Ham Radio SG:
Radio Amateur's Examination Course

Lesson 1A:
Waves, Frequency and Wavelength

Written By: Joyce Ng, 9V1AN

Waves, Frequency and wavelength

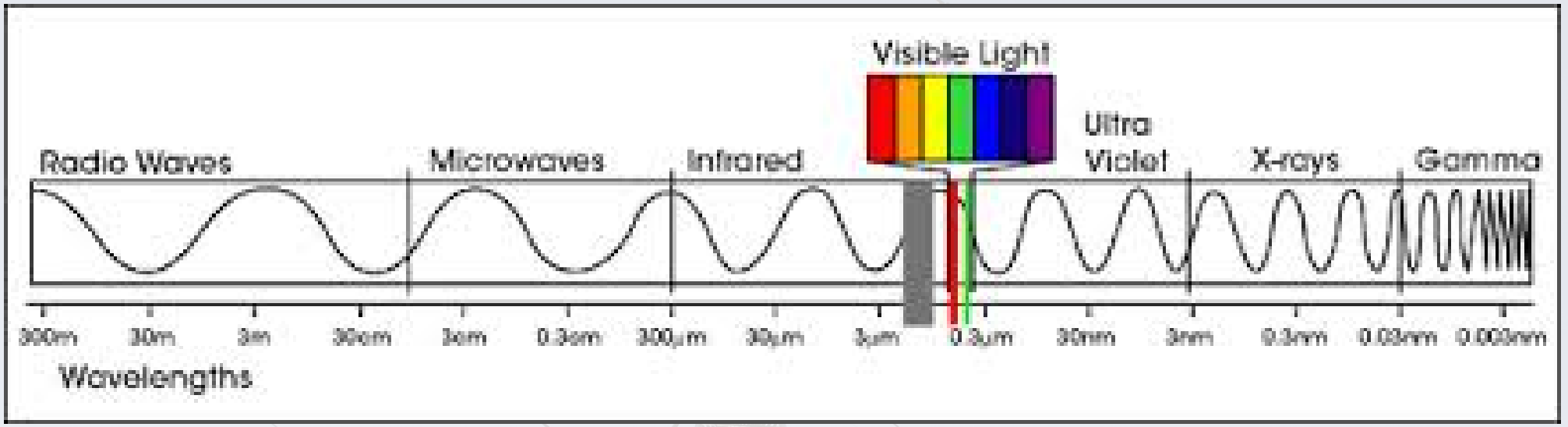
In the physical world, many things like light, sound, heat and even radio work by waves.

What are waves? Simply, waves are described as a disturbance that transfers energy from one place to another.

However, there are many types of waves from radio waves to gamma rays.

What makes the different waves have distinct properties from each other?

