

Chapter 18 The Electromagnetic Spectrum and Light

Calculating Wavelength and Frequency

A particular AM radio station broadcasts at a frequency of 1030 MHz. What is the wavelength of the transmitted radio wave assuming it travels in a vacuum?

1. Read and Understand

What information are you given?

$$\text{Speed} = c = 3.00 \times 10^8 \text{ m/s}$$

$$\text{Frequency} = 1030 \text{ kHz} = 1030 \times 10^3 \text{ Hz}$$

2. Plan and Solve

What unknown are you trying to calculate?

$$\text{Wavelength} = ?$$

What formula contains the given quantities and the unknown?

$$\text{Speed} = \text{Wavelength} \times \text{Frequency}$$

$$\text{Wavelength} = \frac{\text{Speed}}{\text{Frequency}}$$

Replace each variable with its known value.

$$\begin{aligned} \text{Wavelength} &= \frac{3.00 \times 10^8 \text{ m/s}}{1030 \text{ Hz} \times 10^3 \text{ Hz}} \\ &= \frac{3.00 \times 10^8 \text{ m/s}}{1.030 \times 10^6 \text{ 1/s}} = 291 \text{ m} \end{aligned}$$

3. Look Back and Check

Is your answer reasonable?

Radio waves have frequencies greater than 1 mm, so 291 m is a reasonable wavelength for a radio wave.

Math Practice

On a separate sheet of paper, solve the following problems.

- In a vacuum, the wavelength of light from a laser is 630 nm (630×10^{-9} m). What is the frequency of the light?
- If a radio wave vibrates at 80.0 MHz, what is its wavelength?
- A radio station broadcasts at 780 kHz. The wavelength of its radio waves is 385 m. Verify that the radio wave travels at the speed of light.

Math Skill:
Multiplication
and Division
of Exponents

You may want to read more about this **Math Skill** in the **Skills and Reference Handbook** at the end of your textbook.

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WordWise

Complete the sentences using one of the scrambled words below.

nrcteleos	tarfes	qucreynef
treclefs	rigehh	kabcl
mefailnt	riotrafecn	ratenemypocml
yrecurm	snohpot	dairo
sifdel	culstantren	otehcern

Electromagnetic waves consist of changing electric and changing magnetic _____.

You hear thunder from a distant lightning bolt a few seconds after you see the lightning because light travels much _____ than sound.

If you know the wavelength of an electromagnetic wave in a vacuum, you can calculate its _____.

Although light behaves as a wave, the photoelectric effect shows that light also consists of bundles of energy called _____.

Antennas use _____ waves to send signals to television receivers.

Ultraviolet rays have a _____ frequency than waves of violet light.

If you can look through a material but what you see is not clear or distinct, then the material is said to be _____.

When a beam of light enters a new medium at an angle, it changes direction, and _____ occurs.

A truck appears red in the sunlight because its paint _____ mainly red light.

A color of light mixed equally with its _____ color of light yields white light.

Complementary colors of pigments combine to form _____ pigment.

An incandescent bulb produces light by using an electric current to heat a(n) _____.

Inside a fluorescent bulb, an electric current passes through _____ vapor and produces ultraviolet light.

Light that consists of a single wavelength of light with its crests and troughs lined up is called _____ light.

Neon lights emit light when _____ flow through gas in a tube.