PHYS 1022 Fall 2025
Review for Midterm Exam #2

General Concepts Presentation
Examples left for Questions and Answers

Jim Napolitano **December 1, 2025**

Concepts

- Magnetic Forces
- Magnetic Fields
- Electromagnetic Waves
- Light and Color
- The Electromagnetic Spectrum
- Refraction
- Thin Lenses

Know Your SI Units!

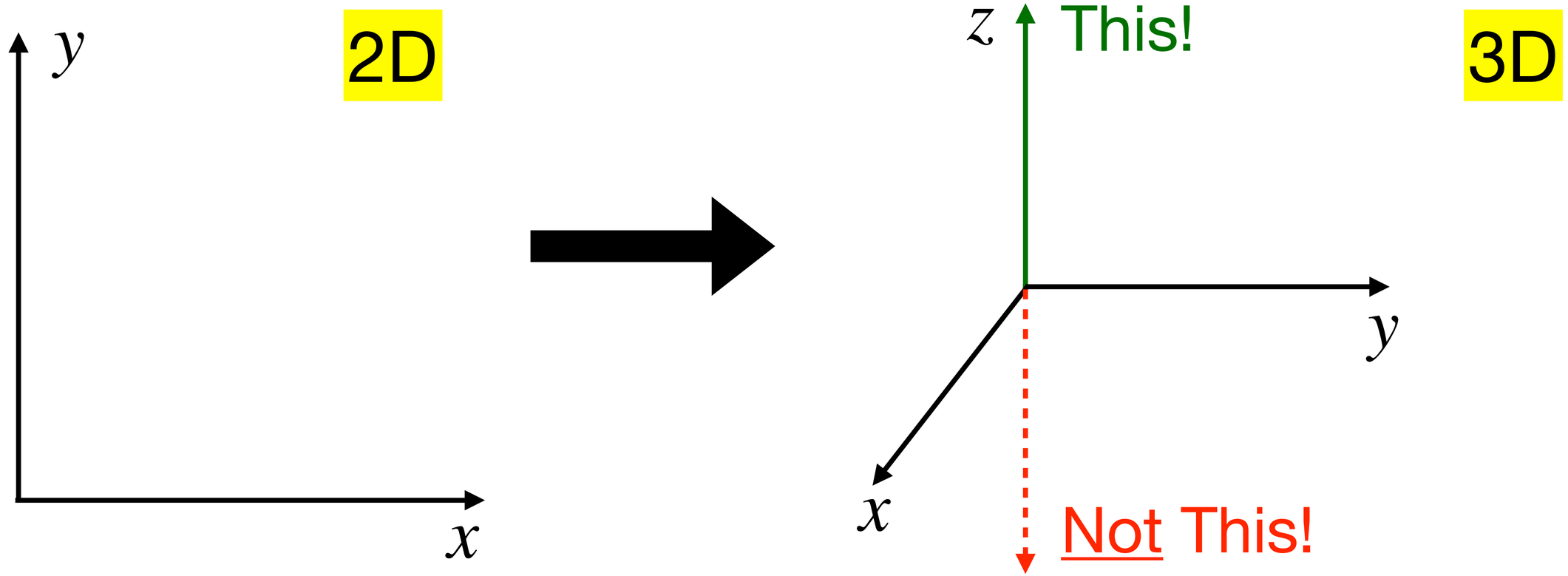
"Base units" and "Derived units"

Dimension	Name	Symbol
Length	meter	m
Time	second	s
Mass	kilogram	kg
Force	Newton	N (kg m/s^2)
Charge	Coulomb	C
Current	Ampere	A (C/s)
Potential	Volt	V

