HW 5 Key

A) Short answer (30 pts)

1. Valle Marineris is a Tectonic / Volcanic feature.
2. Although there is a tiny amount of fresh fluvial erosion, most is old.
3. The polar ice caps have some water, there appears to be a lot of subsurface water, but no surficial water.
4. Olympus Mons has not been seen erupting.
5. The Mercurial solar day (noon to noon) is twice its orbital period; in another words a day there is 176 earth days long. http://btc.montana.edu/MESSENGER/Interactives/ANIMATIONS/Day_On_Mercury/day_on_mercury_full.htm.
6. The Mercurial sidereal day (one spin about it's axis or rotation) is 2/3 of its orbital period or about 58.7 days.
7. Mercury is in a 3:2 resonance; 3 spins = 2 orbits.
8. Comets are primitive bodies that contain ices and dusty material thought to be left over from the original solar nebula or perhaps even from the older interstellar material. Chondrites are from undifferentiated asteroids that formed by accretion after the origin of the solar system. Irons are from differentiated asteroids.
9. It's much easier to find meteorites in Antarctica because there are no plants or soil to obscure them, and as the snow and ice move around buried meteorites may become surficial.
10. The north is largely a basin, and the south a highland.

B) Essay questions

1. Martian Ice Caps (30 pts)

A) At night the ***air*** temperature at both poles get down to at least -130 C, which is cold enough to freeze CO_2. During the summer day, the southern polar air temperature can rise to about 0C, but the northern polar air temperature only rises to about -20 C. Thus there is a substantial asymmetry between the daytime air temperatures with the northern summer being cooler. The polar ***ice*** temperature has the opposite asymmetry. The summer ice temperature of the north cap (-70 C) is warmer than the south cap (-125 C) presumably because the north cap has more dust, is darker, and hence absorbs more sunlight. The northern summer ice temperature is warm enough that water ice remains frozen, but the CO_2 sublimes creating a large asymmetry in the composition of the ice caps.

B) According to a phase diagram on web site at the U of Wisconsin, http://scifun.chem.wisc.edu/chemweek/CO2/CO2.html, at a pressure of about 0.006 bar or 600 Pa, CO_2 freezes at about -125C. Water is, as always, more

interesting and its particularly interesting to note that (http://science.nasa.gov/headlines/y2000/ast29jun_1m.htm) a water triple point exists right at 600 Pa and 0C. On days when the Martian atmospheric pressure is a little lower than average, there can be no liquid water at any temperature, but on a warm day, there can be liquid water if the air pressure is slightly higher than normal. As pointed out in a side bar on the NASA web page, this might be more than a coincidence because the presence of liquid water would allow the formation of carbonate minerals, dropping the atmospheric pressure below the triple point and that would preclude liquid water.

C) The northern ice cap does get to warm for carbon dioxide to stay frozen, but the southern cap is always could enough to trap CO2

D) South is warmer.

E) The north polar cap is larger as expected.

F) The north cap is more dusty and absorbs more solar radiation which warms it enough that the CO2 sublimes.

2. Compare Terrestrial and Martial volcano size (8 pts)

Martian volcanoes can be larger because the force of gravity is less there, and there is no plate tectonics all and larger flows occur because the volcano erupts for a much longer time.

3. Compare Terrestrial and Martial seasons (8 pts)

The terrestrial seasons are very symmetric in north and south both in temperature and duration (+/- a few degrees). Martian seasons are anti-symmetric in duration and exaggerated by the large eccentricity of the Martian orbit.

4. Orbital debris (8 pts)

A) Man made objects in space that no longer serve a useful purpose. Rocks are not orbital debris.

B) Depends on the orbit, but typically 7 or 8 km/s.

C) A fast bullet has a muzzle velocity of about 2 km/s, quickly slows to the speed of sound 1 km/s. Space debris is moving much faster.

D) They damage useful objects in space.

5. http://marsrovers.jpl.nasa.gov/mission/traverse_maps.html Mars Rover Sprit is at "Home Plate" about 4 km SE of its landing site in Gusev Crater (175.5°E 14.6°S). Opportunity is driving around on the edge of Victoria Crater (5.5°W 2.0S) looking for a place to descend into the crater.

6. Neither have surface water or vegetation. Both have substantial Aeolian erosion.