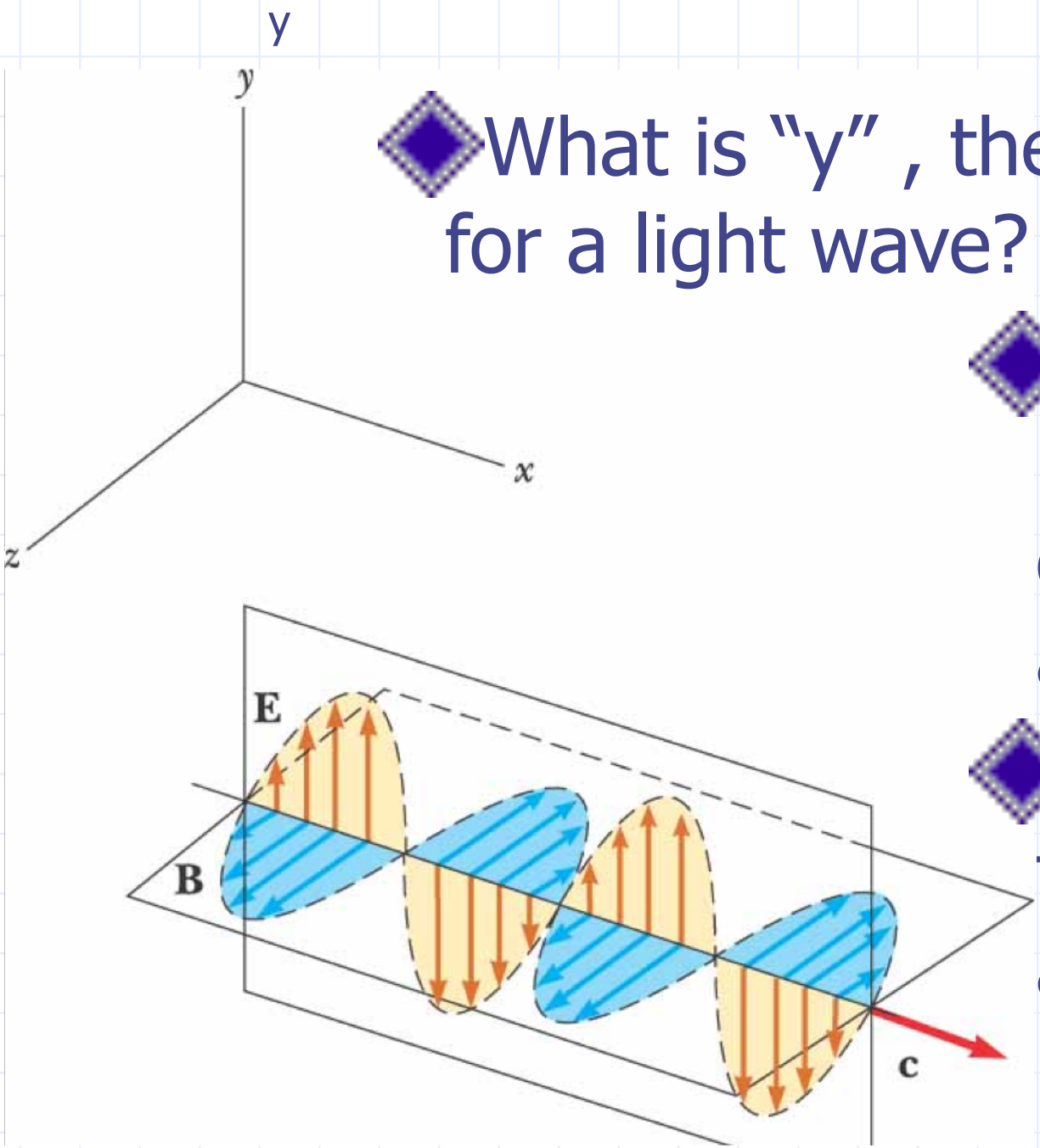
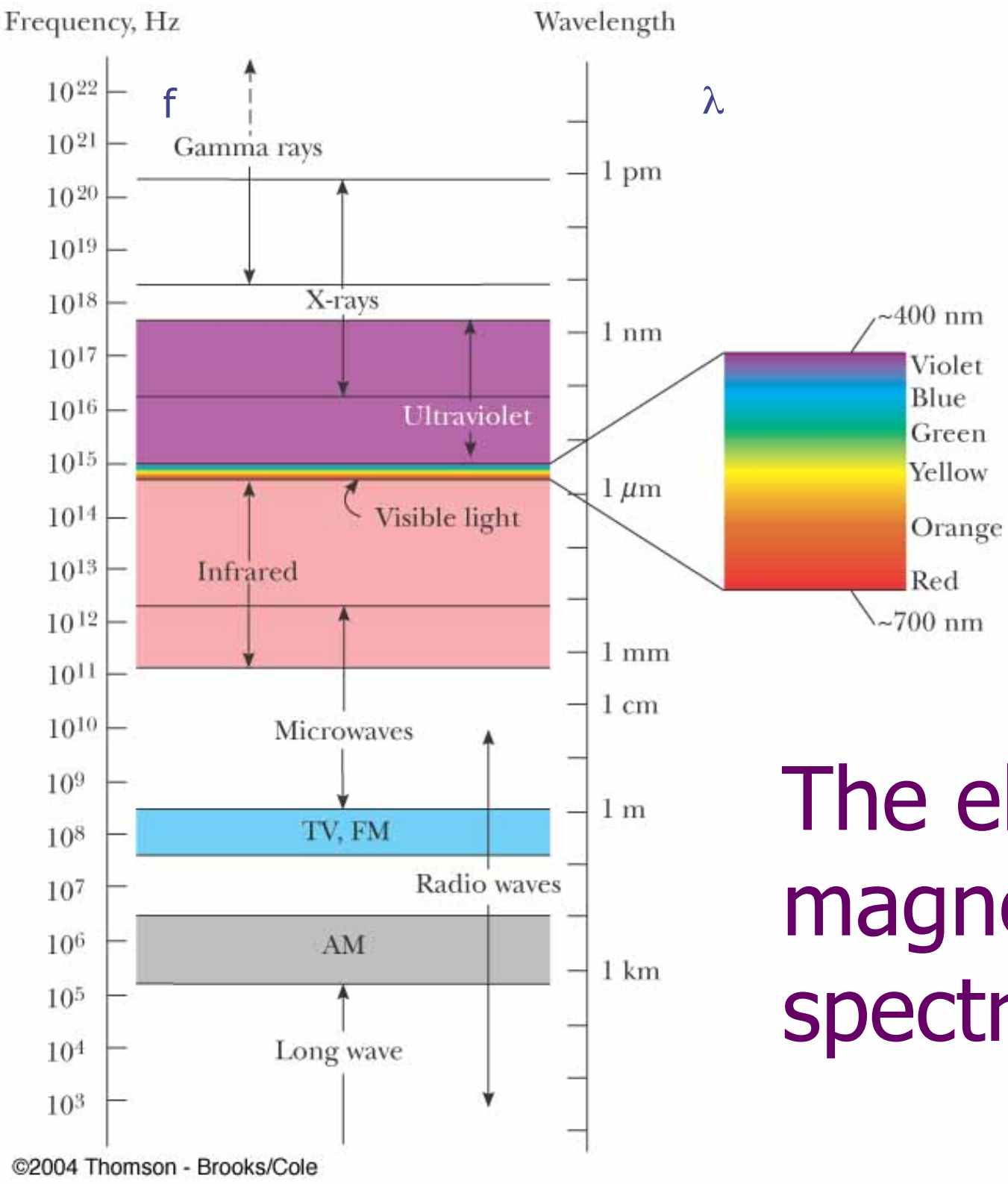
Chapter 16. Light