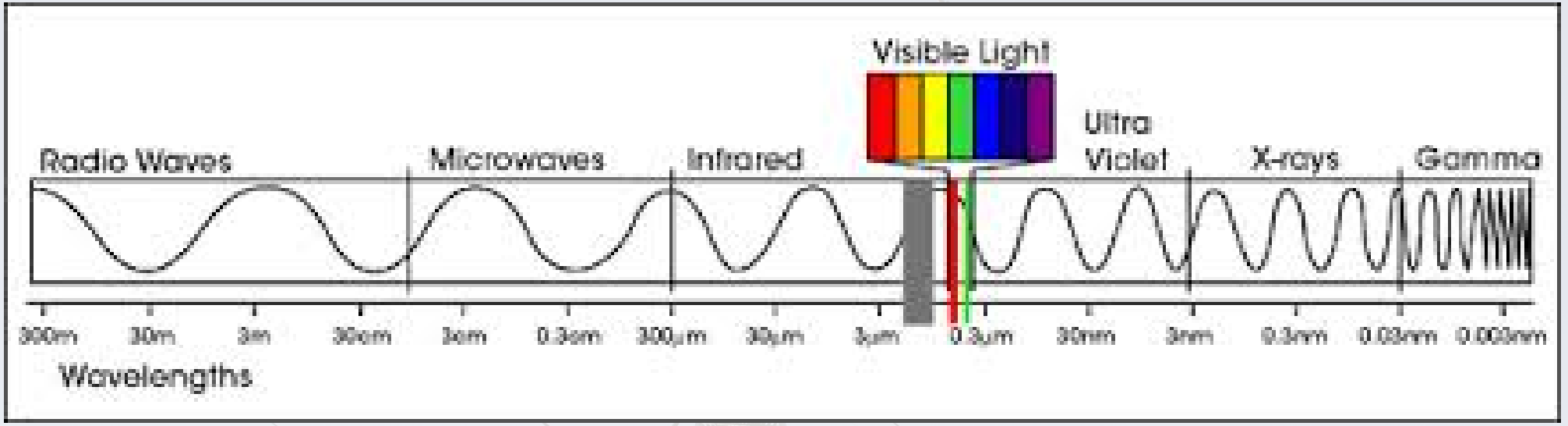
Waves, Frequency and wavelength



The answer? Frequency and wavelength! Different waves have distinct frequencies and wavelengths.

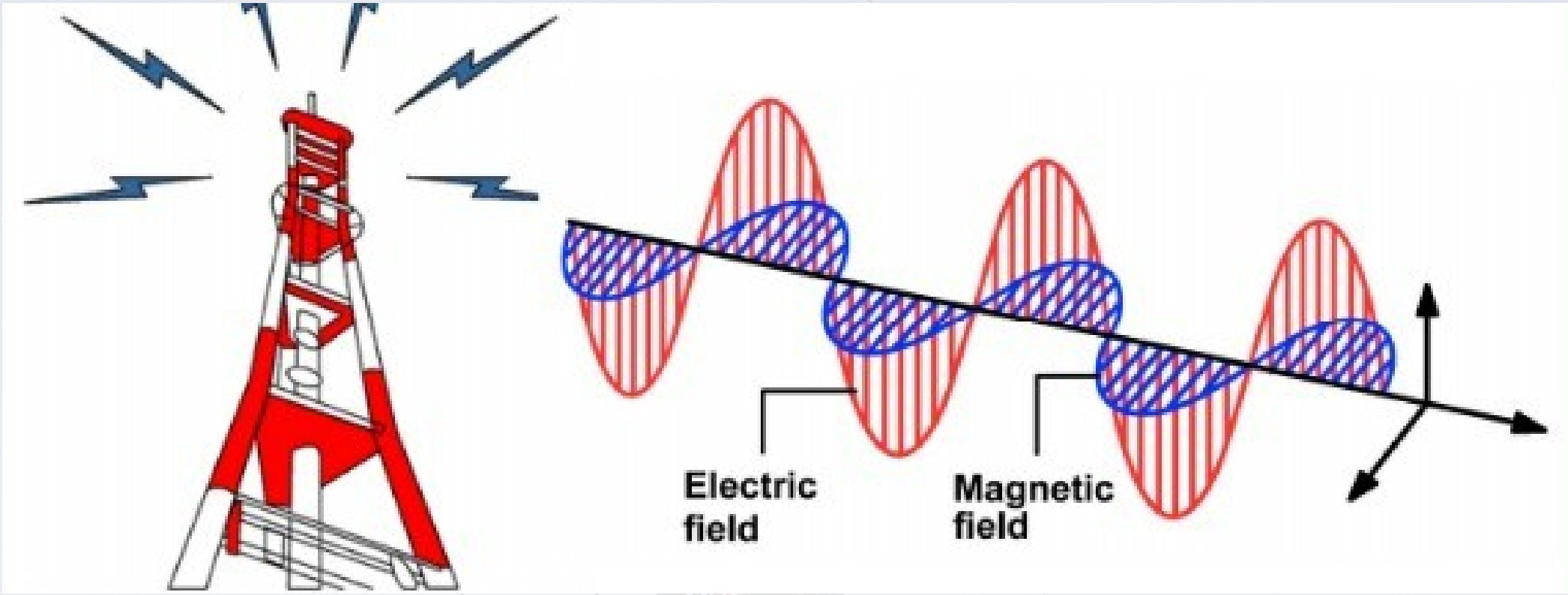
Note that the longer the wavelength, the lower the frequency.

