ASTR 220 Spring 2017
Learning Goals for Midterm 1 & Equation List

Learning Goals

- Overall
  - The student should be able to define the astronomical terms introduced and be able to use them appropriately.
- Lecture 2: The student should be able to...
  - ...place the major solar system bodies in correct locations relative to each other.
  - ...discuss the relative spacing of the major bodies compared to their sizes.
  - ...discuss defining characteristics of terrestrial planets, jovian planets, and asteroids.
  - ...describe major characteristics and sizes/distances of the Milky Way and Local Group
- Lecture 3: The student should be able to...
  - ...calculate the gravitational force on an object given a word problem with relevant physical characteristics and distances.
  - ...compare gravitational forces on objects with proportional reasoning.
  - ...understand which physical characteristics affect the gravitational force on an object, and which do not.
  - ...understand that the strength of the gravitational force between two objects decreases with the square of the distance between the objects.
  - ...understand that the strength of the gravitational force between two objects is the same on each object, but is exerted in opposite directions.
  - ...explain what inertia is, for both a moving object and an object at rest.
- Lecture 4: The student should be able to...
  - ...explain the competing physical effects that cause an object to remain in a stable orbit.
  - ...compare circular orbital speeds using proportional reasoning.
  - ...explain and/or predict the relative speed of an object on an elliptical orbit, given its location on the orbit.
  - ...understand conceptually how knowing an asteroid's average orbital velocity means that we also know its average distance from the Sun.
  - ...compare orbital periods using proportional reasoning.
- Lecture 5: The student should be able to...
  - ...compare kinetic energies of objects using proportional reasoning.
  - ...explain why an increase or decrease in an object's orbital energy causes its orbit to get larger or smaller.

  - ...explain how a gravitational encounter causes the orbit of an object to change.

- Lecture 6: The student should be able to...
  - ...list the major components of a spacecraft and what they do.
  - ...discuss how a spacecraft is launched.
  - ...discuss why a spacecraft takes a particular path to reach an object, and why that path is not a straight line.

- Lecture 7: The student should be able to...
  - ...list chronologically and discuss the major stages of solar system formation.
  - ...explain how the formation process caused the following key characteristics of the solar system to develop: the planets orbit the Sun in the same direction and in the same plane; there are two types of planets (terrestrial and jovian); and the existence of asteroids and comets.
  - ...explain the significance of the frost line in the solar system's formation.
  - ...interpret graphs relating the formation temperatures of the planets, the condensation temperatures of materials, and the frost line.
  - ...discuss where asteroids and comets originally formed within the solar system and how and why their orbits and numbers were affected by the Heavy Bombardment.

- Lecture 8: The student should be able to...
  - ...understand the proportionality or inverse proportionality between the characteristics of wavelength, frequency, and radiative energy for light waves.
  - ...compare two light waves' wavelengths, frequencies, or energies using proportional reasoning.
  - ...understand how invisible types of light (such as infrared) relate to visible light in terms of wavelength, frequency, and energy.
  - ...explain why a telescope may not be able to resolve a distant object's shape.
  - ...calculate the diameter of an object that the Hubble Space Telescope can resolve at a given distance.
  - ...use the calculation from the previous learning outcome as a criterion to decide if a particular object will be resolvable by the HST and explain why.

- Lecture 9: The student should be able to...
  - ...discuss why taking an image of an asteroid is the best way to determine its shape and size and why astronomers don't use this method exclusively.
  - ...explain how and why an object gets dimmer with the square of the distance from it.
  - ...compare the brightnesses of objects using proportional reasoning.
  - ...discuss how an asteroid's albedo affects its brightness.
  - ...calculate the apparent brightness of the sunlight hitting an asteroid.
  - ...calculate the cross-section area of an asteroid based on its apparent brightness and albedo.
  - ...calculate the radius of an asteroid based on its cross-section area.
  - ...discuss each of the terms in the cross-section area equation and explain how and why each term physically affects the cross-section area calculation.

- Lecture 10: The student should be able to...
  - ...discuss what an asteroid lightcurve is.
  - ...discuss which physical characteristics may be able to be determined from an asteroid's lightcurve and how.
  - ...discuss what occultations are, how they are observed fro asteroids, which physical characteristics may be determined, and what the limitations of occultation observations are.
  - ...discuss what radar is, how it is used on asteroids, which physical characteristics may be determined, and what the limitations of radar use are.

Equations

$$F = \frac{GM_1M_2}{d^2}$$

$$v_{ave} = \sqrt{\frac{GM_r}{r_{ave}}}$$

$$P = \frac{2\pi r_{ave}}{v_{ave}}$$

$$E_k = \frac{1}{2}mv^2$$

$$c = \lambda f$$

$$L = 2.4 \times 10^{-7} d$$

$$I = \frac{L}{4\pi d^2_{Sun-asteroid}}$$

$$\sigma = \frac{4\pi d^2_{Earth-asteroid} b}{IA}$$

$$R = \sqrt{\frac{\sigma}{\pi}}$$