1D Kinematics

1. Single step problems

   (a) A snowmobile on a frozen pond is moving at 15.0 m/s when the driver decides to pass a slow-moving sled. If the driver accelerates to a speed of 19.5 m/s in a time of 4.00 s, what was the acceleration?

   (b) What distance will be covered by the snowmobile in the time that it takes to accelerate? Use the values from part (a).

   (c) A wagon is initially rolling UP a hill at a velocity of 4.6 m/s. The wagon accelerates down the hill at 0.64 m/s^2 until its final velocity is 2.3 m/s DOWN the hill. Calculate the displacement from the initial position.

   (d) Your friend is on a quad is moving at 14.0 m/s when you breeze by on your bike. Your friend accelerates at 2.0 m/s^2 for 3.0 seconds. How far does she travel during this time?

   (e) An oil tanker, initially traveling *west* at 18 km/h is accelerated uniformly until it is traveling *east* at 21.6 km/h. The acceleration is 0.20 m/s^2 towards the *east*. Compute the total *displacement* from the tanker's initial position.

   (f) A corvette can accelerate during high speeds at about 2.0 m/s^2. At this rate how long does it take the car to accelerate from 80 km/h to 160 km/h?

   (g) A snowmobile with an initial speed of 5.6 m/s travels 24.0 m in 2.0 s. What final speed does it attain? Express your answer first in m/s and then in km/hr.

   (h) A motorcycle with an initial speed of 2.2 m/s accelerates at 3.6 m/s^2 and covers a distance of 12.0 m. What is its final speed?

   (i) A hockey puck initially travelling to the right at 34 m/s is slowed down by rough ice at a rate of 2.0 m/s/s. It moves for 7.2 s before finally coming to rest. How far did it travel?

2. A car moves at 12 m/s for 30.0 seconds. It then accelerates at 1.5 m/s^2 for 8.00 seconds. Finally, it continues on at this top speed for another 12.0 seconds. Calculate the net displacement during the whole time interval.

3. A police cruiser is travelling at 20.0 m/s when the officer spies a speeder. The cruiser accelerates at 3.0 m/s^2 for 5.0 seconds, at which time the speeder pulls over and starts thinking up excuses to try and get out of getting a ticket. The cruiser then slows to a stop at 5.0 m/s^2. How far does it go in the entire time?

4. A sprinter who is running a 250 m race accelerates from rest at 7.5 m/s^2 for 1.2 s and maintains this speed for the remainder of the race. What is her time for the race?

5. Superman is flying at an initial velocity of 33.5 m/s north when he decides to slow to 10.0 m/s north in a time of 8.05 s. He then continues at this velocity for 12.4 s before accelerating at 2.35 m/s^2 north until he reaches a final velocity of 23.8 m/s north.
   (a) Calculate Superman's displacement in this time. (Hint: This motion has three unique parts)
   (b) Calculate Superman's average velocity for his entire flight.

6. A model rocket blasts off with a constant acceleration of 12.3 m/s^2 until its runs out of fuel 10.2 s later. It then enters free fall for the remainder of its flight.
   (a) Calculate the maximum height above the ground reached by the model rocket.
   (b) Calculate the total time the rocket is in the air. (Careful: There are two different accelerations on the way up, but only one on the way down. This creates three parts to the motion.)

7. A rocket sled accelerates from rest for a distance of 645 m at 16.0 m/s^2. A parachute is then used to slow it down to a stop. If the parachute gives the sled an acceleration of -18.2 m/s^2 and there is 500.0 m of sled track remaining after the shoot opens, will the sled stop before running off the track? Show why or why not?

8. On a 150 m straight sprint, a cyclist accelerates from rest for 4.5 s at 3.8 m/s^2. How long will it take her to complete the 150 m track, assuming she maintains her speed for the remaining part of the track?

9. A ski-doo moving at 12 m/s west accelerates at 6.0 m/s^2 west. How long will it take to experience a displacement of 63 m west?

10. Two cars accelerated uniformly from a stationary start on a straight racing track, Car A at 2.5 m/s^2, and Car B at 2.0 m/s^2.
    (a) At what time where the cars separated by 25 m?
    (b) What was the speed of car A at the instant that the speed of car B was 14 m/s?

11. A police car stopped at a set of lights has a speeder pass it at 100.0 km/h. If the police car can accelerate at 3.6 m/s^2,
    (a) how long does it take to catch the speeder?
    (b) how far would the police car have to go before it catches the speeder?
    (c) what would be its speed when it caught up with the speeder? Is this speed reasonable?