Unit 9: Gravity

Text:
Chapter 13.

Problems (p. 351-8)
#1: 3, 7, 8, 13, 17, 23, 24 (*Universal Gravitation*)
#2: 30, 32, 34, 36, 37 (*Energy*)
#3: 51, 52, 54, 63, 65, 68, 90 (*Orbits*)

Vocabulary:
G, escape speed, tides, Universal Law of Gravitation, black hole, central force

Math:
definitions: $F = G\frac{m_1 m_2}{r^2}$ $G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

derived formulas: $T^2 = \left(\frac{4\pi^2}{GM}\right)R^3$ $v_e = \sqrt{\frac{2GM}{r}}$ $U = -\frac{Gm_1 m_2}{r}$

$E = -\frac{GMm}{2R}$

skills: no new math skills needed

Other Information:

$M_{earth} = 6 \times 10^{24}$ kg	$R_{earth} = 6.4 \times 10^6$ m	
$M_{sun} = 2 \times 10^{30}$ kg	$R_{sun} = 7 \times 10^8$ m	$D_{earth\text{-}sun} = 1.5 \times 10^{11}$ m
$M_{moon} = 7.35 \times 10^{22}$ kg	$R_{moon} = 1.8 \times 10^6$ m	$D_{earth\text{-}moon} = 3.8 \times 10^8$ m

Key Objectives:
- ☐ derive/prove Kepler's Third Law for the special case of circular orbits.
- ☐ derive/prove Kepler's Second Law for any central force
- ☐ explain what is meant by the term "escape speed" and be able to derive/use the equation given above.
- ☐ do calculations involving Newton's Universal Theory of Gravitation.
- ☐ do calculations involving work, kinetic and potential energy using the equations above.
- ☐ do calculations involving orbital parameters and energies for orbiting systems.
- ☐ in general, be able to use and explain the vocabulary listed above.
- ☐ in general, be able to do calculations similar to the worksheet/homework done in class
- ☐ be able to derive/explain what happens to the force of gravity as you dig a hole to the center of a planet.
- ☐ be able to derive/calculate the time to fall through a hole through the center of the earth.
- ☐ be able to explain what you would feel gravitationally if you were inside and outside a hollow sphere.
- ☐ explain the source of tides.