Name: _____

Homework 10 – Ast 281 – Spring 2009
Due Tuesday 4/21/09 – 12:00pm Wat 420 – 100 pts

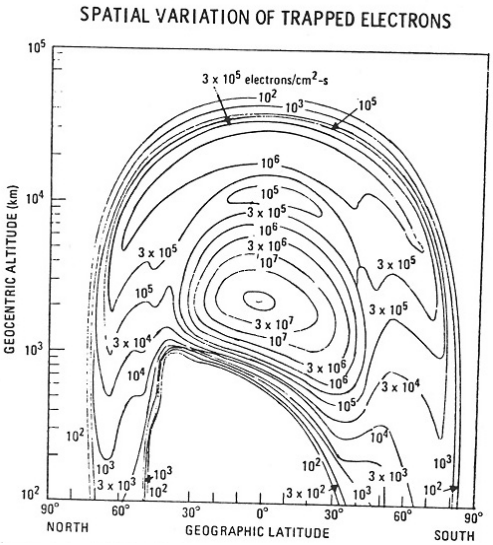
1. This question relates to your understanding of space hazards and the radiation environment.

   (a) What is the difference between cosmic rays and the solar wind? [5]

   (b) What is more dangerous in terms of radiation exposure – 1.0 MeV neutrons or 1.0 MeV alpha particles (α particles) and why? [5]

   (c) What is the rem dosage for 1.0 MeV neutrons and 1.0MeV protons (for a single particle). Express your answer in rads. (Hint: use conversions between eV to Joules to ergs to rads). [8]

   (d) In order to calculate the total dosage you would have to know how many particles per second were hitting you (the flux) and how long you were in exposed. The energies calculated above are for single particles. What is the electron flux (electrons per sec per cm^{-2}) for an orbit at latitude of -35° and an altitude of about 650 km? Use the figure at the right to estimate this from the contours. [2]



(e) The maximum single dose (30 day limit) for the most sensitive human tissue (bone) is 25 rem. Using the electron fluxes obtained from the graph and assuming α-particle energies in rad as calculated above, what is the maximum exposure time unshielded before a dangerous radiation dose was reached? [10]

(f) Why is too little shielding worse than none at all? [5]

2. We have seen in class how the space program and NASA have evolved since their creation in the 1960's. What do you think the means of getting large expensive enterprises into space are (*e.g.* colonies, manned missions to the Moon and Mars), and what are the benefits and downsides to these missions. [Note: this question is not asking about the physical launch / construction process, rather what within society will motivate this to become reality?] Do you think we ought to be have manned explorations into space? [10]

3. This question is a bit of a review, but helps us understand some of the issues in space colonies. Below is a table of atmospheric composition as a function of altitude in Earth's atmosphere (from the lecture on the Space Environment). Note: The atomic weight was originally defined based on oxygen atoms, 1 atomic mass unit (amu) is 1/16 the weight of the oxygen atom, and is equal to 1.6604×10^{-27} kg. The weights in the table are expressed in amu.

Species	μ	**Sea Level** [%]	**200 km** [%]	**300 km** [%]	**800 km** [%]
N_2	28	79	30	18	0.01
O_2	32	20	34	1.3	–
O	16	–	36	80	24
Ar	40	1	0.03	0.01	–
He	2	–	0.05	0.53	61
H	1	–	–	0.03	14
O^+	16	–	–	0.08	–
C	12	–	–	–	–
Xe	131	–	–	–	–

(a) What is scale height? [5]

(b) What is the average mean molecular weight of the Earth's atmosphere at sea level and at 800 km altitude, and how will this affect the scale height of the atmosphere at 800 km (*i.e.* will the scale height be larger or smaller). [5]

(c) What could affect the scale height of Earth's atmosphere on (*i*) long time scales and (*ii*) short time scales and why is this important for satellites, space telescope and any space stations in orbit? [5]

4. Listed below are several types of human hazards in space:

(1) micrometeorite impact	(2) meteor impact (few kg)
(3) galactic cosmic ray	(4) solar UV
(5) solar flare events	(6) high energy solar x-rays and γ-rays from quiet sun

   (a) Which of the above hazards need not be shielded against for an EVA from the space shuttle to retrieve a satellite for repair? [2] _____

   (b) Which of the above hazards are the least predictable? [2] _____

   (c) Which of the above are the most hazardous? [2] _____

   (d) Which of the above hazards won't be as great a concern for the shuttle in LEO as compared to a space station in GEO? [2] _____

   (e) Which of the above can be shielded from with a thin thickness of metal, such as the films found in space suits? [2] _____

5. How does the Earth's atmosphere shield us from hazards in space? [5]

6. While working in one of the science labs on the space colony under construction there is an accident in which a mixtures of CO_2 and xenon (Xe) gas leaks into your compartment replacing 75% of the room's atmosphere with these gases. The door jams and you have no life support system (these gases are not breathable).

   (a) What is your best chance at survival until help arrives (*i.e.* what can you do?). Hint, use the table in Question 3 to get the molecular weights of various gases we have discussed in class which might be present on a space station. Also, colonies are large structures which unlike space stations are designed for long-term habitation, and artificial gravity is created. [5]

   (b) Would this be a more or less dangerous situation on the space station and why? [5]

(c) List 5 major basic resources we are going to need when we begin to inhabit space long-term, and discuss where the best sources for these resources would be. Consider both the feasibility of acquiring the resources and the economics. [10]

(d) We have discussed in class that we need shielding when we are in space. List the hazards from which we need shielding in space, and note which are the most dangerous, and will require the most significant shielding. [5]