ASSIGNMENT 3. Astronomy 101. Nov. 2006

Available: Wed. Nov 1, 2006. Due : Wed. Nov 8, 2006 * by 5PM * in _your_ lab slot, Hennings 312.
Late Penalty: -30% if in slot by 5 PM Thursday Nov 9, -50% by 5 PM Frid. Nov. 10th. FINAL DEADLINE.

Format: Normal lined 8.5x11" paper with pages STAPLED together if >1 page. Name and Student ID# on 1st page
Grading: Only 1 question of 3 will be graded, determined randomly.

Q1. If a perfect one square-meter detector in low-Earth orbit is pointed at the Sun (that is, the plane of the detector is perpendicular to the Earth-Sun line) it will absorb 1.37 kW of power. This is called the Solar Constant; note that it is per square meter, and per second!
(a) Compute the total power flowing away from the Sun through a sphere of 1 AU radius. (In fact, this same amount of energy passes each second through a sphere of ANY radius centered on the Sun).
(b) The Sun's radius is 6.95x10^8 meters, calculate the flux (J/sec/square meter) coming from its surface. Then compute the surface temperature assuming the Sun is a perfect blackbody. Show your work clearly.
(c) Neptune is 30 times further from the Sun than the Earth. What is the energy flux (per square meter of detector) at Neptune? Look up Neptune's and Earth's radii (to two significant figures) and compute the ratio of the energy *absorbed* by each planet assuming they absorb *all* the incident solar energy.

Q2. Terrestrial ages of meteorites. The time that meteorite falls found in Antarctica have been on the Earth can be measured by isotopic analysis of the meteorites. Once the meteorites is on the Earth, they are protected by our atmosphere from galactic cosmic rays (energetic particles coming into our Solar System from the galaxy). However, while the meteoroid was in space, during the voyage to Earth after the collision which knocked it out of its parent body, these cosmic rays enter the rock and create the element chlorine 36 (Z=17, A=36), which is an element normally absent from rocks; this element does not escape, but it is radioactive and decays with a half-life of 310,000 yr (2 significant figures). While in space the cosmic-ray bombardment is so intense that the rock quickly reaches 'saturation', by which one means that every kg of meteorite will have enough Cl-36 atoms that 24 disintigrations per minute (dpm) will occur (and can be detected by radiation detectors called Geiger counters). That is, while in space the rate at which the Cl-36 atoms decay is equal to the rate at which they are created by the bombarding cosmic rays.

Once on Earth the production of new Cl-36 atoms stops and those chlorine atoms that are present begin to decay away with their typical half-life. For the 3 ordinary chondrite meteorites below, calculate how long ago the meteorite fell to Earth (called the 'terrestrial age'). Explain your reasoning in 2-3 sentences.

Meteorite	Measured Activity	
ALH 77231	6.0 dpm/kg	
ALH 78154	3.0 dpm/kg	
PCA 82500	12. dpm/kg	
Y 790724	17.3 dpm/kg	(You will need to remember logarithms for this last one).

Q3. Text problem 55 from Chapter 9 of your textbook (4th edition!).