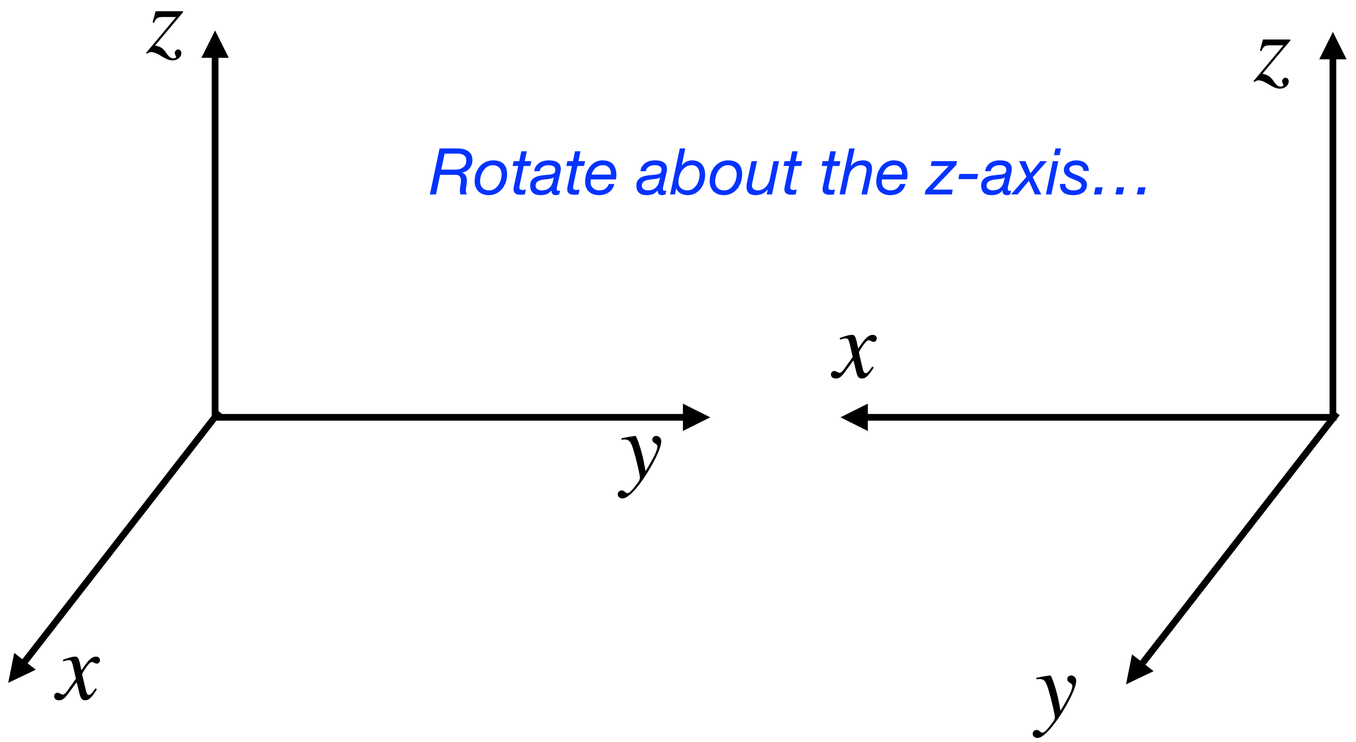
Prefix	Symbol	Meaning
Milli	m	10^{-3}
Micro	μ	10^{-6}
Nano	n	10^{-9}
Pico	p	10^{-12}
Kilo	k	10^{3}
Mega	M	10^{6}
Giga	G	10^{9}

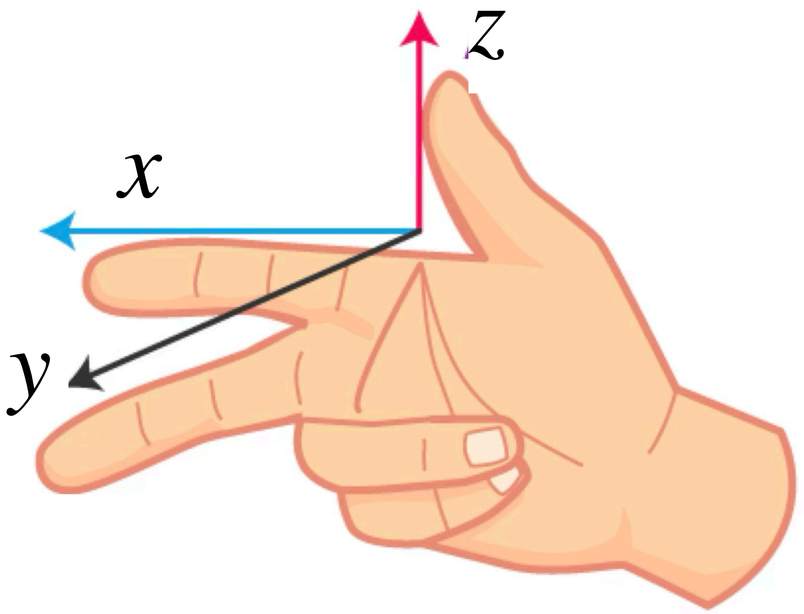
The Right Hand Rule

Needed to define directions in 3D space



Your Right Hand Reveals the Directions





If you did all this with your left hand, the z-axis would point in the opposite direction!

