HW 2
Due October 12, 2007

Please answer all questions clearly and concisely. While you need not transcribe the question completely, it should be clear from your answer alone what you are talking about.

You are strongly encouraged to discuss the homework with your classmates, but you must complete the written homework by yourself, and of course, the material you submit must be your own.

Remember, show all of your work!

1. To give you the idea of the level of (qualitative) knowledge I expect you to have gotten from our discussion of fundamental forces and particles, please answer the following short questions:

   (a) List the 4 fundamental forces in order of strength

   (b) What is the atomic mass (A) and number (Z) of the most common isotope of Carbon? How many up quarks does it contain? You may consult a periodic table.

   (c) What is the charge number (Q), Baryon number, (B), and lepton number (L) of the following:

       i. e (electron)
       ii. p (proton)
       iii. e^+ (positron)
       iv. γ (photon)
       v. $\bar{\nu}$ (anti-neutrino)
       vi. He (Helium nucleus)

   (d) When we think of "contact forces" to which force are we generally referring?

2. Near the surface of the earth, the acceleration due to gravity is constant: $\vec{a}_g = -g\hat{j}$ (assuming non-relativistic speeds).

   Recall that with a constant force, a projectile which starts from position $\vec{r}_0$, and with velocity $\vec{v}_0$, will have a velocity of:
   $$\vec{v}(t) = \vec{v}_0 + \vec{a}t \tag{1}$$

   and be at a position of:
   $$\vec{r}(t) = \vec{r}_0 + \vec{v}_0 t + \frac{1}{2}\vec{a}t^2 \tag{2}$$

   You throw a ball from the origin at time t=0. It has a velocity of $\vec{v}_0 = 20 \ m/s \ \hat{i} + 10 \ m/s \ \hat{j}$.

   (a) What is the height of the ball after 1 second?

   (b) What is the *speed* of the ball after 1 second?

   (c) What is the (vector) momentum of the ball after 1 second?

   (d) At what time does the ball hit the ground?

3. A small asteroid is in circular orbit around a central star of mass $4 \ times 10^{30} \ kg$ at a distance of $10^{12} \ m$.

(a) What is the gravitational acceleration on the asteroid?

(b) What is the speed of the asteroid?

(c) What is the period of the asteroid's orbit (how long will it take to traverse the distance all the way around the star)?

(d) Express this period in years.

4. 2.P.26

5. 2.P.32

6. 2.P.38

7. 3.P.34

8. 3.HW.37