Physics 20, Fall 2011
Homework Set 2
Due: 5pm Monday, October 10, 2011

Turn homework into the **Phys 20 box on the 2nd floor of Broida Hall,** directly in front of the elevators. (It's labeled with the names of the professor and TA.)

DME 10/03/11

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1. For many months, a well-known high-energy physicist commuted weekly between Boston, Massachusetts and Geneva, Switzerland, the two cities being separated by a distance of 4000 miles. What was the physicist's average speed during this period? Do you need to know the speed of the airplane to solve this problem?

2. The position of a particle moving along the x axis is given in centimeters by $x = 9.75 + 1.50t^3$, where t is in seconds. Consider the time interval $t = 2$ to $t = 3\,\mathrm{s}$ and calculate:

   (a) the average velocity;

   (b) the instantaneous velocity at $t = 2\,\mathrm{s}$;

   (c) the instantaneous velocity at $t = 3\,\mathrm{s}$;

   (d) the instantaneous velocity at $t = 2.5\,\mathrm{s}$;

   (e) the instantaneous velocity when the particle is midway between its positions at $t = 2$ and $t = 3\,\mathrm{s}$. (RHK4 2.13)

3. How far does the runner whose velocity-time graph is shown in Fig. 1 travel in 16 s?

4. What is the acceleration of the runner in Fig 1 at $t = 11\,\mathrm{s}$?

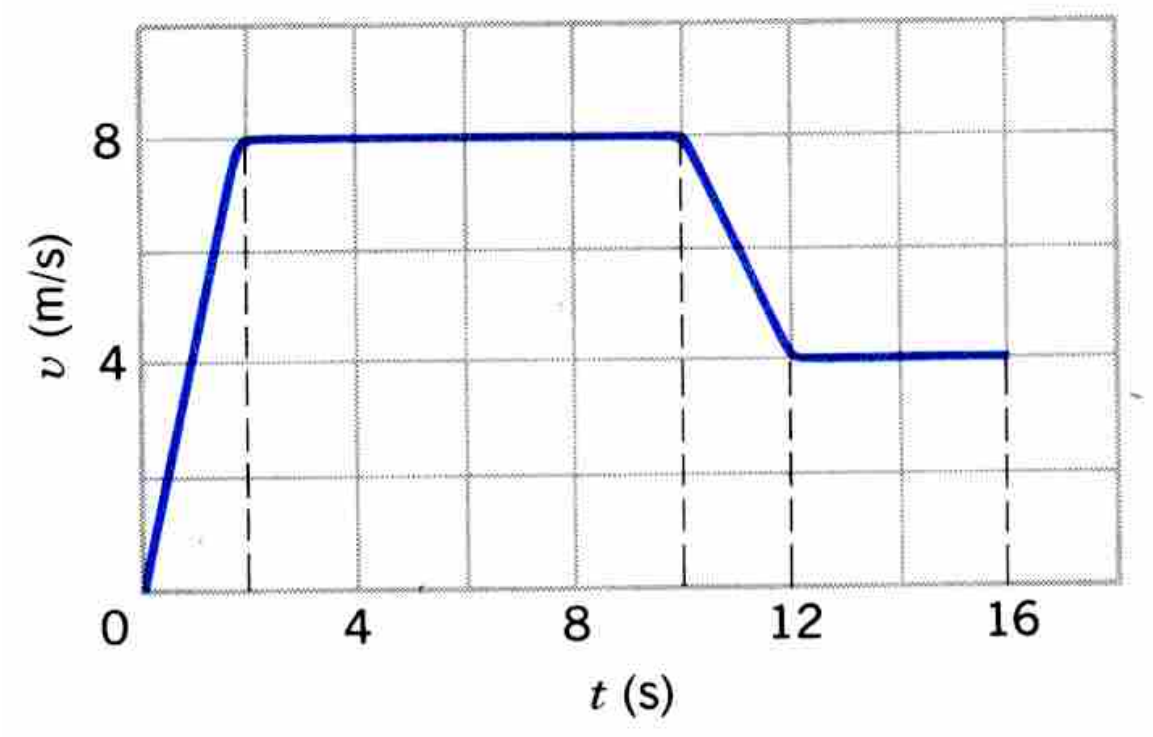

Figure 1: Problems 3 and 4.

5. In a video game, a spot is programmed to move across the screen according to $x = 9.00t - 0.750t^3$, where x is the distance in centimeters measured from the left edge of the screen and t is the time in seconds. When the spot reaches the screen edge, at $x = 0$ or $x = 15\,\text{cm}$, it starts over.

   (a) At what time after starting is the spot instaneously at rest?

   (b) Where does this occur (give the x) ?

   (c) What is the acceleration when this occurs?

   (d) In which direction does it move in the next instant after coming to rest?

   (e) When does it move off the screen?

6. A rocketship in free space moves with constant acceleration equal to $9.8\,\text{m/s}^2$.

   (a) If it starts from rest, how long will it take to acquire a speed one-tenth of the speed of light?

   (b) How far will it travel in so doing?

   The speed of light is $3.0 \times 10^8\,\text{m/s}$.

7. You are called upon to give advice to a lawyer concerning the physics involved in one of their cases. The question is whether a driver was exceeding a 30-mile/hour speed limit before he made an emergency stop, brakes locked and wheels skidding. The length of the skid marks on the road was 19.2 ft. The police officer made the assumption that the maximum deceleration of the car would not exceed the acceleration of a freely falling body (=32 ft/s^2) and did not give the driver a ticket. Was he speeding? Explain.