The star Sirius in the constellation of Canis Major has a surface temperature of 12,000 K. What is the wavelength of maximum emission in nanometers?

$\lambda_{max} = \frac{2.9 \times 10^{-3}\ Km}{12000\ K} = 2.42 \times 10^{-7}\ m =$ **242 nm**

(6) The bright star Antares in the constellation of Scorpius emits the greatest intensity of radiation at a wavelength of 700 nm. What is the surface temperature of this star?

$T = \frac{2.9 \times 10^{-3}\ km}{700 \times 10^{-9}\ m} =$ **4142.86 K**

(7) The H_α line in the spectra of a star is measured to be at 785 nm (H_α spectral line is normally at 656.285 nm). (a) Is the star's spectra red-shifted or blue-shifted? (b) Is this star moving away or towards us?

$V = \frac{\Delta\lambda}{\lambda_o} c = \frac{\lambda - \lambda_o}{\lambda_o} c$ → λ_o = wavelength in Lab; λ = star's wavelength

$\lambda - \lambda_o$ will give us the answers we want ↙ a positive number means

(a) $\lambda - \lambda_o = 785_{nm} - 656.285_{nm} = 128.75_{nm}$ "RED SHIFT"

(b) red-shift means star is moving away

(8) The H_α line in the spectra of a star is measured to be at 345 nm (H_α spectral line is normally at 656.285 nm). (a) Is the star's spectra red-shifted or blue-shifted? (b) Is this star moving away or towards us?

(a) $345_{nm} - 656.285_{nm} = -311.285$ negative means "BLUE SHIFT"

(b) blue shift means star is moving towards us