There are different approaches! Ask questions if you are wondering!

Magnetic Forces: RHR for direction

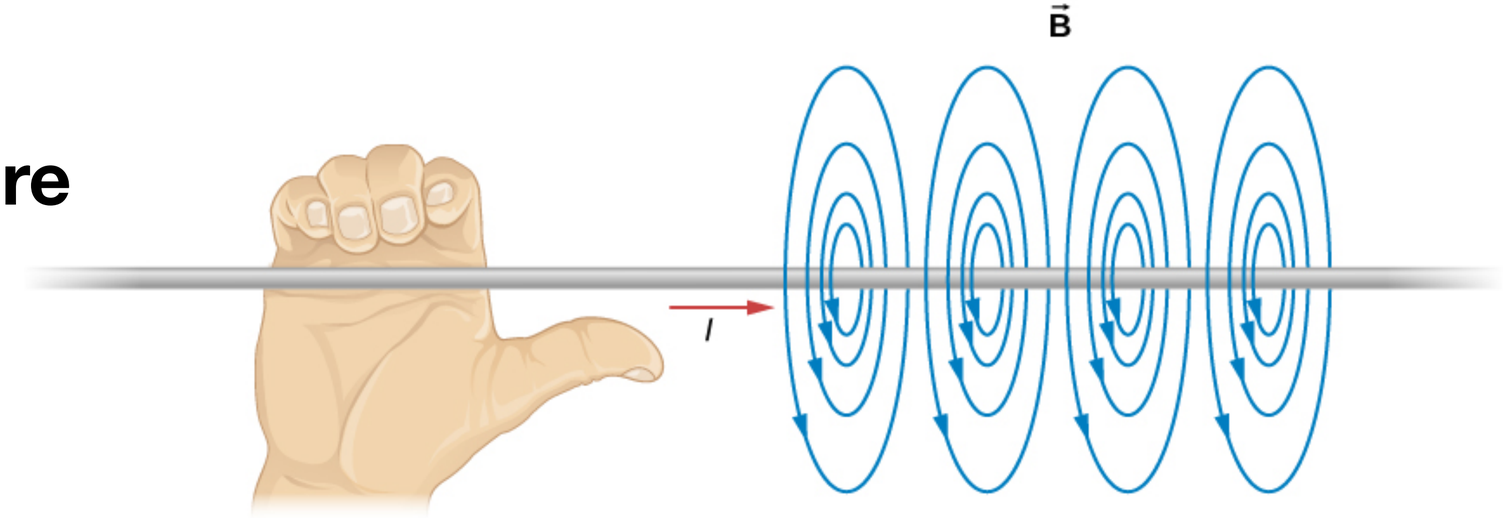
- $F = I\ell B$ for the force on a wire with $\ell \rightarrow x$ and $B \rightarrow y$ and $F \rightarrow z$

- $F = qvB$ for the force on a wire with $v \rightarrow x$ and $B \rightarrow y$ and $F \rightarrow z$ but beware of the sign of the charge! (For example, “an electron”.)

- Important: Only the component of the magnetic field B that is perpendicular to the direction of ℓ (or v) matters! Remember your trigonometry and look at the angles. If B is in the same direction as ℓ (or v) then the force is zero!

