

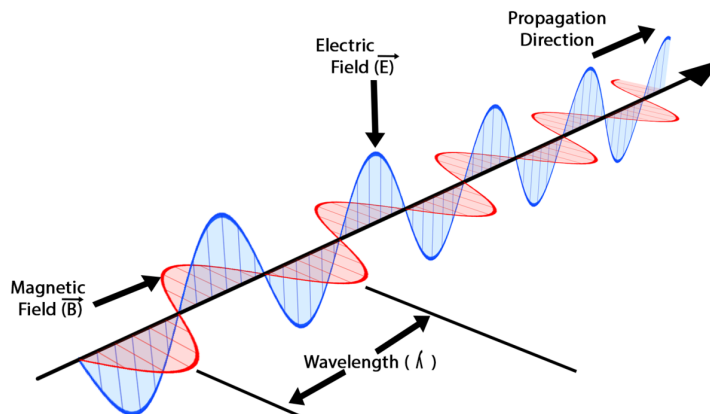
## 6.2.1 Electromagnetic waves

Electromagnetic waves are waves that move (propagate) through space via oscillations in the electric and magnetic fields. They carry energy.



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### Electromagnetic Wave

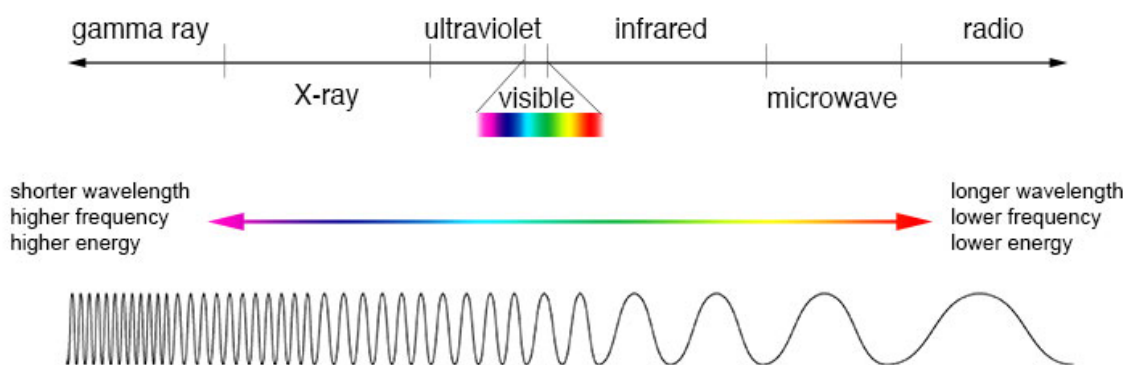


The oscillations of the magnetic field and electric field are at right angles to the direction that the wave propagates.

(1) *Are electromagnetic waves transverse or longitudinal waves? Explain.*

### The electromagnetic spectrum

There is a range of different electromagnetic (EM) waves. This is called the EM spectrum. The only difference in these waves is their wavelength.



Our eyes are able to detect EM waves in the visible part of the spectrum.

(2) *Which EM waves have the shortest wavelength (highest frequency)?*

(3) ✎ Which EM waves carry the least amount of energy?

The order of colours in the visible spectrum is Red, Orange, Yellow, Green, Blue, Indigo and Violet. A useful acronym for remembering this is ROY G. BIV.

All EM waves travel at the same speed in a vacuum. This is the speed of light (=  $3.0 \times 10^8 \text{m/s}$ ). They also travel at this speed in air.

(4) ✎ Rearrange the wave equation ( $\text{speed} = \text{frequency} \times \text{wavelength}$ ) to make frequency the subject (i.e.  $\text{frequency} =$ ).

(5) ✎ Visible light has wavelengths between 400-750nm (nanometre =  $10^{-9}\text{m}$ ). Using the wave equation, find the frequency range of visible light. (Hint. Use your rearranged wave equation from (4), the values of the wavelength at either end of the visible range, and the speed of light.)

(6) ✎ What EM waves are found off the red end of the visible spectrum (i.e. with longer wavelengths than red)?

(7) ✎ What EM waves are found off the violet end of the visible spectrum (i.e. with shorter wavelengths than violet)?

We can't detect infrared (IR) with our eyes but we can sometimes feel the radiation as heat.

(8) ✎ What instrument could we use to detect IR?

We can't detect ultraviolet (UV), but some materials fluoresce (give out visible light) when exposed to ultraviolet.

(9) ✎ Explain how can secret messages be sent using this effect.

[https://en.wikipedia.org/wiki/UV\\_marker](https://en.wikipedia.org/wiki/UV_marker)

