Environmental Science II

Problems Chapter 1

1.1.1 A sound wave is moving according to y = A cos (*kx*- ω*t*). The amplitude is 0.034 μm and the period T = 5.2 ms. Calculate the maximum particle speed.

Solution
Applying the formula $\omega = 2\pi/T$ we get the angular velocity ω. If we take the derivative of the equation y = A cos (*kx*- ω*t*) and look for the maximum we get $v_{ymax} = A\omega = 0.034x10^{-6} \times 2\pi/5.2x10^{-3}$ m/s = 41 μm/s.

Answer: 41 μm/s

1.1.2 A sound wave is moving according to y = A cos (*kx*- ω*t*). The amplitude is 0.034 μm and the period T = 5.2 ms. Calculate the maximum particle acceleration.

Solution
Applying the formula $\omega = 2\pi/T$ we get the angular velocity ω. If we take the derivative, twice of the equation y = A cos (*kx*- ω*t*) and look for the maximum we get $a_{ymax} = A\omega^2 = 0.034x10^{-6} \times (2\pi/5.2x10^{-3})^2$ m/s^2 = 0.0496 m/s^2 = 50 mm/s^2.

Answer: 50 mm/s^2

1.7.1
Let us compare the ability to isolate of Mineral wool (Mineralull) and Glass wool (Glasull). How much better is Glass wool compared to Mineral wool?

Solution
From the tables we find that k = 0.038 for Mineral wool and for Glass wool k = 0.036 W/m·K. We get 0.038/0.036 = 1.05556 = 100%+5.6%.

Answer: 5.6% better

1.7.2 If we want to build a wall using either Mineral wool (Mineralull) or Cell plastic (cellplast). How much thicker must the wall be if we use Mineral wool instead of Cell plastic?

Solution
The heat conductivity coefficients are 0.038 W/m·K and 0.014 W/m·K. The thickness of Mineral wool must be 0.038/0.014 = 2.7 times larger.

Answer: 2.7 times thicker

1.7.2
Looking at a house with a total area of is 240 m^2 (windows included), while the area of the windows is 30 m^2. Let us use the Swedish building classification. If we change

all the windows of the house and use windows with U = 1.9 instead of windows with U = 2.9, calculate the change in U-value for the house. (If we change U-values of the windows by a factor a, we can say that we change the area of the windows by the same factor a).

Solution
The Swedish building classification describes the U-value of the house as: U_{house} = 0.18 + 0.95(Awindows/Atotal) [W/m^{2}K]. We have with areas 30 m^2 and 240 m^2. Thus U_{house} = 0.18 + 0.95(30/240) W/m^{2}K = 0.299 W/m^{2}K. If we use the other windows we get U_{house} = 0.18 + 0.95(30(1.9/2.9)/240) W/m^{2}K = 0.258 W/m^{2}K. The U-value reduction becomes =1- 0.258/0.299 = 1- 0.863 = 14%.

Answer: 14%

1.7.3 If we want to have value of *U* =0.25 W/ m^2·K of a roof, using glass wool, how thick would the layer of isolation be?

Solution
Glass wool has k = 0.036 W/m·K and with k = U·d, we get d = k/U = 0.034/0.25 m = 1.4 dm.

Answer: 1.4 dm

1.7.4 If we want to have value of *U* =0.25 W/ m^2·K of a roof, using cell plastic, how thick would the layer of isolation be?

Solution
Glass wool has k = 0.014 W/m·K and with k = U·d, we get d = k/U = 0.014/0.25 m = 5.6 cm.

Answer: 5.6 cm