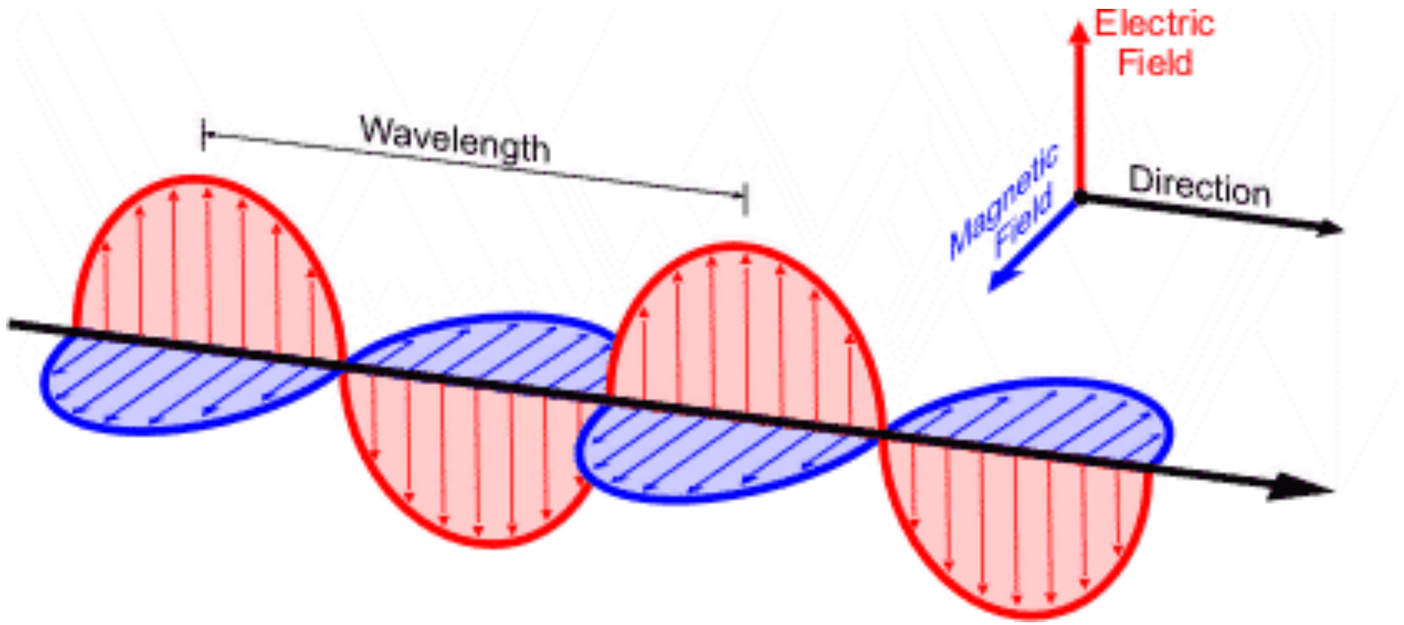
Magnetic Field

… from a long straight wire



$$B = \frac{\mu_0}{2\pi}\frac{I}{r}$$

Electromagnetic Waves



Right Hand Rule!

$E \rightarrow x \qquad B \rightarrow y$

and Direction $\rightarrow z$

Wavelength λ (m)

Frequency f (Hz=1/s)