Electromagnetic (EM) Spectrum



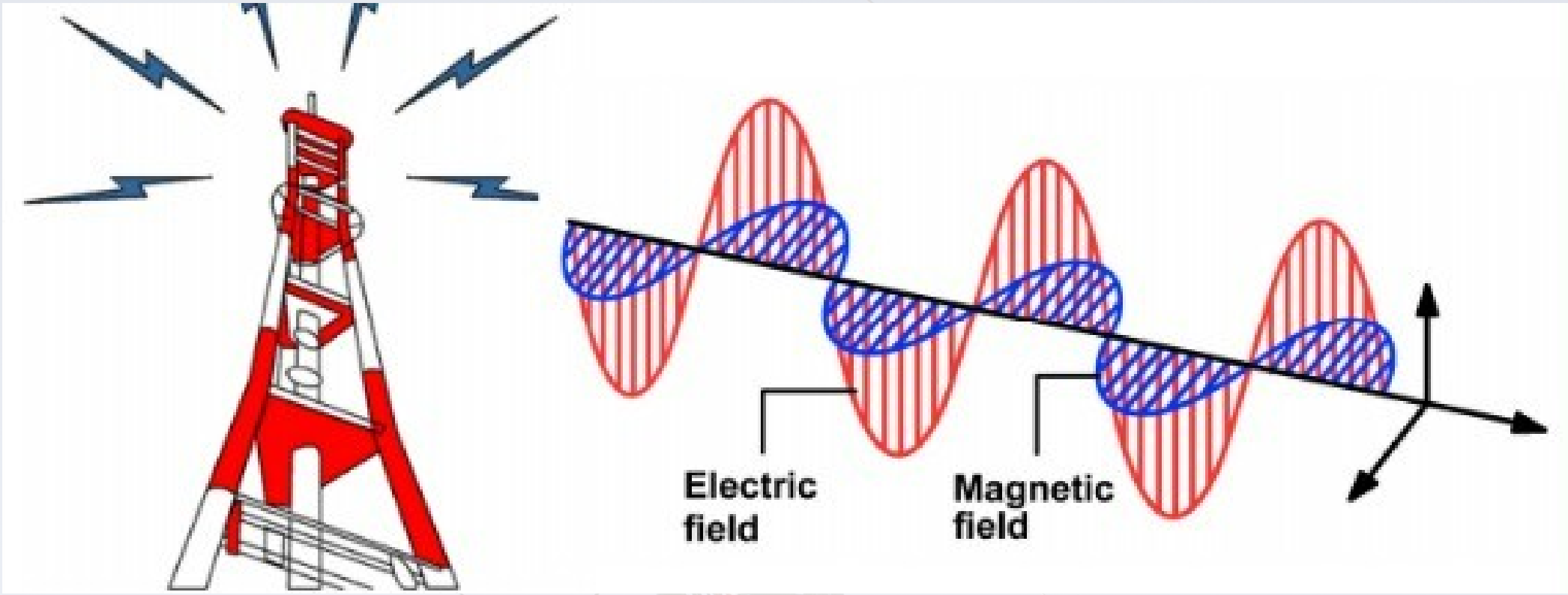
Radio waves, microwaves, light and other waves as shown in the image, are part of what is known as the electromagnetic (EM) spectrum.

