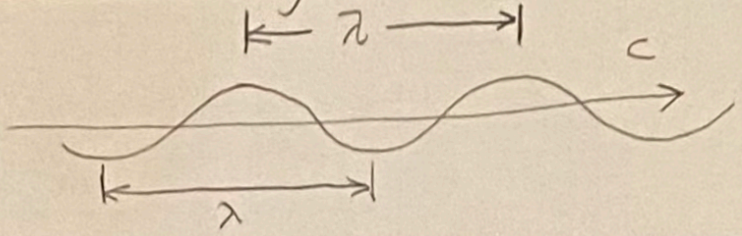
# A rapid review of light waves



Photons have energy and momentum, and this determines their frequency and their wavelength. I don't want to get into that. I just want to work with light sometimes as if it were photons, and sometimes as if it were waves.

If the repetition in the wave (from crest-to-crest or trough-to-trough) is in a distance λ, and you are watching the wave crests zip by, they repeat in a time T that is $T = \frac{\lambda}{c}$.

We *define* f, the frequency, as $f \overset{\text{the triple equals means definition}}{\equiv} \frac{1}{T}$. The typical units for frequency are Hertz (Hz) and $1\,Hz = \frac{1}{1sec}$

To summarize what we have so far:

$$T = \frac{\lambda}{c} \quad \text{and} \quad f \equiv \frac{1}{T}$$

Out of these, we can make *at least* four more equations (e.g., $f = \frac{c}{\lambda}$, $cT = \lambda$, $\lambda = \frac{c}{f}$, ...).

The two other things we looked at were (1) the electromagnetic spectrum

shorter wavelength →

← longer wavelength

radio waves microwaves infrared visible ultraviolet X-rays γ-rays

700nm 400nm

ROYGBIV

and (2) The Hydrogen-α line which is a deep red at 656.46nm. If you round up to λ=657nm, it is easy to compute

SHORT!

$$T = \frac{\lambda}{c} = \frac{657nm}{3\times10^{8}m/s} = 219\,\frac{10^{-9}m}{10^{8}m/s} = 219\times10^{-17}s = 2.19\times10^{-15}s$$