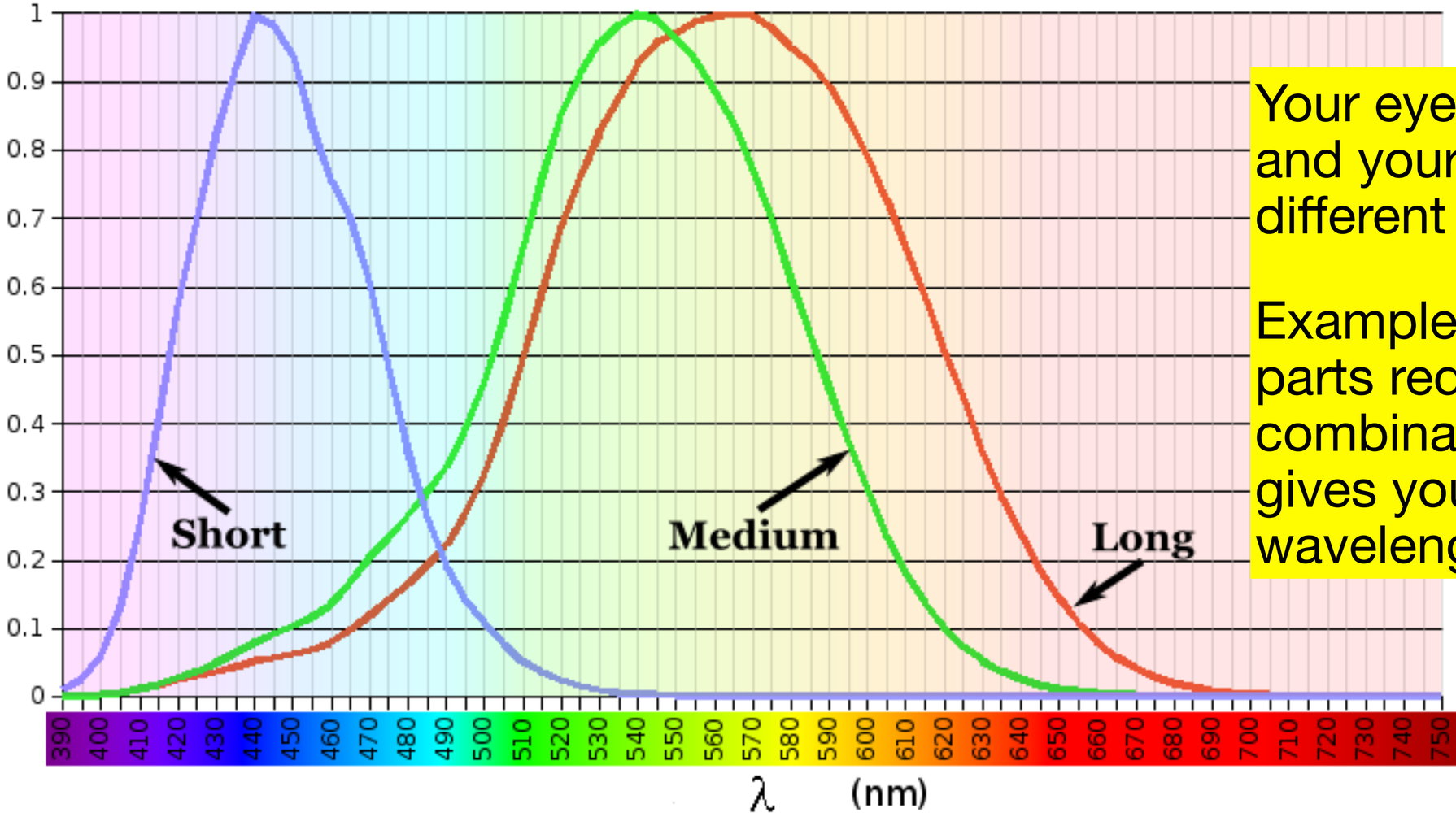
Speed $c = \lambda f$ (m/s)

Period $T = 1/f$ (s)

Wavenumber $\nu = 1/\lambda$ (1/m)

Light and Color

"Rainbow" colors are not necessarily the "perceived" colors



Your eye has three receptors and your brain mixes the different rainbow colors.

Example: "Purple" is equal parts red and blue, but no combination of receptors gives you that with a single wavelength.