Electromagnetic (EM) Spectrum



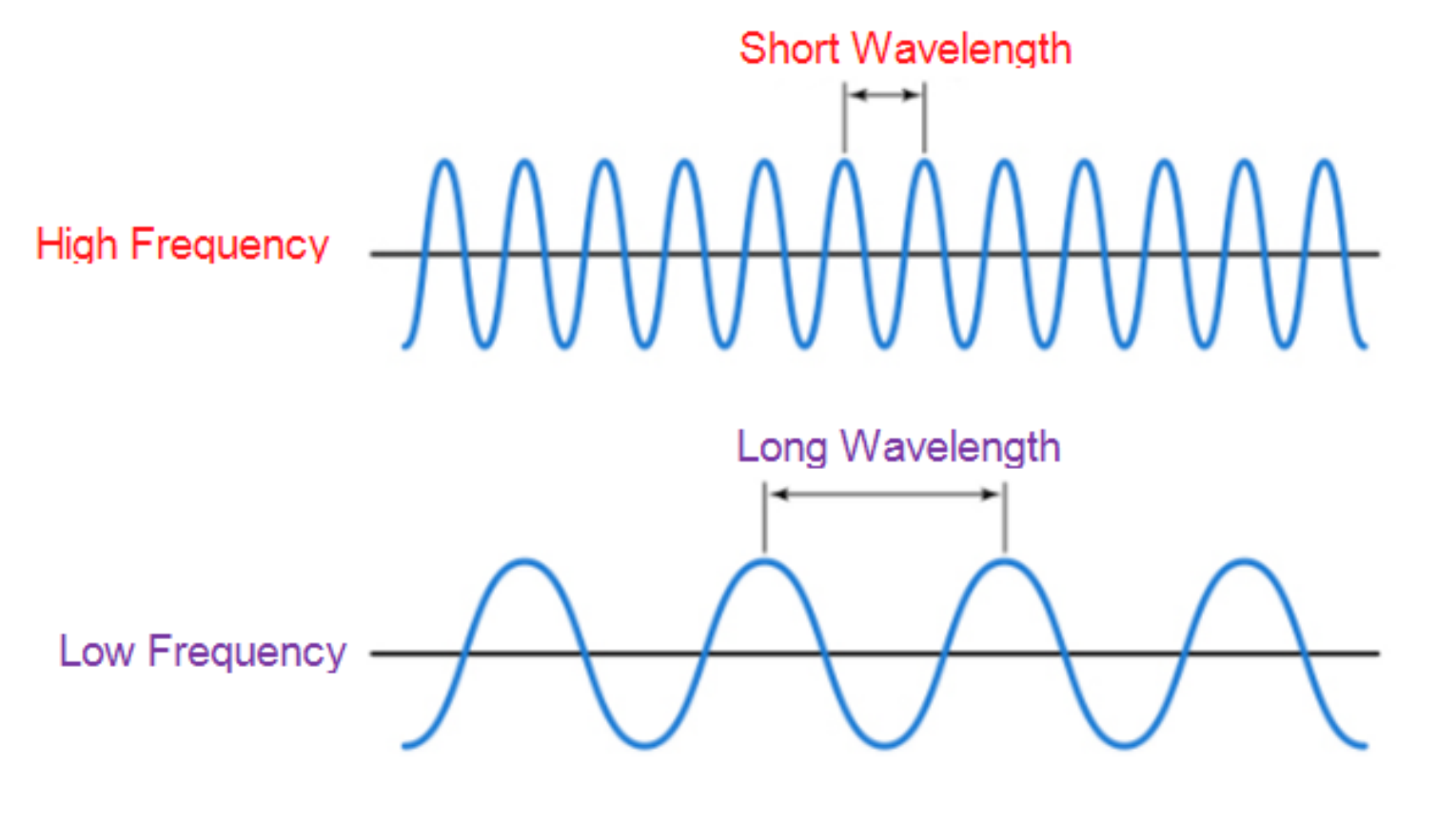
Waves in the EM spectrum have two components: a Magnetic Field and an Electric Field that are perpendicular to each other.

