

Professor: J.D. WilsonValue: 15%Due 26 Oct., 2005

Instructions: A maximum of one page per question will be marked. Your assignment need not be typed, but, tidiness and legibility will factor into your score. You are permitted to work with others to perform this assignment, however, you are expected to hand in work that reflects your own reasoning, ordering and writing. As best you can, strive to make your responses creative, clear and interesting.

1. An aircraft is flying at $z_1 = 9,144$ m ASL¹, at which level the pressure and temperature are $p_1, T_1 = (300 \text{ mb}, -57^\circ\text{C})$. The pilot receives an instruction to descend to $z_2 = 8,839.2$ m. Estimate the atmospheric pressure and temperature at the new flight level, noting any uncertainties and/or any assumptions you make in your reasoning. (4%)
2. Suppose the radiative energy output of a certain star in its “solar band” is $Q = 10^{28}$ W. Calculate the “solar constant” S_0 for a planet whose orbit is a circle of radius $R = 10^{13}$ m. Assuming this planet is a perfect black body (albedo $a = 0$, emissivity $\epsilon = 1$), that it is isothermal, has no atmosphere, and has no internal energy sources, calculate its equilibrium temperature T_{eq} . (4%)
3. Write up to one page, explaining in your own words the diurnal temperature cycle in the lowest 10 m above ground. Assume a fair-weather day (no cloud, no fronts), and identify the processes “driving” the diurnal cycle, and the significant flows of energy. Comment on the meteorological situation an observer would note in relation to time of day (eg. winds diminishing or rising overnight, etc.), and explain in what way the diurnal cycle would differ between two fair days sharing the same cycles in Q^* , but differing in that day 2 has much stronger winds than day 1. (7%)

Notes: In (1,2) show your reasoning and working. Make whatever unit conversions are necessary, and always show units in association with numbers. Use diagrams if appropriate and where they clarify your work. Orderly and comprehensible presentation of your answer is important; brevity and directness are also important, to which purpose you may use point form with abbreviations. In (3) you should define and use symbols (eg. Q_H [W m^{-2}], the vertical flux of sensible heat) and use a diagram if helpful. You will have to find a compromise between an exhaustive treatment (impossible in one tidy, legible page) and an overview.

¹Above Sea Level. For historical reasons, pilots usually cite altitude in feet ASL; then, $z_1 = 30,000$ feet and $z_2 = 29,000$ feet.