The Electromagnetic Spectrum

Visible light is just one small slice in wavelength

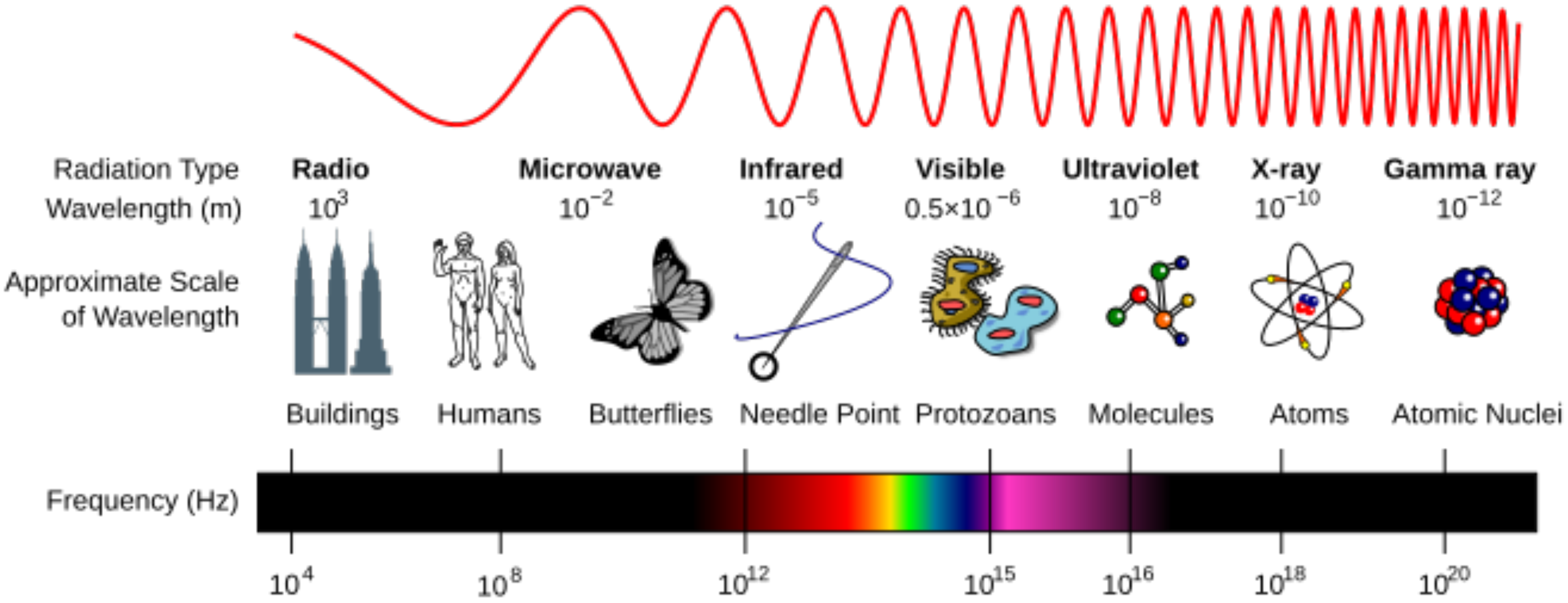
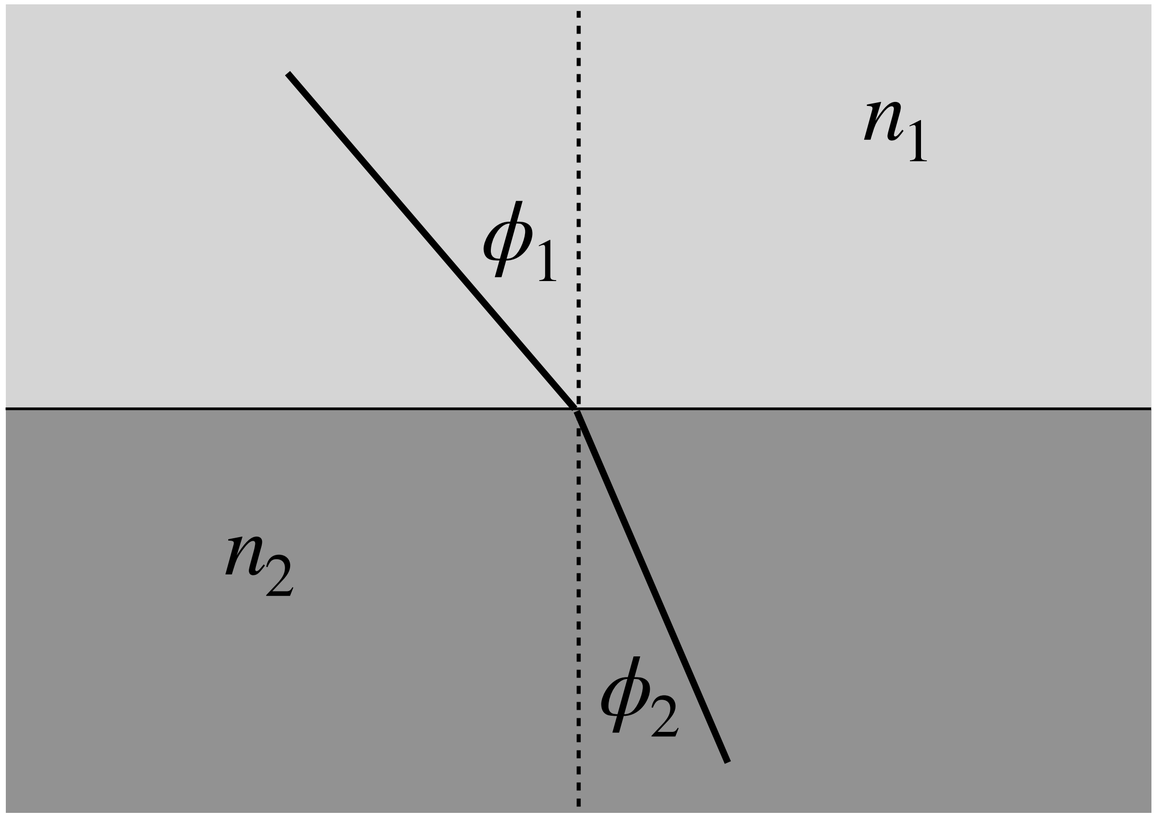


