Part I

1. An object goes from one point in space to another. After it arrives at its destination

   (a) its displacement is the same as its distance traveled.

   (b) its displacement is always greater than its distance traveled.

   (c) its displacement is always smaller than its distance traveled.

   (d) its displacement is never larger than its distance traveled.

   Answer: (d). Displacement is always the distance between the initial position and the final position. The distance depends on the path taken so can be longer but not shorter.

2. An accelerating body must at all times

   (a) have positive velocity.

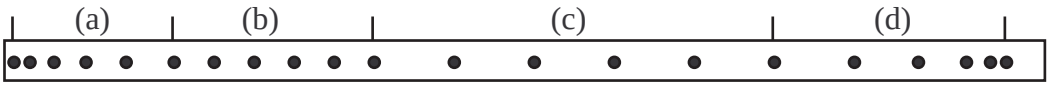
   (b) have an increasing speed.

   (c) have a changing direction.

   (d) have a changing velocity.

   Answer (d). Acceleration means that the velocity is changing. An object can have constant speed and accelerate provided its direction is changing. An accelerating object can have constant direction provided its speed is changing.

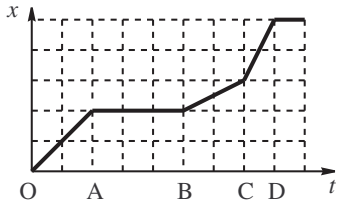
3. The diagram below shows a piece of a ticker tape which passed through a vibrating marker which vibrated at a constant rate of 20 s^{-1}



   Which region shows where the size of the acceleration was greatest?

   Answer (d). The change in velocity is greatest in this interval.

4. The motion of a particle is described by the position-time graph shown below. During which interval is the *instantaneous* velocity of the particle greatest?



   (a) OA (b) AB (c) BC (d) CD

   Answer (d): Instantaneous velocity is the slope of the position time graph.

5. For the above position-time graph during which interval is the *average* velocity greatest.

   (a) OA (b) OB (c) OC (d) OD

   Answer (a): During this interval $\Delta x/\Delta t$ is largest.

Part II

1. A car travels 120 km along a road at 40 km/hr and then immediately returns along the same road at a speed of 60 km/hr.

   (a) How long does each leg of the trip take?

   $v = d/t$, so $t = d/v$. So for the away trip $t = 120/40 = 3$ hrs. For the return trip $t = 120/60 = 2$ hrs.

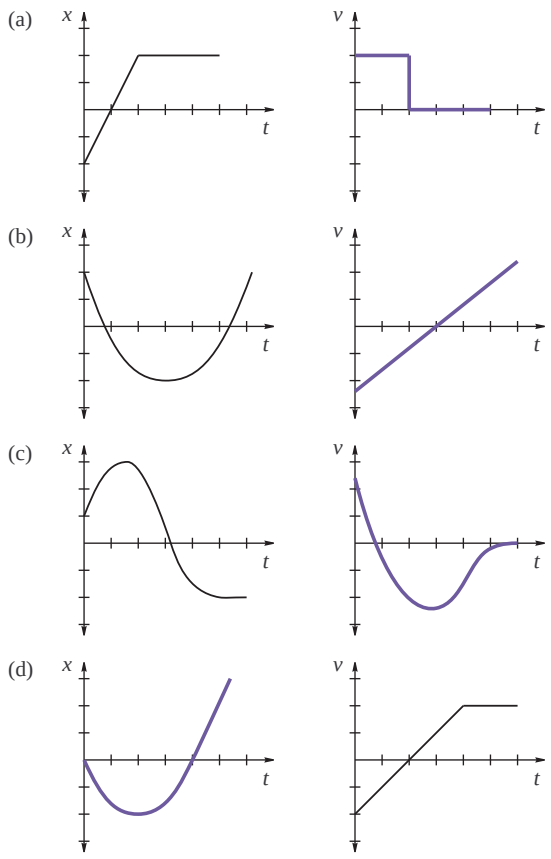
   (b) What is the average speed for the round trip?

   Average speed is total distance over total time (NOT the average of the two speeds). Total distance is 240 km and total time is 5 hrs, so the average speed is $240/5 = 48$ km/hr.

   (c) What is the average velocity for the round trip?

   Since the total displacement is zero, the average velocity is zero.

2. The following graphs show the motion of a toy car along a straight track. For each situation describe the motion and complete and sketch the missing graph.



3. The phrases "slows down" and "decreases velocity" do not have identical physical meaning. Describe each of the following physical situations using the appropriate phrase. When both are appropriate indicate this, when neither are appropriate indicate this also.

   (a) An object increasing its speed traveling in the negative direction "decreases velocity"

   (b) An object decreasing its speed traveling in the positive direction "slows down" and "decreases velocity"

   (c) An object increasing its speed traveling in the positive direction neither phrase

   (d) An object decreasing its speed traveling in the negative direction. "slows down"

4. A sprinter in a 100 dash accelerates uniformly from rest reaching a top speed of 14.7 m/s after 6.00 seconds. He then runs at constant speed for the remainder of the race.

   (a) What is his rate of acceleration during the initial phase of the race?
   $a = \dfrac{\Delta v}{\Delta t} = (14.7 - 0)/6.0 = 2.45 \text{ m/s}^2$

   (b) How far did he travel in the first phase of the race?
   The distance covered is $\Delta x = \frac{1}{2}\, at^2 = \frac{1}{2}\,(2.45)(6)^2 = 44.1$ m

   (c) What was his time in the race?
   For the first part of the race $t_1 = 6.00$ s.
   For the second part $t_2 = \dfrac{\Delta x}{v} = \dfrac{100 - 44.1}{14.7} = 3.80$ s so total time is $t = 9.80$ s

   (d) What was his average acceleration over the entire race?
   $\bar{a} = \dfrac{\Delta v}{\Delta t} = \dfrac{14.7 - 0}{9.80} = 1.50 \text{ m/s}^2$

   (e) What was his average speed over the entire race?
   $\bar{v} = \dfrac{\Delta x}{\Delta t} = \dfrac{100}{9.8} = 10.2 \text{ m/s}$