CH EN 3453 – Heat Transfer

Introduction to Radiation

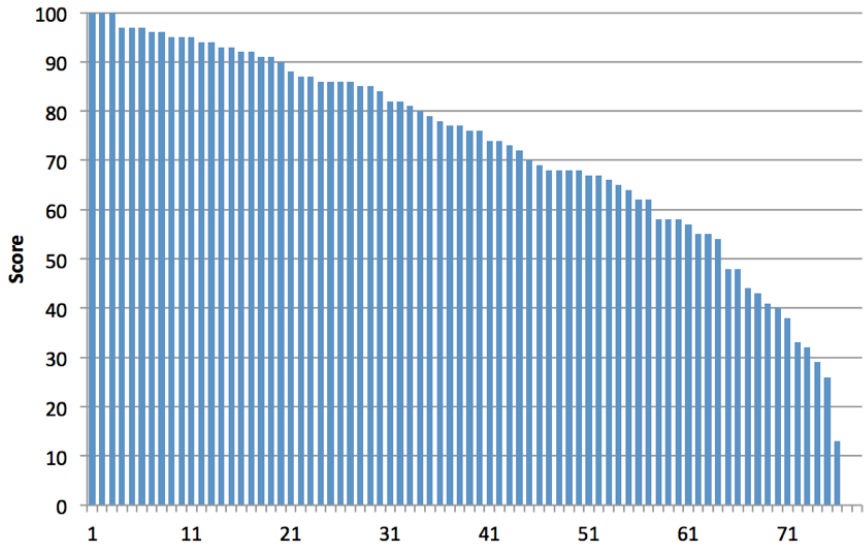
Sections 12.1 to 12.3

News!

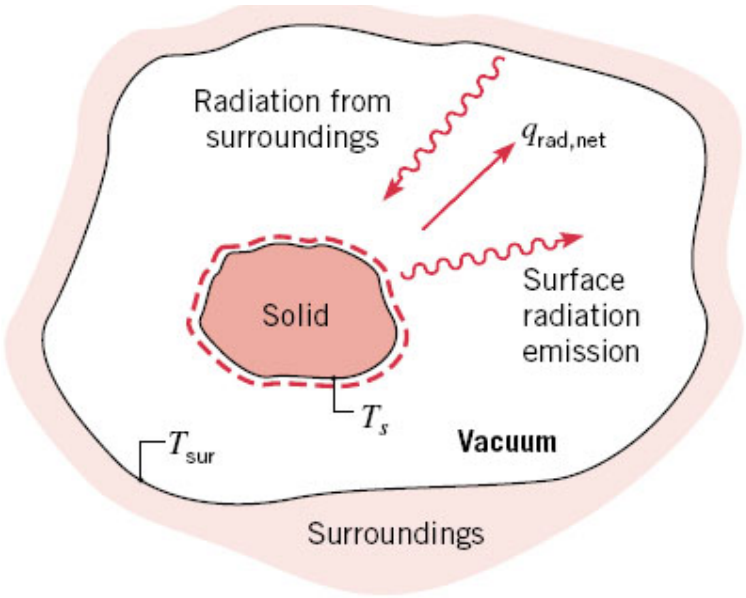
- Homework #10 due Friday next week
  - Help session Wed at 4:30 pm in MEB 2325
- Results and Discussion section due 4PM today
  - Be sure to include at least 1 table, 1 graph and explain how the results were calculated
- Intro and Conclusions sections due Friday next week
  - These will be submitted electronically along with the whole draft report. Details to follow...
- Bethany teaches class Monday and Wednesday next week
- Web site scores and histogram will be updated this morning

