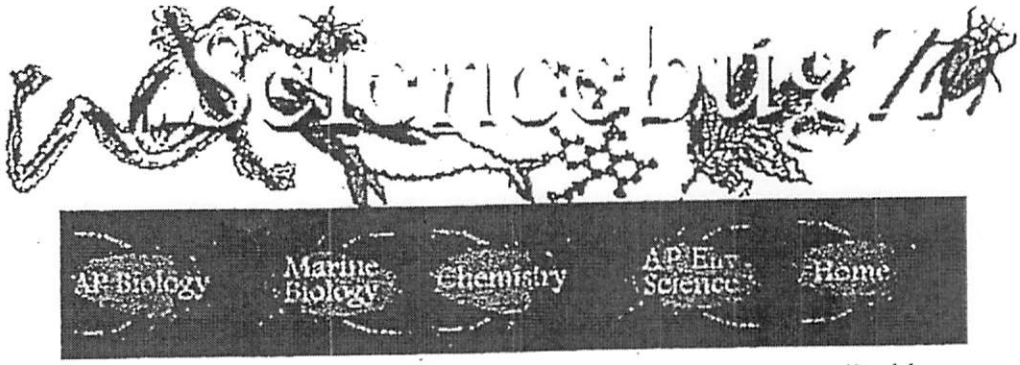

Frequency Answers Frequency Solutions Problems

Frequency and Energy Problems

Frequency and Energy Problems

$\lambda = c/\nu$ $c = 3.00 \times 10^8$ m/s

$\triangle E = h\nu$ $h = 6.626 \times 10^{-34}$ J·s 1Hz = 1/s $= s^{-1}$

1) What is the energy of a photon whose frequency is 3.0×10^{12} Hz?

2) Calculate ν for a $\lambda = 700$,nm. $\nu = c/\lambda$ ~~nm = nanometers~~ 7.00×10^{-7} m
Calculate ν for a $\lambda = 400$,nm. $\nu = c/\lambda$ ~~nm = nanometers~~
Calculate the energy for each wavelength.
Which wavelength has the greatest frequency? Which wavelength has more energy?

3) A red light has a wavelength of 728 nm.
What is the frequency of the light?
What is the speed of the wave in m/s?

4) A purple light has a frequency of 7.42×10^{14} Hz.
What is its wavelength?
What is the energy of one quanta of light.

5) You broke your big toe! The x ray they take of toe uses waves that have a length 2.19×10^{-10} m
2.19×10^{10}m.
What is the speed of the wave in m/s?
What is the wavelength in nm?
What is the frequency of the x ray?

(1) What is the energy of a photon whose frequency is 3.0×10^{12} Hz?

$$\Delta E = h\nu$$

$$= (6.626 \times 10^{-34}\ \text{J}\cdot\text{s})(3.0 \times 10^{12}\ \text{s}^{-1})$$

$$= \boxed{2.0 \times 10^{-21}\ \text{J}}$$

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(2) Calculate ν for a $\lambda = 700.\ \text{nm}$

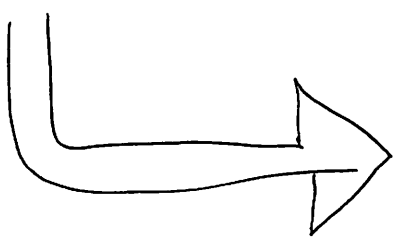
$$\nu = \frac{c}{\lambda} \quad \leftarrow \quad \lambda = 7.00 \times 10^{-7}\ \text{m}$$

$$= \frac{3.00 \times 10^{8}\ \text{m/s}}{7.00 \times 10^{-7}\ \text{m}} = \boxed{4.29 \times 10^{14}\ \text{Hz}}$$

Calculate ν for $\lambda = 400.\ \text{nm}$

$$\nu = \frac{c}{\lambda} \quad \leftarrow \quad \lambda = 4.00 \times 10^{-7}\ \text{m}$$

$$= \frac{3.00 \times 10^{8}\ \text{m/s}}{4.00 \times 10^{-7}\ \text{m}} = \boxed{7.50 \times 10^{14}\ \text{Hz}}$$



Calculate the energy for each wavelength

$\Delta E = h\nu$ $\quad \nu$ for 700 nm $= 4.29 \times 10^{14}$ Hz

$= (6.626 \times 10^{-34}\ J \cdot s)(4.29 \times 10^{14}\ s^{-1})$

$= \boxed{2.84 \times 10^{-19}\ J}$

$\Delta E = h\nu$ $\quad \nu$ for 400. nm $= 7.50 \times 10^{14}$ Hz

$= (6.626 \times 10^{-34}\ J \cdot s)(7.50 \times 10^{14}\ s^{-1})$

$\boxed{= 4.97 \times 10^{-19}\ J}$

Which wavelength has greatest frequency?

$\boxed{400\ nm}$

Which wavelength has more energy?

$\boxed{400\ nm}$

(3) A red light has a wavelength of 728 nm.

What is the frequency of the light?

$$\nu = \frac{c}{\lambda}$$

$$= \frac{3.00 \times 10^{8}\ m/s}{7.28 \times 10^{-7}\ m}$$

$$= 4.12 \times 10^{14}\ s^{-1}$$

$$= \boxed{4.12 \times 10^{14}\ Hz}$$

$728\ nm \left(\frac{1\ m}{10^{9}\ nm}\right) =$

$7.28 \times 10^{2}\ nm \left(\frac{1\ m}{10^{9}\ nm}\right) =$

$7.28 \times 10^{(2-9)}\ m =$

$\boxed{7.28 \times 10^{-7}\ m}$

What is the speed of the wave in m/s?

TRICK! Speed of all Energy = $\boxed{3.00 \times 10^{8}\ m/s}$

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(4) A purple light has a frequency of $7.42 \times 10^{14}\ Hz$.

What is its wavelength?

$$\lambda = \frac{c}{\nu}$$

$$= \frac{3.00 \times 10^{8}\ m/s}{7.42 \times 10^{14}\ s^{-1}} = \boxed{4.04 \times 10^{-7}\ m}$$

What is the energy of one quanta of light?

$$\Delta E = h\nu$$

$$= (6.626 \times 10^{-34}\ J \cdot s)(7.42 \times 10^{14}\ s^{-1})$$

$$= \boxed{4.92 \times 10^{-19}\ J}$$

(5) The x-rays have a length of 2.19×10^{-10} m.

What is the speed of the wave in m/s?

TRICK! 3.00×10^{8} m/s

What is the wavelength in nm?

$$2.19 \times 10^{-10}\ m \left(\frac{10^{9}\ nm}{1\ m} \right) =$$

$$2.19 \times 10^{(-10+9)} = \boxed{2.19 \times 10^{-1}\ nm}$$

What is the frequency of the x-ray?

$$\nu = \frac{c}{\lambda}$$

$$= \frac{3.00 \times 10^{8}\ m/s}{2.19 \times 10^{-10}\ m}$$

$$= 1.37 \times 10^{18}\ s^{-1}$$

$$= \boxed{1.37 \times 10^{18}\ Hz}$$