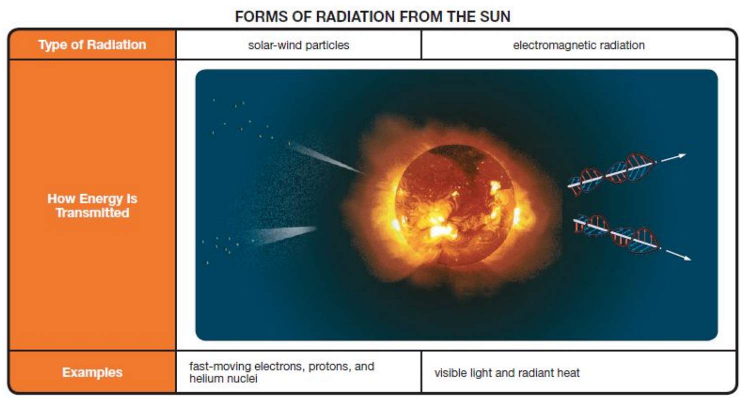
Science 30	Unit C: Physics
Lesson 9 - Electromagnetic Radiation	84 mins

Radiation

Radiation - energy emitted in the form of particles or waves



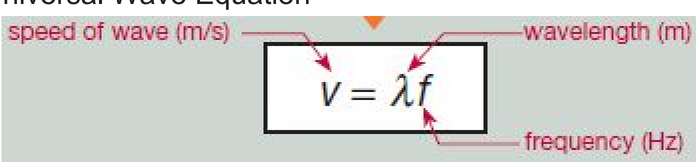
Waves

- motion that transfers energy from one point to another

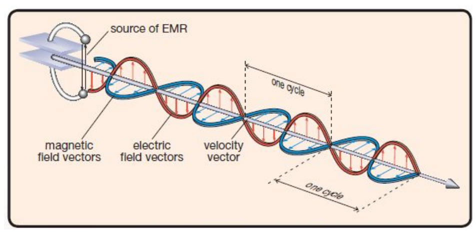
Properties

- Cycle - one complete vibration of a wave
- Wavelength (λ) - the distance between each cycle
- Frequency (Hz) - number of cycles that pass a point per second takes to pass a point (1 Hz = cycles/s)

Universal Wave Equation



Draw Compression (sound) vs. Transverse (water)



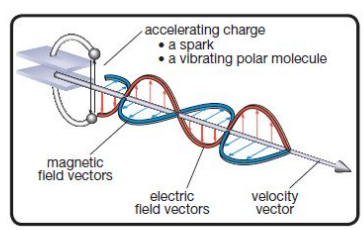
Electromagnetic Radiation

- a wave that consists of a changing electric field and a changing magnetic field travelling at right angles to one another

- EM radiation moves at a fixed speed of 3.00×10^8 m/s (speed of light)

EM Wave Equation

$$c = \lambda f$$



Wavelength and Frequency are inversely related:

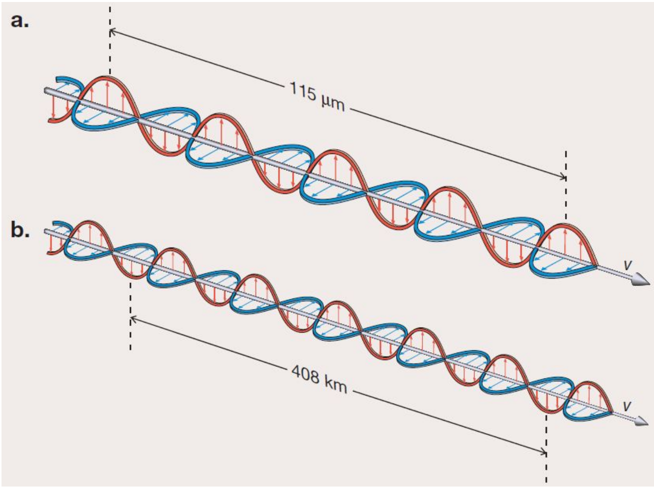
$$\lambda \uparrow f \downarrow$$

Science 30 - Lesson 33 - Unit C - Waves

Name: ___________________________________

EXAMPLES:

1. Determine the wavelength of the following examples of electromagnetic radiation.



2. Determine the frequency of the following examples of electromagnetic radiation.

a. In 1.00 ms, 740 radio waves pass the antenna of a radio.

b. In 1.00 ms, 2450 microwaves pass through a point on a piece of cheese in a microwave oven.

3. An excited atom in a neon sign emits electromagnetic radiation with a wavelength of 6.4×10^{-7} m.

a. Calculate the frequency of the electromagnetic radiation.

b. If the neon sign was located 25.0 m from an observer, how long would it take the light from the sign to reach the observer?

4. The antenna of a FM radio station broadcasts electromagnetic radiation with a frequency of 104.5 MHz. A driver in a car is receiving these FM radio waves while travelling down a highway at 90.0 km/h, or 25.0 m/s.

a. Calculate the wavelength of the electromagnetic radiation.

b. Some of the FM radio waves can leave Earth's atmosphere and travel into space. Calculate how long it would take these radio waves to reach the Moon, which is located about 3.84×10^8 m from Earth.

c. Use your answer to part b. to determine how far the car would travel in the same time it takes the radio wave to travel from Earth to the Moon.

Practice

1. The X-rays used by a dentist to produce images of a patient's teeth have a frequency of 7.2×10^{18} Hz.

a. Calculate the wavelength of these dental X-rays.

b. Hydrogen is the smallest atom. When a hydrogen atom is unexcited, the orbit of the electron is about 5.29×10^{-11} m from the nucleus. Compare the wavelength of the dental X-ray to the radius of the electron's orbit for an unexcited hydrogen atom.

2. A GPS satellite emits two microwave signals: one with a wavelength of 19.0 cm and the other with a wavelength of about 24.4 cm. Calculate the frequency of each of these signals.

3. The door of a microwave oven includes a window made from a metal mesh screen attached to glass. Explain why the metal screen is a critical part of the design.