Midterm #2

- Average: 73
- Median: 77
- Three students received 100



Radiation To and From an Object



“Volumetric” vs. “Surface” Emission

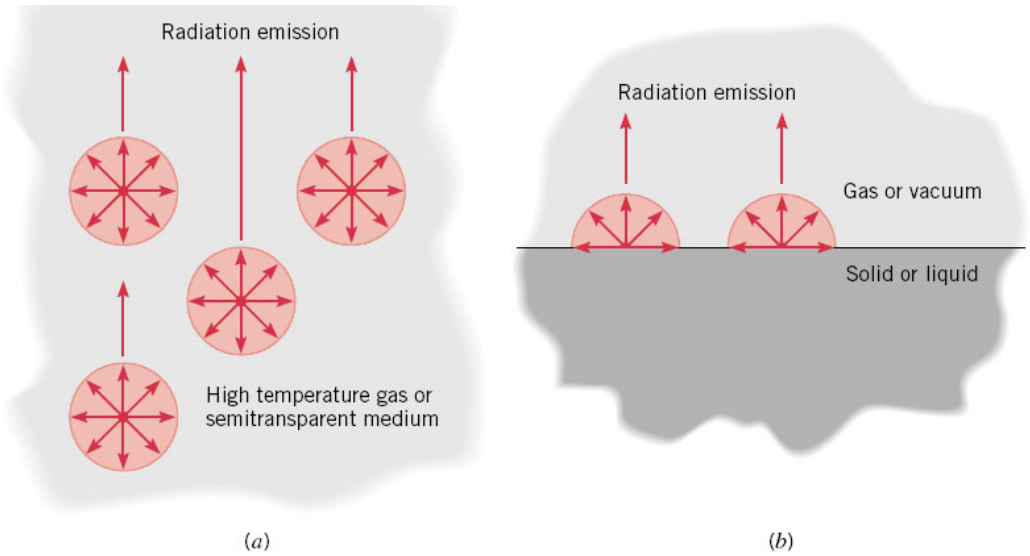


FIGURE 12.2 The emission process. (*a*) As a volumetric phenomenon. (*b*) Surface phenomenon.

Radiation Spectrum

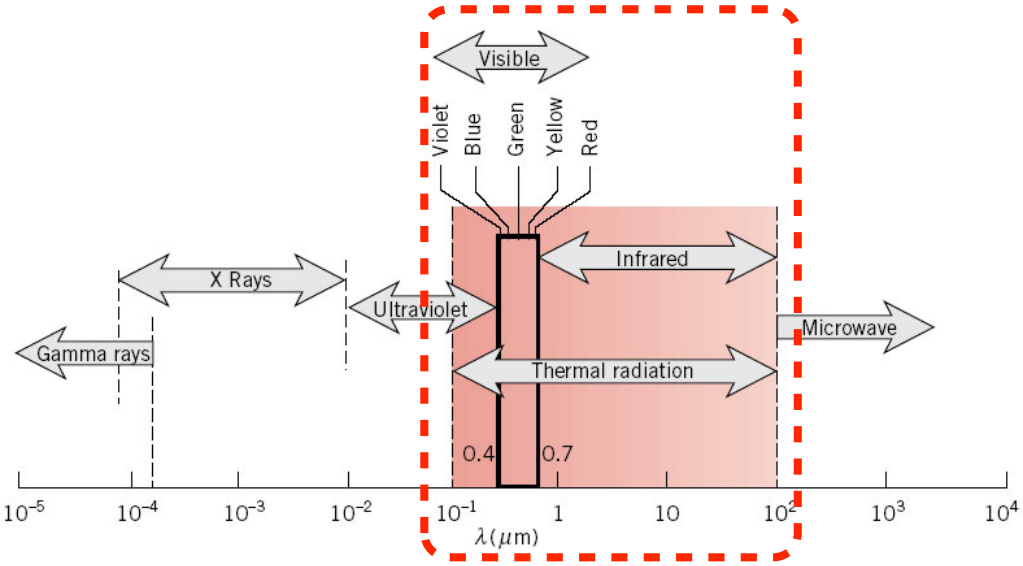


FIGURE 12.3 Spectrum of electromagnetic radiation.