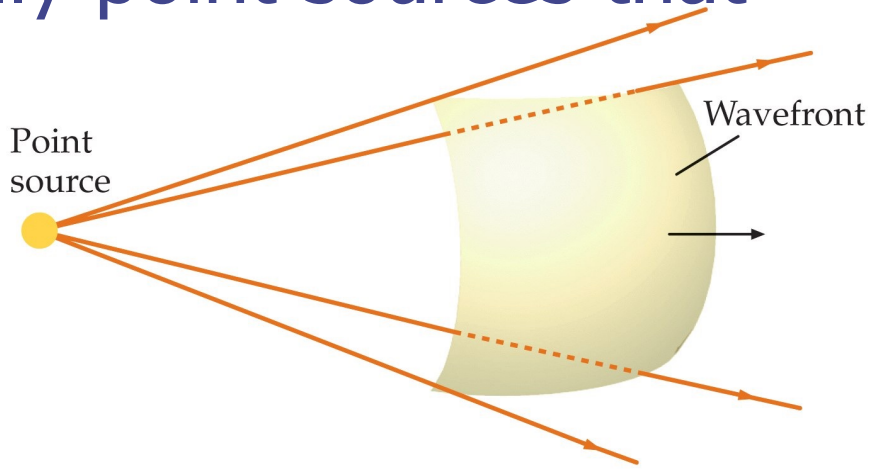


- What is "y" , the magnitude, for a light wave?
  - The wave magnitude is the oscillating electric and magnetic field
  - We take the wave to move at speed c along the x-axis

