Astronomy I - The Solar System (Astr 1010)
Spring 2015
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REVIEW FOR SECOND EXAM

1. Solar System

   - Planet names, order, basic properties (which are Terrestrial and Jovians, biggest/smallest, etc)
   - Know about space exploration, in terms of the lowest energy transfer orbit (Hohmann orbits); know how to use Kepler's third law to find the travel time from one planet to another
   - Planetary astronomy:
     - atmospheric escape/retention - competition between thermal speed and escape speed, with a dependence on mass of gas particle; this composition helps to explain why some worlds have atmospheres, why some don't, and helps to understand the differing compositions of atmospheres that are kept
     - isothermal atmosphere - new what "isothermal means", know that scale height represents the vertical extent of an atmosphere; know the scale height for Earth is 8 km
     - temperatures of planets - concept of albedo, cooler when farther away, dependence on solar temperature and size
     - relation between density and composition: know rough values for ice, rock, and iron (1000, 3500, and 8000 kg per cubic meter)
     - know about planetary magnetic fields in relation to the dynamo mechanism: circulating conducting fluid is necessary to sustain a planetary magnetic field

2. *Sun*

   - be familiar with general properties of the Sun
   - interior – fusion, p-p chain (conversion of hydrogen into helium), neutrinos, the neutrino problem and resolution, know how long the Sun can live (10^{10} years); know how long it takes energy made in the core to leak out to the photosphere
   - atmosphere – photosphere, chromosphere, corona, sunspots, solar flares; know that light made in the core takes a couple 100,000 years to get from the core to the surface; know that photosphere is what we see in the visible, corona is over a million degrees and emits X-rays, chromosphere is inbetween these two layers
   - the solar cycle – the periods are 11 years for sunspots and 22 years for magnetic reversal, know about the Babcock model
   - be familiar with the concepts of the solar wind and mass loss from the Sun

3. The Earth

   - has a dipole magnetic field, nearly lined up with rotation axis; know about the van Allen belts
   - atmosphere - know about the destruction of the ozone layer, concept of greenhouse effect; know about the concept of climate change and global warming ideas; know the value of the atmospheric scale height (8 km)
   - interior - know components of core, mantle, and crust
   - weather - know about Hadley cells and the Coriolis force mechanism for circulation
   - erosion, volcanism as resurfacing

- plate tectonics - know about earthquakes and their use for studying the Earth interior (seismology)

4. The Moon
   - phases - know their names, understand the viewing geometry, be able to relate time of day with Moon position in sky and lunar phase
   - eclipses - know about solar and lunar eclipses, why and how they occur
   - surface - know about mare, terrae, impact basins
   - craters - impacts and the idea of relative dating
   - interior - Moon is iron poor, lacks a magnetic field
   - know about the tidal force, tidal locking, synchronous oribt and rotation of the Moon
   - origin of the Moon - know the major models, their strengths and weaknesses
   - colonization of the Moon - know about the issues (water, air, lower gravity, radiation)
5. Mercury – interior (large iron core), lack of atmosphere, orbital properties, orbital-rotational resonance
6. Venus – thick CO_2 rich atmosphere, strong Greenhouse effect, volcanism and resurfacing, comparisons to Earth, retrograde rotation, very slow rotation, lack of magnetic field
7. Mars – slight magnetic field, thin CO_2 atmosphere, evidence for past water at Mars and for subsurface frozen water ice, evidence for and against past life at Mars (Lowell and "canali"), comparisons of Mars with Earth
8. Comparative Planetology –
   - Why do Mars and Venus have CO_2 atmospheres but Earth does not? Where is the CO_2 on Earth?
   - Why does Earth have an oxygen-rich atmosphere?
   - Why does Venus lack oceans?

EQUATIONS

- Kepler's third law relating period P to semi-major axis a

$$P^2 = a^3$$

- The average density ρ for a spherical body of mass M and radius R is given by

$$\rho = \frac{3M}{4\pi R^3}$$

- The escape speed from its surface is then

$$v_{\rm esc} = \sqrt{\frac{2GM}{R}}$$

- The average thermal speed of particles in a gas with temperature T and mass m is

$$v_{\rm th} = \sqrt{\frac{3kT}{m}}$$

- If heated entirely by sunlight (with the Sun having temperature $T_\odot$ and radius $R_\odot$), the expected temperature T_p of a planet with orbital distance d_p and albedo A_p will be

$$T_p = T_\odot \sqrt{\frac{R_\odot}{2d_p}} \sqrt[4]{1 - A_p}$$