Electromagnetic (EM) Spectrum



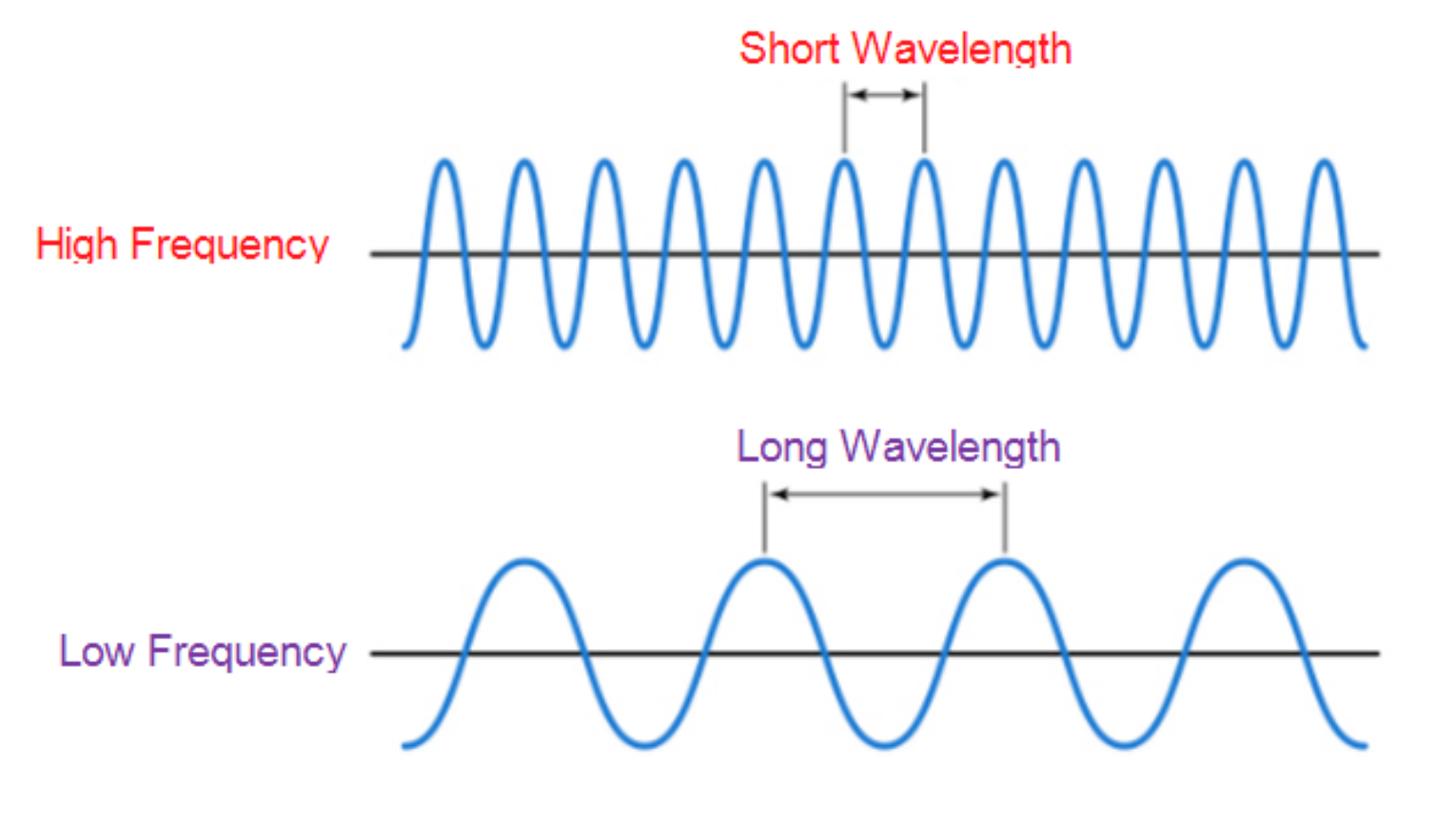
Waves in the electromagnetic spectrum travel at the speed of light, or 3×10^8 **meters** per second in a vacuum.