Intensity vs. Wavelength and Direction

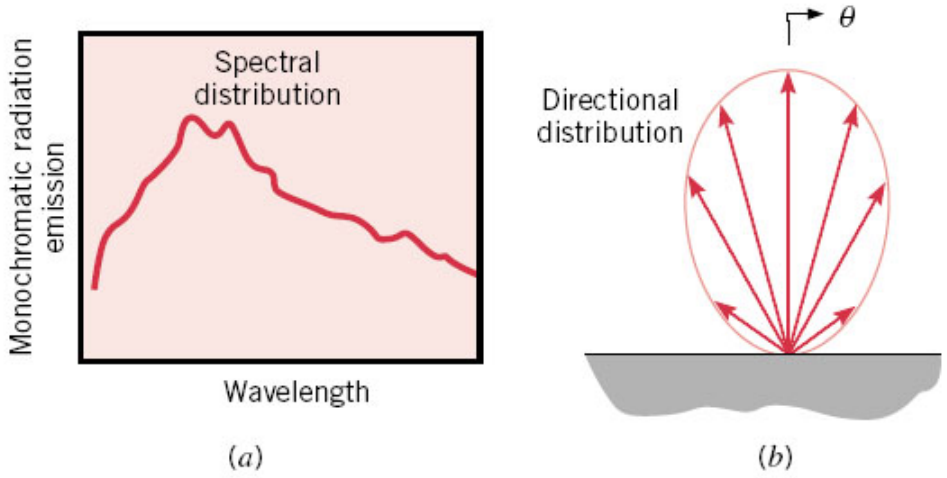
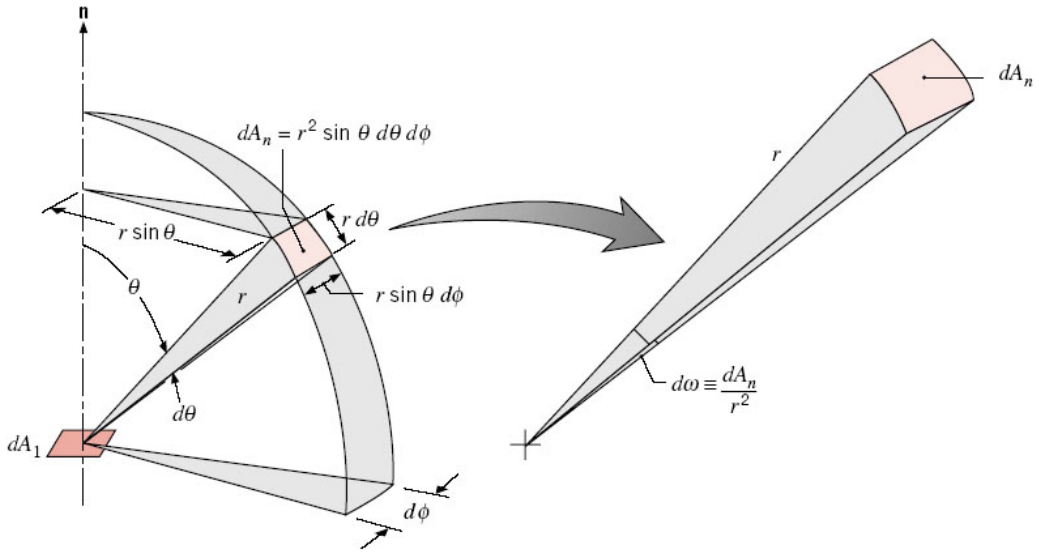
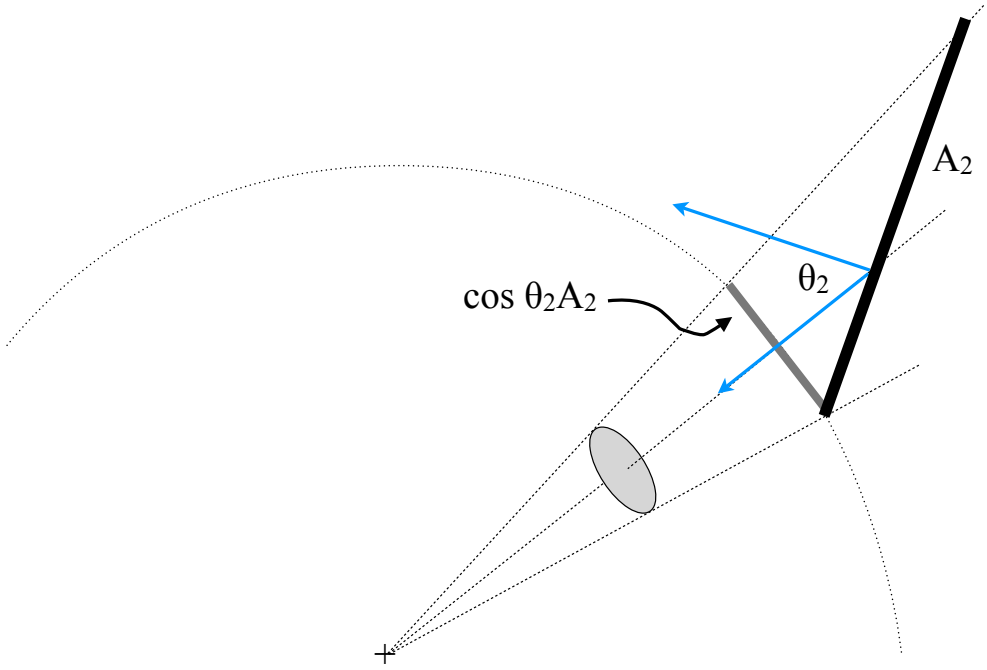


FIGURE 12.4 Radiation emitted by a surface. (*a*) Spectral distribution. (*b*) Directional distribution.

