1 Chapter 1.

1. 26,400 ft for H=8 km
2. 0.0041
3. 0.819 hPa (using H=8 km, 1 mile =1.6km)

4a) 40,212 km

4b) 111.7 km deg^{-1}

4c) 96.7 km deg^{-1}

5. 50,000 km^2
8. 11.175 km s^{-1}
9. $2\sqrt{2gh}$

2 Chapter 2.

1. 1.276, 1.231, 1.189 kg m^{-3}
2. 0.795 kg m^{-3}
3. 212.2 hPa
4. 12,52 N
5. 2.687×10^{25} molecules m^{-3}
6. $R_d = 2.87\,\mathrm{hPa\,K^{-1}\,m^3\,kg^{-1}}$
7. Differentiate $\mathcal{P}(v)$ with respect to v and set it to zero. See Table 2.1.
8. 461.2, 493.0, 412.5, 1842.7 m^{-1}
9. 630.2 Pa. 1 kg m^{-1}. Pressure with moisture=78467.7 Pa. Density of moist mix=1 kg m^{-3}. Density of dry air at same temperature and pressure: 1.00148 kg m^{-3}.
10. 1.601×10^8 J
11. 211672 J
12. $n_0 = 2.65 \times 10^{25}$ molecules m^{-3}, H=8000 m, N=2.12×10^{29} molecules
13. $z_{\lambda=H} = H\ln(\sigma_c H)$
14. $\frac{gp_0}{RT_0}\int_0^\infty ze^{-z/H}dz = \frac{gp_0}{RT_0}$

15. $\frac{N}{2} m_0 \overline{v^2} = \frac{3N}{2} k_B T$, see # 12. for N.

16. $f_{yellow} = c/\lambda = 6.0\times 10^{14}\,\mathrm{s}^{-1}$. $f_{coll} = n_0 \sigma_c \overline{v} \approx 3\times 10^{25} \times 0.4\times 10^{-18} \times 811 = 9.7\times 10^{9}\,\mathrm{s}^{-1}$. An excited atom might suffer tens of collisions before it relaxes to the lower energy level.

3 Chapter 3

1. d) $p_0 \frac{z}{H^2} e^{-z/H}$

2. a) ρR; Let $1/T \equiv x$, then take the partial with respect to x.

3. $\kappa_T = \frac{1}{p}$; to get κ_θ use $pV^\gamma = p_0 V_0^\gamma$; result: $\frac{1}{\gamma p}$

4. $\beta = \frac{1}{T}$

6. 195.8 kJ

7. $T = T_0 \left(\frac{1}{e=2.78\ .\ .}\right)^{0.286} = 205.1\,\mathrm{K}$. $\Delta T = -67.9\,\mathrm{K}$. Therefore, $\Delta U = 48.72\,\mathrm{J}{=}W$, since $Q = 0$.

8. a) 10.05 kJ; b) 7.18 kJ; c) $dU + V\,dp \rightarrow dU$.

9. $H = RT/g = 8777\,\mathrm{m}, p = p_0 e^{-z/H}$; then $p(1000\mathrm{m}) = 892\,\mathrm{hPa}$. $\Delta \approx V \frac{\Delta p}{p} V_0$

10. $1.2015\,\mathrm{kg\,m^{-3}}$. $Q = -0.003 \times 2.5 \times 10^6 = -7500\,\mathrm{J}$. Use the mass of the dry air only as an approximation. $\Delta T = \mathcal{M} c_v Q$

11. $T_{600} = 248.7\,\mathrm{K}$. $\Delta U = \mathcal{M} c_v \Delta T, \quad \Delta H = 0$

12. $0.02\,\mathrm{K\,s^{-1}}$; $20\,\mathrm{J\,s^{-1}}$; ΔU per unit time= $14.3\,\mathrm{J\,s^{-1}}$

13. a) 10,000 kg. b) mass of an 'air' molecule=$29/N_A = 4.82 \times 10^{-23}$ kg. $N = 2.08 \times 10^{26}$ molecules. c) 1.07×10^{41}

14. $c_s = \sqrt{RT}$ for isothermal; $\sqrt{\gamma RT}$, $\gamma = 1.40$ for adiabatic compression waves

15 (16). $\theta = T_0 \left(\frac{p_0}{p}\right)^{0.286}$