PHYSICS 6 **SPRING 2006**

HOMEWORK 2 SOLUTIONS

1. **A hockey puck is hit and travels at a velocity of 90 Km/hr toward the goal, 60 m away. How long will it take to reach the goal?**
   time=distance/speed=60m/($90x10^3$m/hr)=$6.67x10^{-4}$ hr
   =$6.67x10^{-4}$ hr x 3600 sec/hr = 2.4 sec

2. **A spy satellite travels around the earth in a low orbit every 90 minutes. What is the speed of the satellite?**
   Circumference of earth =24,000 miles = 38,000 Km
   90 min=1.5 hr
   Speed = 24,000 mi /1.5 hr = 16,000 mph = 26,000 Km/hr
   or 4.4 miles/sec = 7.0 Km/sec
   Is it accelerating? Yes, since its direction is changing continually.

3. **A ball is dropped straight down from the top of a building. The ball hits the ground in 5 sec.**
   a. **How tall is the tower?**
      Distance fallen = (1/2)gt^2 = (1/2) (9.8 m/sec^2) (5 sec)^2
      = 4.9 x 25 m = 120 m
   b. **If the ball is thrown from the tower horizontally at 10 m/s, how long does it take to reach the ground?**
      Same 5 sec.
   c. **In the latter case, how far from the tower does the ball land?**
      Distance horizontal is independent of vertical motion, so
      d horizontal =10 m/s x 5 s = 50 m

4. **The same ball that is dropped straight down from the top of a tower (and hits the ground in 5 sec) is viewed from a small plane going by horizontally at 100 Km/hr. How far back does the ball hit the ground, in the plane's frame of reference?**
   In 5 sec the plane advances 5 sec x $100x10^3$ m/3600 s
   = 140 m

5. **An astronaut is in a spaceship zooming by the earth at 0.95 c (where c=$3.0x10^8$m/s).**
   a. **In one second of the astronaut's life, how much time elapses on the earth?**
      Earth sees astronaut's clock running slow, via

$$t_{earth} = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}} = \frac{1\ \text{sec}}{\sqrt{1-0.9025}} = \frac{1}{\sqrt{0.0975}} = \frac{1}{0.312} = 3.2\ \text{sec}$$

b. What would the diameter of the earth measure according to the astronaut (consider the diameter that is parallel to the direction of motion of the spaceship)?

From astronaut's frame, lengths that move are contracted, so diameter is shortened by same square root as in (a), but in the numerator, astronaut's diameter of earth = 0.312 x 8000 mile
= 2500 mi

c. What about the measurement of the diameter that is perpendicular to the motion of the spaceship?

Lengths that are perpendicular to direction of motion are unchanged, so remain 8000 miles.