Figure from Wikipedia

Refraction



$$n_1 \sin\phi_1 = n_2 \sin\phi_2$$

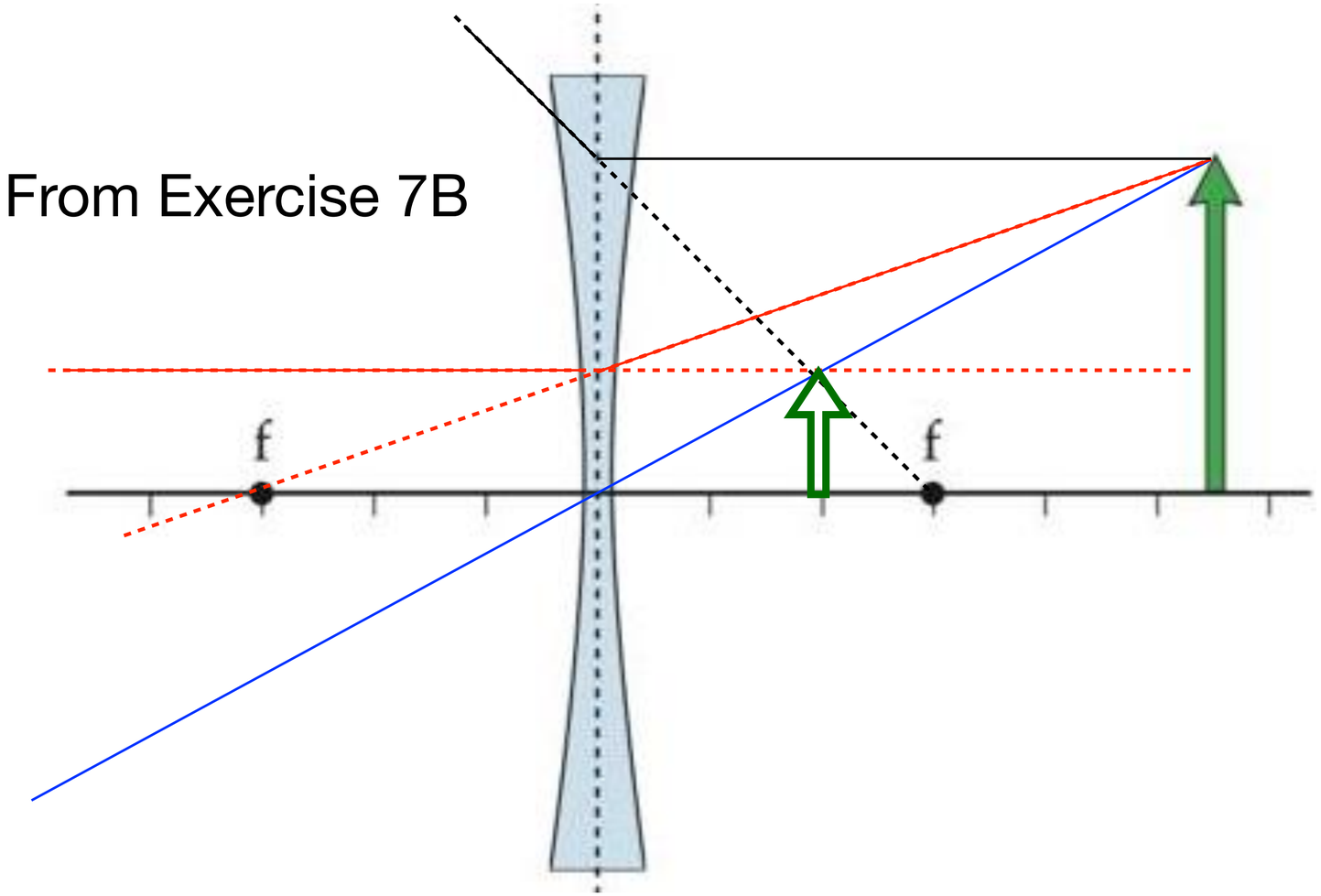
Always check that you are using the correct angle in the formula!

For light going from a smaller index into a larger index, watch for "total internal reflection"

Thin Lenses and Images

We did this (I) with ray tracing and (II) with the thin lens formula

From Exercise 7B



$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

- d_o is always positive
- $d_i > 0$ for a real image (i.e. "where the light shines")
- $f > 0$ for a convex lens and $f < 0$ if concave
- Magnification $M = -d_i/d_o$