Environmental Science, Solutions Chapter 5

5.1

With the equation $p = p_0 e^{-z/H}$ we get

$$10 = 1000e^{-30000/H} \Rightarrow \ln\left(\frac{10}{1000}\right) = -\frac{30000}{H} \Rightarrow -4.605 = \frac{30000}{H} \Rightarrow H = \frac{30000}{4.605}\,\text{m} \approx 6.5\,\text{km}$$

Answer: $\mathbf{H = 6.5\ km}$

5.2

With the equation $p = p_0 e^{-z/H}$ we get

$$500 = 1000e^{-z/6515} \Rightarrow \ln\left(\frac{500}{1000}\right) = -\frac{z}{6515} \Rightarrow -0.693 = -\frac{z}{6515} \Rightarrow z = 0.693{\cdot}6515\,\text{m} \approx 4.5\,\text{km}.$$

Answer: $\mathbf{z = 4.5\ km}$

5.3

With the equation $t = t_0\,(1 - k\Delta z)$ we get

$$-10 = -60\,(1 - k\,(50 - 25)) \Rightarrow \frac{-10}{-60} = 1 - k{\cdot}25 \Rightarrow k = \frac{1 - \frac{1}{6}}{25}\,\text{km}^{-1} \approx 0.033\,\text{km}^{-1}.$$

Answer: $\mathbf{k = 0.033\ km^{-1}}$

5.4

With the equation $t = t_0\,(1 - k\Delta z)$ and $k = 0.033\ \text{km}^{-1}$ we get

$$t = -60\,(1 - 0.033\,(40 - 25)) \Rightarrow t = -30\ ^\circ\text{C}$$

Answer: $\mathbf{t = -30\ ^\circ C}$

5.5

The mass of the wind is $m = \rho V$ and the Coriolis force is given by

$$F_C = 2mu\Omega sin\theta = 2\rho V u\Omega sin\theta = 2{\cdot}0.5{\cdot}1000^3{\cdot}120{\cdot}7.27{\cdot}10^{-5} sin43^o\ \text{N} = 5.95{\cdot}10^6\ \text{N} \approx 6{\cdot}10^6\ \text{N}$$

Answer: $\mathbf{6 \cdot 10^6\ N}$