Frequency and wavelength



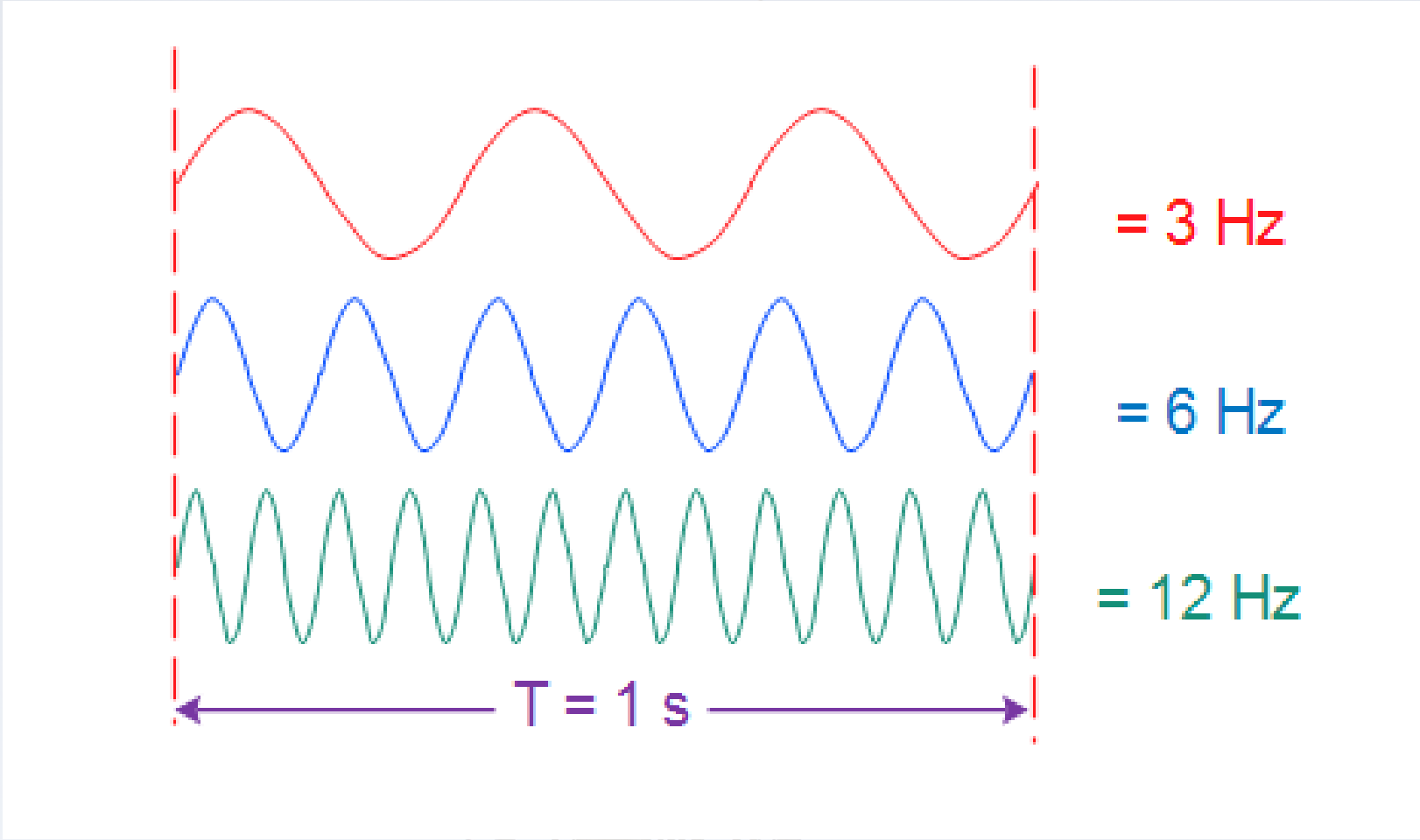
As mentioned, a wave can be described using its frequency and wavelength.

