PHYS 111
HOMEWORK #1

Due : 1 Sept. 2016

Homework must be submitted in class on its due date. We will go over these in discussion; no homework can be accepted for a grade once solutions have been posted publicly to the course website. Read the syllabus carefully and make sure you are following the proper format for submitting homework. All problems must show clear and complete work.

This homework assignment is designed to introduce you (or perhaps re-introduce you) to some of the reasoning used in physics, and also to help you review important mathematics for the course.

1. Appendix E at the back of your text provides the astronomical information you will need. Mass density is defined as mass/volume (the volume of a sphere is 4/3 πR^3).

a) Determine the density of the Earth and the sun in $\mathrm{kg} \big/ m^3$

b) Imagine a star having the same mass as the sun but a radius 100 times larger than the sun' s. What is the density of this star?

2. The magnitude of centripetal acceleration experienced by an object in circular motion is given by v^2/r where v is the speed and r the radius of the circle. If an object doubles it speed while traveling along the same arc, by what factor does the centripetal acceleration change?

3. The surface gravity on a planet is proportional to $M \big/ R^2$ where M is the mass of the planet and R is the radius. Consider a planet 100 times as massive as the Earth with a radius 10 times the radius of the Earth. How does the surface gravity on the hypothetical planet compare to the surface gravity on Earth? How does the density of this planet compare to the density of the Earth? (Which planet in the solar system most closely approximates this hypothetical planet?)

4. If a ball is thrown vertically down from an initial height of H with an initial speed of v, its height above the ground , h, is given by:

$$h = H - v\,t - \frac{1}{2}g\,t^2$$

where g is the acceleration of gravity (9.8 m s^{-2}) and t is the time elapsed after the ball is released. If a ball is thrown down with an initial speed of 8m/s from a height of 100m, how long will it take for the ball to reach the ground?

5. Solve the following equation for x :

$$x^{2/5} - 3\,x^{1/5} + 2 = 0$$

(Do not use calculator or computer algorithms to solve this)

6. Draw a right triangle with sides a and b and hypotenuse c. Use the Pythagorean theorem to show that $\sin^2\theta + \cos^2\theta = 1$.

7. Consider a triangle with sides 10, 12, and 19. What is the angle opposite the longest side? What is the angle of the longest side of the sides' lengths are 10, 12 and 24? (If you are puzzled by your answer to this part, think about why you might be getting an odd answer)

8. Kepler' s Third Law of planetary motion relates the orbital period of a planet (P) to the mass of the sun (M), the distance of the planet from the sun (d), and a constant of nature (G). Kepler' s Third Law is usually written as :

$$M\,P^2 = \frac{4\,\pi^2}{G}\,d^3$$

Solve this equation for d. (Meaning rewrite the equation so that d appears alone on one side).

9. Rewrite equation 11.17 on p. 333 of the text in terms of x.

10. In question 4 you solved a quadratic equation, and as you know, there are two solutions to a quadratic equation. The physically meaningful answer gave you a positive value of time; but you should have also found a negative value of time. What is the meaning of the negative answer? In other words, what trajectory would give rise to that result?