Motion Problems

Read from **Lesson 6** of the **1-D Kinematics** chapter at **The Physics Classroom**:

http://www.physicsclassroom.com/Class/1DKin/U1L6a.html
http://www.physicsclassroom.com/Class/1DKin/U1L6b.html
http://www.physicsclassroom.com/Class/1DKin/U1L6c.html
http://www.physicsclassroom.com/Class/1DKin/U1L6d.html

Show your work on the following problems.

1. An airplane accelerates down a run-way at 3.20 m/s^2 for 32.8 s until is finally lifts off the ground. Determine the distance traveled before take-off.

2. A race car accelerates uniformly from 18.5 m/s to 46.1 m/s in 2.47 seconds. Determine the acceleration of the car and the distance traveled.

3. A feather is dropped on the moon from a height of 1.40 meters. The acceleration of gravity on the moon is 1.67 m/s^2. Determine the time for the feather to fall to the surface of the moon.

4. A bullet leaves a rifle with a muzzle velocity of 521 m/s. While accelerating through the barrel of the rifle, the bullet moves a distance of 0.840 m. Determine the acceleration of the bullet (assume a uniform acceleration).

5. An engineer is designing a runway for an airport. Several planes will use the runway and the engineer must design it so that it is long enough for the largest planes to become airborne before the runway ends. If the largest plane accelerates at 3.30 m/s^2 and has a takeoff speed of 88.0 m/s, then what is the minimum allowed length for the runway?

6. A student drives 4.8-km trip to school and averages a speed of 22.6 m/s. On the return trip home, the student travels with an average speed of 16.8 m/s over the same distance. What is the average speed (in m/s) of the student for the two-way trip? (Be careful.)

7. A tortoise and a hare are having a 1000-meter race. The tortoise runs the race at a constant speed of 2.3 cm/s. The hare moves at an average speed of 1.5 m/s for 10.0 minutes and then decides to take a nap. After waking up from the nap, the hare recognizes that the tortoise is about to cross the finish line and immediately accelerates from rest with a constant acceleration of 0.500 m/s/s for the remaining distance of the race. If the tortoise wins by a hair (no pun intended), then what is the time in hours (accurate to the third decimal place) that the hare napped?

8. A car and a motorcycle at rest and 1000 m apart start towards each other at the same time on a level track. The car accelerates at a uniform rate of 3.70 m/s^2 and the motorcycle accelerates at a uniform rate of 4.40 m/s^2.
   a. At what position will they pass each other relative to the car's starting point?
   b. How fast is each vehicle moving at the instant that they pass?

9. In a race, a car and a motorcycle start from rest at the same time, but the motorcycle is 25.0 m behind the car. The car accelerates at 3.70 m/s^2 and the motorcycle accelerates at 4.40 m/s^2.
   a. If the motorcyle is to win the race, what must be the minimum distance to the finish line?
   b. How fast are both vehicles moving when they are side by side?

10. A two-stage model rocket accelerates at +6.2 m/s/s for 3.8 seconds (first stage) and then at +4.7 m/s/s for 4.2 seconds (second stage).
   a. Determine the height of the rocket at the end of the second stage.
   b. Determine the time required for the rocket to land back on the ground.
   c. Determine the average speed of the rocket during the sixth second (from t =5 s to t =6 s).