The Solid Angle



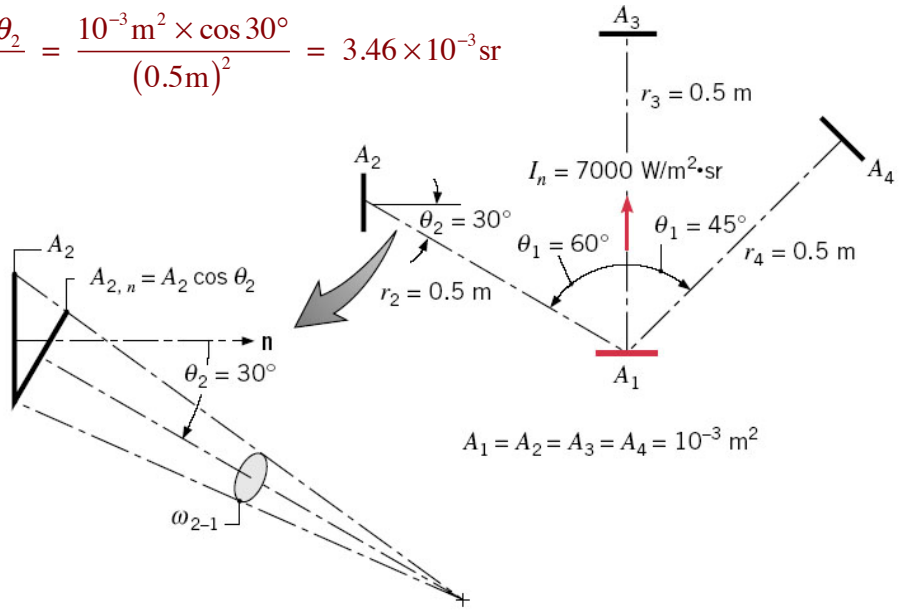
Solid Angle Geometry



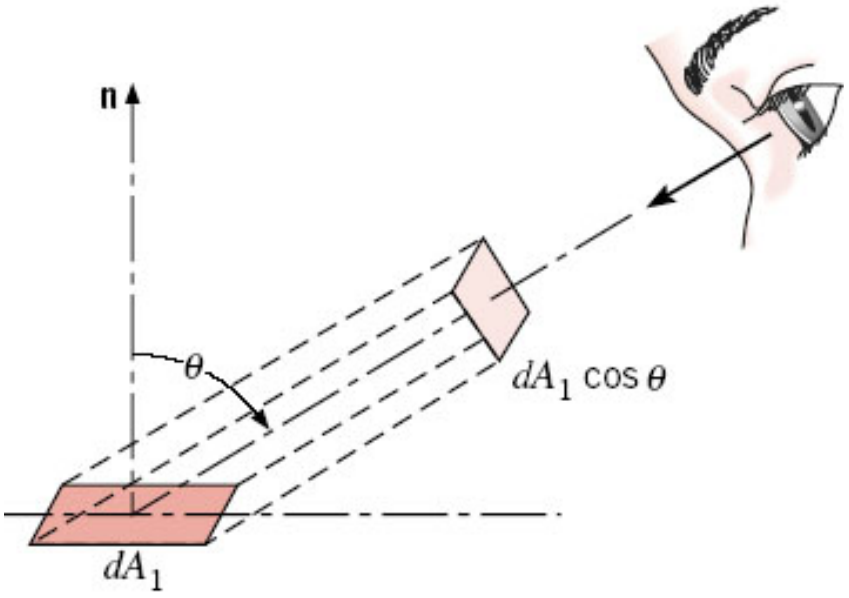
From Example 12.1...

$$\omega_{3-1} = \omega_{4-1} = \frac{A_3}{r^2} = \frac{10^{-3}\,\text{m}^2}{(0.5\,\text{m})^2} = 4.00\times10^{-4}\,\text{sr}$$

$$\omega_{2-1} = \frac{A_2\cos\theta_2}{r^2} = \frac{10^{-3}\,\text{m}^2\times\cos 30^\circ}{(0.5\,\text{m})^2} = 3.46\times10^{-3}\,\text{sr}$$



Projected Area



Example: Problem 12.2

Consider a small surface area of $A_1 = 10^{-4}$ m^2, which emits diffusely with a total, hemispherical emissive power of $E_1 = 5 \times 10^4$ W/m^2.

(a) At what rate is this emission intercepted by a small surface of $A_2 = 5 \times 10^{-4}$ m^2, which is oriented as shown?

(b) What is the irradiation G_2 on A_2?