

# PHYSICS 1030

## Homework #2

(Due Sept. 13, 2017)

1. The position  $x$  of a particle at time  $t$  is given by

$$x(t) = 10t^3 + 6t^2 - 12t + 8 \quad \text{meters}$$

where  $t$  is in seconds. Find (a) the particle's velocity at  $t = 3.0$  sec; (b) the particle's acceleration at time  $t = 3.0$  sec. (c) What must be the units of the 6 (the  $t^2$  coefficient) in the above equation?

2. Mary bikes from her home to her office at a constant speed of 20 km/hr, and she bikes back home at a constant speed of 40 km/hr. What is the average speed of her ride? (Take this to mean the *total* distance traveled (twice the distance from her home to her office) divided by the total time.)

3. Elmo bikes from his home to his office (starting from rest) at a constant acceleration of  $30 \text{ km/hr}^2$  for one hour; he then bikes back home from his office (starting from rest) at a constant acceleration of  $60 \text{ km/hr}^2$ . What is the average speed of his ride? (Take this to mean the *total* distance traveled (twice the distance from his home to his office) divided by the total time.)

4. Jules Verne in 1865 suggested sending people to the Moon by firing a space capsule from a 220-m-long cannon with a launch speed of 10.97 km/s. What would have been the unrealistically large acceleration experienced by the space travelers during launch? Compare your answer with the free-fall acceleration  $9.80 \text{ m/s}^2$ .

5. (Serway 2-50) The height of a helicopter above the ground is given by  $h = 3.00t^3$ , where  $h$  is in meters and  $t$  is in seconds. At  $t = 2.00$  s, the helicopter releases a small mailbag. How long after its release does the mailbag reach the ground?

**6.** (Serway 2-59) The speed of a bullet as it travels down the barrel of a rifle toward the opening is given by

$$v = (-5.00 \times 10^7)t^2 + (3.00 \times 10^5)t$$

where  $v$  is in meters per second and  $t$  is in seconds. The acceleration of the bullet just as it leaves the barrel is zero. (a) Determine the acceleration and position of the bullet as functions of time when the bullet is in the barrel. (b) Determine the time interval over which the bullet is accelerated. (c) Find the speed at which the bullet leaves the barrel. (d) What is the length of the barrel?

**7.** A ball is shot straight up from the ground. After 6 seconds, the ball is at the same height as it was after 4 seconds. What was the initial velocity?

**8.** Alice travels twice the speed of Bob and three times the speed of Carly. How many minutes will it take Carly to cover the distance Bob covers in in 36 minutes?