Environmental Science, Problems Chapter 5

5.1

The pressure p of the atmosphere decreases with height z above the ground. Suppose we are on the ground and the pressure is $p_0 = 1000$ hPa. At $z = 30$ km the pressure is 10 hPa. Determine the constant H in the pressure equation

$$p = p_0 e^{-z/H}$$

Answer: H = 6.5 km

5.2

The pressure p of the atmosphere decreases with height z above the ground. Suppose we are on the ground and the pressure is $p_0 = 1000$ hPa. At what height will the pressure be half of that? The constant $H = 6515$ m in the pressure equation

$$p = p_0 e^{-z/H}$$

Answer: z = 4.5 km

5.3

The temperature t of the stratosphere increases with height z above the ground from -60 °C at 25 km to -10 °C at 50 km. Suppose we have a temperature equation

$$t = t_0\,(1 - k\Delta z)\,.$$

Here Δz stands for the difference in height. Determine the constant k.
Answer: k = 0.033 km^{-1}

5.4

The temperature t of the stratosphere increases with height z above the ground. At 25 km we have the temperature -60 °C. Suppose we have a temperature equation

$$t = t_0\,(1 - k\Delta z)\,,$$

where Δz stands for the difference in height. Determine the temperature at 40 km. The constant $k = 0.033$ km^{-1}.
Answer: t = -30 °C

5.5

A large volume (1 km^3) of the wind (density 0.5 km/m^3 at a particular height) is moving at a speed of 120 m/s in the South-North direction over Marseille (latitude 43^o). Calculate the Coriolis force on the volume. The angular velocity is $7.27 \cdot 10^{-5}$ rad/s.
Answer: $6 \cdot 10^6$ N