W1.04A

Acceleration—Counting problems

Note—all accelerations are uniform

(9-19-05)

1. A car begins at rest and accelerates to a speed of 20 m/s in 5 seconds.
   a. What is its acceleration?
   b. How far does it travel while accelerating?
   c. If its acceleration continued, how long would it take to reach 30 m/s?

2. A bus is seen moving at 30 m/s as the driver applies the brakes and begins to slow down uniformly at -2 m/s/s.
   a. How long would it take to slow to 12 m/s?
   b. How far would the bus travel while slowing to 12 m/s?
   c. How far would the bus travel if the acceleration continued until the bus came to a stop?
   d. Draw an *s vs. t* and a *v vs. t* graph of the motion while the bus slows to rest.

3. A spaceship is moving forward at 100 m/s when it begins to fire its retro rockets (retro rockets push the ship backwards). It continues to fire those rockets until its velocity is 60 m/s in reverse 8 seconds later.
   a. What was the acceleration of the rocket?
   b. How far forward did it travel before coming (instantaneously) to rest?
   c. How far backward did it travel after that?
   d. What is the rocket's average speed during the entire 8 seconds?
   e. Can you see a one-step method of calculating the overall displacement of the rocket? If so, do the calculation.
   f. When the rocket is instantaneously at rest, is its acceleration 0? Why or why not?

4. Annie is running *s vs. t* at a constant speed of 6 m/s when she passes Nick standing on the side of the track. If Nick has a maximum acceleration of 2 m/s/s and a maximum speed of 8 m/s, how long would it take him to catch Annie if she maintains her speed at 6 m/s and Nick starts running immediately when Annie passes? (Try to estimate this answer if you can't calculate it directly—hint: break the problem into segments)

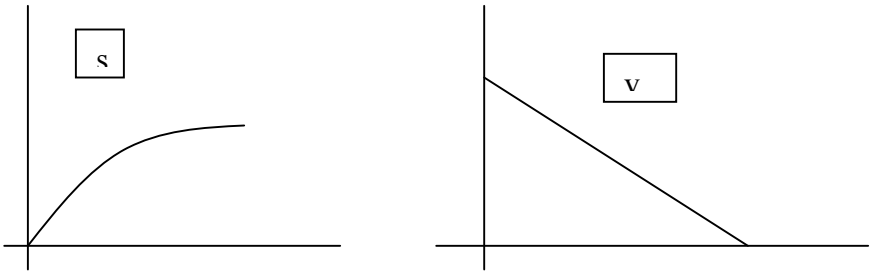
5. Graph the motion in the above problem on a *v vs. t* plot showing both people.

6. Two trains are approaching each other on a single track. When they are 3500 meters (3.5 kilometers) apart, they both apply their brakes trying to avoid a collision. The first train (train A) is traveling at 30 m/s and brakes at 0.25 m/s/s, and the second train (train B) is traveling at 40 m/s and brakes at 0.50 m/s/s. Do the trains collide? Demonstrate (mathematically) why or why not.

W1.04A Acceleration—Counting problems KEY

1. a. 4 m/s/s b. 50 meters c. 7.5 seconds
2. a. 9 seconds b. 189 meters c. 225 meters d.
3. a. –20 m/s/s b. 250 meters c. 90 meters d. +20 m/s e. +160 meters f. no
4. 8 seconds
5.
6. No—they stop 100 meters apart.

2.d.



5.