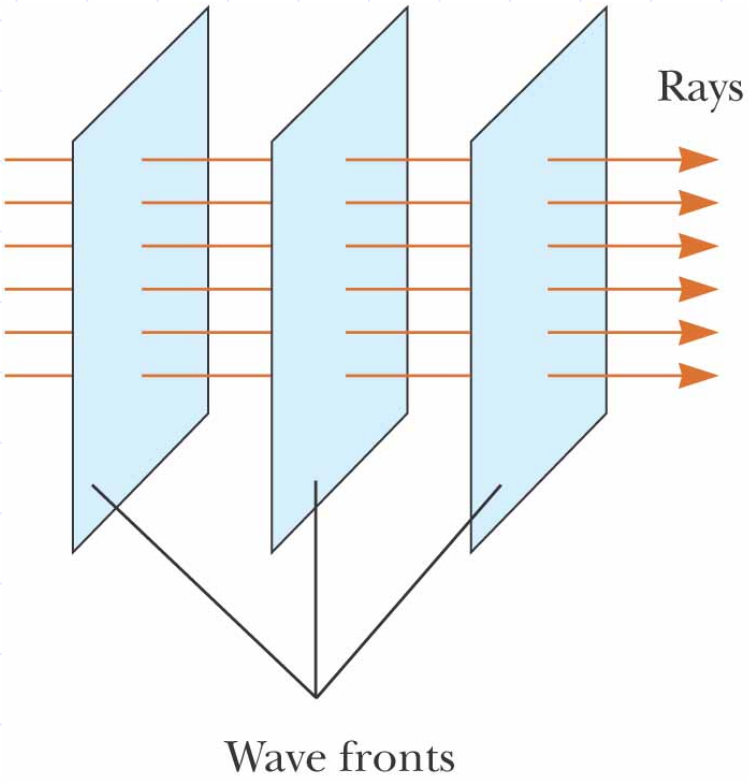


The electro-magnetic spectrum

- What is optics? The study of how light behaves as it encounters different media during its propagation
- Why study optics? We can understand how many things work: the eye, glasses, cameras, telescopes, …, the effects at Disney's Haunted Mansion, …
- Light sources are generally point sources that emit spherical waves

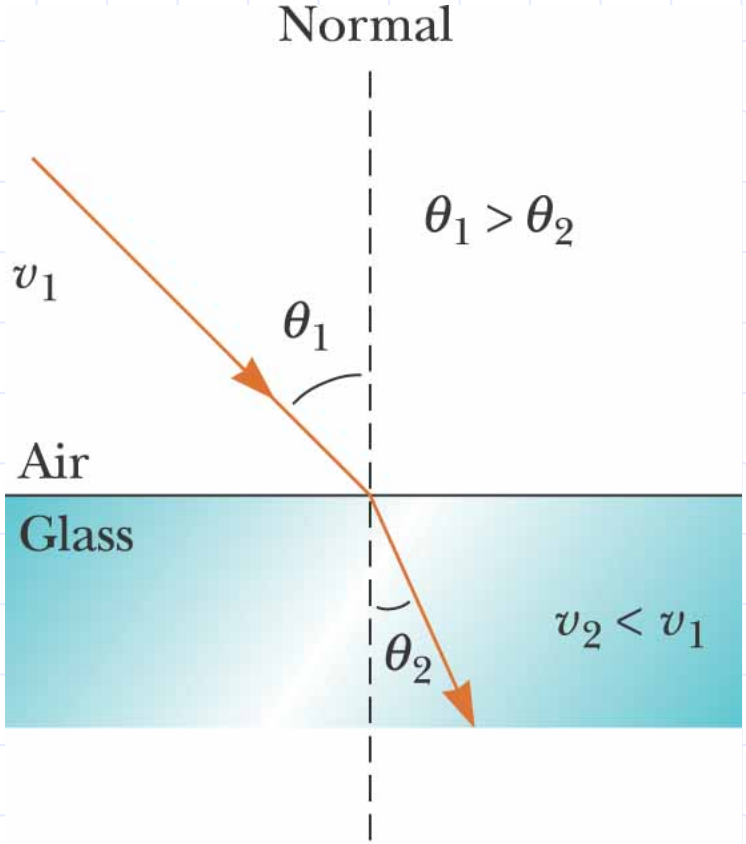


- A wave front is a point on the wave (peak or trough) that propagates at speed c with the wave
- A ray defines the direction of the wave and is perpendicular to the wave front
- We adopt the **ray approximation** which assumes that the wave moves through a medium in a straight line in the direction of the rays
- At a sufficiently far distance from the source, a spherical wave can be approximated as a plane wave



- When light travels through any medium, its speed v < c, since c is the speed of light in a vacuum. However, the speed of light in air is ≈ $c=v_1$.
- After the light enters the new medium (e.g. glass), its speed v_2 decreases
- Since the speed changes, the ray is bent and propagates through the second medium at a new angle:

$$\frac{\sin\theta_2}{\sin\theta_1} = \frac{v_2}{v_1} = \text{constant}$$



- What is this constant? It is related to the two media that the light propagates through.
- For any medium, we can make the following definition from the ratio:
(speed of light in vacuum)/
(speed of light in the medium) or

$$\frac{c}{v} = n$$

- n is the index of refraction. n ≥ 1. Table 16.2 gives the index of refraction for some materials. Examples: air (1.0003), glass (1.50), diamond (2.42).

Problem 16.25

- A light wave has a 670 nm wavelength in air. Its wavelength in a transparent solid is 420 nm. (a) What is the speed of light in this solid? (b) What is the light's frequency in the solid? (c) What is the index of refraction of the light?