Frequency and wavelength



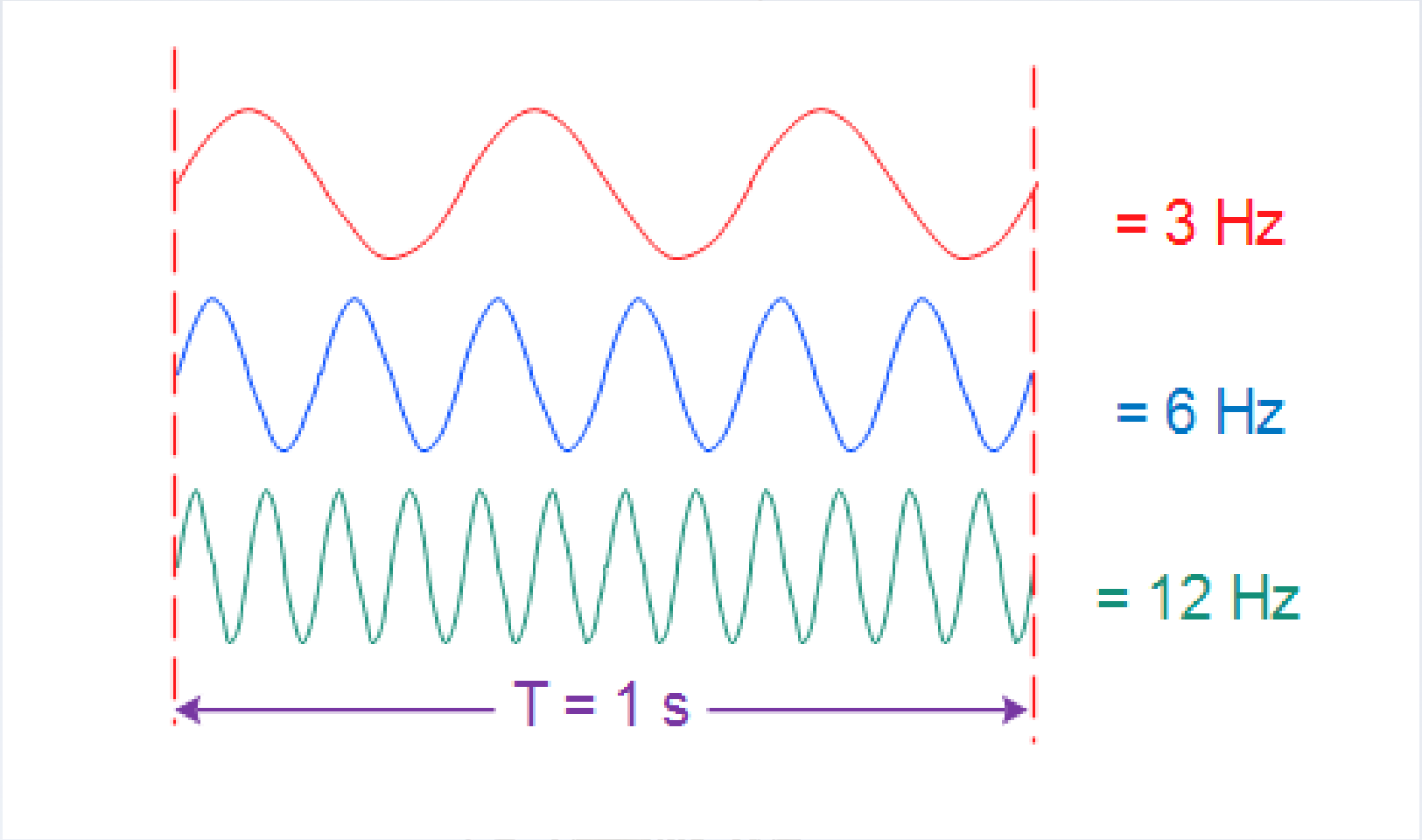
The higher the frequency of the wave, the shorter its wavelength.

