MONT 100N – Modeling the Environment
Selected Solutions for Problem Set 1
September 22, 2017

Chapter 1 Problems

(5) The iceberg formed by the calving of the Larsen C ice shelf:

(a) To convert from square kilometers to square miles, multiply by the square of the conversion factor for kilometers to miles:

$$44200\text{km}^2 \times (.621\text{m/km})^2 \doteq 17045 \text{ mi}^2.$$

(b) The thickness of the ice sheet is 350 m = .350 km. So the volume in km^3 is

$$44200 \times .350 = 15470 \text{ km}^3.$$

Then to convert to cubic feet we need to multiply by the cube of the conversion factor from km to ft, which is $\doteq 3281$ft/km. This gives a *very large* number of cubic feet:

$$15470 \text{ km}^3 \times (3281)^3 \text{ (ft/km)}^3 \doteq 5.46 \times 10^{14} \text{ ft}^3.$$

(Get in the habit of using scientific notation instead of putting in 14 decimal places for things like this!!)

(7) In this problem people were a bit confused about what kind of unit a *light year* is in part (b). For that reason, I treated it as an extra credit part.

(a) To convert meters per second to miles per hour:

$$299,792,458 \text{ m/sec} \times 3600 \text{ sec/hr} \times \frac{1}{1609} \text{ mi/m} \doteq 6.7 \times 10^8 \text{ mi/hr}.$$

(b) The light year is a unit of *distance* (even though it sounds like it should involve time, the time only comes into the definition as the distance traveled by light in one year). In km, one light year is

$$299,792,458 \text{ m/sec} \times .001 \text{ km/m} \times \ 60^2 \times 24 \times 365 \text{ sec} \doteq 9.45 \times 10^{12} \text{ km}.$$

In miles, this is

$$\doteq 9.45 \times 10^{12} \text{ km} \times .621 \text{ mi/km} \doteq 5.87 \times 10^{12} \text{ mi}.$$

(c) At half the speed of light it will take about $2 \times 4.25 \doteq 8.5$ years to reach Proxima Centauri, since the distance is about 4.25 light years from Earth [1]

[1] According to `https://en.wikipedia.org/wiki/Proxima_Centauri_b`.

(13) (Sound intensities.)

(b) All parts of this and (c) are similar. The idea is that to solve for the p_m, we need to exponentiate to remove the logarithm. Suppose $L = 1$dB for instance. Then

$$1 = 20 \times \log_{10}\left(\frac{p_m}{20}\right).$$

We start by dividing the 20 to the left side, then raise 10 to the power of each side:

$$10^{1/20} = 10^{\log_{10}(p_m/20)} = p_m/20.$$

Then solving for p_m, we get.

$$p_m = 20 \times 10^{1/20} \doteq 22.44 \text{ micropascals}$$

(13) The kudzu vines.

(c) We need to convert 235 kilograms per hectare per year to the equivalent number of pounds per square mile per month:

$$235 \text{ kg/(ha} \cdot \text{yr)} \times 2.2 \text{ lb/kg} \times 259 \text{ ha/sq.mi.} \times .0833 \text{ yr/mo.}$$

This gives approximately 1.15×10^4 pounds per square mile per month.