Frequency and wavelength



The frequency of the wave describes how many times a wave repeats itself in a second.

Frequency and wavelength



The unit for frequency is Hertz. (**Hz**)

Frequency and wavelength

- These distinct frequencies and wavelengths determine where in the electromagnetic spectrum (pictured in third slide) a wave fits in. For example, a 30 MHz EM wave falls in the radio frequency spectrum whereas a 10 GHz EM wave is in the microwave band.

- An interesting thing to note is that in between two portions of the electromagnetic spectrum, there is no distinct separation. A wave could have properties belonging to two adjacent portions of the electromagnetic spectrum. We will discuss this in Lesson 1B.

Frequency and wavelength

You may have seen this equation before:
$V = F\lambda$

Where:
V - Speed of wave
F - Frequency (in Hz)
λ – Wavelength (in meters)

Doing some rearrangement of the equation, we find that frequency can be calculated by:

$F = V/\lambda$

Frequency and wavelength

So how do we calculate the frequency based on wavelength?

Say someone tells you they are on the 20 meter band. Using the re-arranged equation, $F = V/\lambda$, we can get the frequency:

$F = V/\lambda$
$= (3 \times 10^8) / 20$
$= 14989623$ Hz
$= 14.989623$ MHz

Frequency and wavelength

In the same way, given the frequency, we can find the wavelength of a wave.

By re-arranging the equation, $V = F\lambda$, you can calculate the wavelength of any band by $\lambda = V/F$.

Frequency and wavelength

For example, for a wave with a frequency of 3 MHz, we can calculate the wavelength:

$\lambda = V/F$
$= (3 \times 10^8) / (3 \times 10^6)$
$= 99.930819$ meters
$= 99.9$ meters

Simple and easy, ain't it?

Your turn to try and practice!

Now, try these questions. The answers are in the next slide.

1.) What is the frequency of a radio wave with a wavelength of 2 meters?

A) 20 MHz B) 50 MHz C) 150 MHz D) 200 MHz

2.) What is the wavelength of a radio wave at 27 MHz?

A) 15 m B) 27 m C) 18 m D) 11 m

Answers

Here are the answers to the questions. Don't worry if you made mistakes as everyone learns by making mistakes! :)

1.) What is the frequency of a radio wave with a wavelength of 2 meters?

A) 20 MHz B) 50 MHz C) 150 MHz D) 200 MHz

2.) What is the wavelength of a radio wave at 27 MHz?

A) 15 m B) 27 m C) 18 m D) 11 m

Let us try some more questions, shall we?

Your turn to try and practice!

Try these questions. The answers are in the next slide.

3.) What is the wavelength of a radio wave at 440 MHz?

A) 2 m B) 0.1 m C) 10 m D) 0.68 m

4.) What is the frequency of a radio wave with a wavelength of 0.23 m?

A) 1300 MHz B) 144 MHz C) 60 MHz D) 7 MHz

Answers

Here are the answers to the questions.

3.) What is the wavelength of a radio wave at 440 MHz?

A) 2 m B) 0.1 m C) 10 m D) 0.68 m

4.) What is the frequency of a radio wave with a wavelength of 0.23 m?

A) 1300 MHz B) 144 MHz C) 60 MHz D) 7 MHz

Takeaway

We have discussed:

- Waves
- Some properties of waves in the EM spectrum
- Speed of waves in EM spectrum (3 x 10^8 m/s)
- Calculating frequency of wave from wavelength
- Calculating wavelength of wave from frequency