1.7 : Motion at Different Velocity

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Week 4

# Chapter 1. Simple Motion

1.7 Motion at Different Velocity (P2.1D)

Only a few things move with uniform motion for a long periods of time. Generally they speed up or slow down or change direction.

What to do?

1. Study sample problem below

2. Do practice exercises numbers 1, 2, 3, 4.

3. Show your work and submit.

4. Answers are shown below (in blue) to verify your work.

5. When submitting, write the section number, Example:

   Section 1.7 (Motion at Different Velocity) Exercises numbers 1, 2, 3, 4.

Sample Problems;

The following position-time graph depicts the motion of a jogger moving along a straight path.
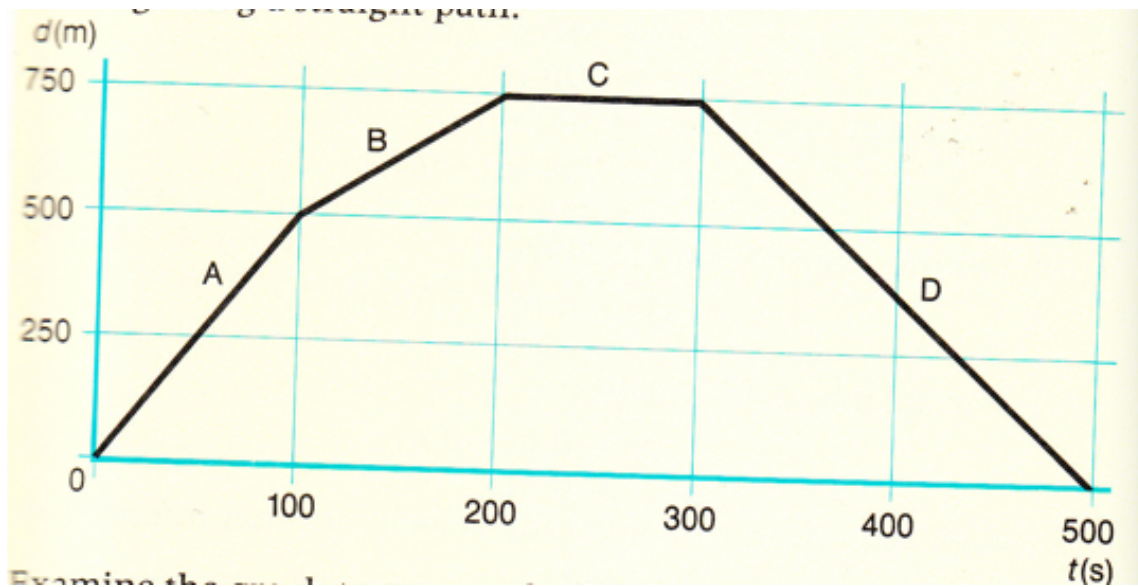
Examine the graph above to answer the following questions:

a) When was the jogger running the faster?
b) What was the farthest point reached by the jogger?
c) When, if ever, did the jogger rest?
d) State the jogger's displacement for the following time intervals.

    i)   0 to 200 s
    ii) 100 s to 300 s
    iii) 300 s to 500 s
    iv) 0 to 500 s

e) Find the velocity for each of the lettered sections A, B, C, and D.

f) What was the total distance travelled by the jogger?

Solutions

a) Since the slope of a position-time graph gives the velocity, we know that the greater the slope, the greater the velocity. Since section A has the steepest slope, it represents the interval during which the jogger ran faster.

b) Between 200 s and 300 s the jogger's position remained at 750 m from her starting point and then she started back. Therefore, the farthest point reached was 570 m.

c) The position of the jogger doesn't change between 200 and 300 s. Therefore, she must have been resting during this time interval.

d) We know the positions, then we can find the displacement by using the relationship:

$$\vec{\Delta d} = \vec{d_2} - \vec{d_1}$$

Therefore, the displacement for each of the specified intervals may be determined as follows:

i) For the interval 0 to 200 s

$$\overrightarrow{\Delta d} = 750 \text{ m} - 0 \text{ m}$$
$$= 750 \text{ m}$$

ii) For the interval 100 s to 300 s.

$$\overrightarrow{\Delta d} = 750 \text{ m} - 500 \text{ m}$$
$$= 250 \text{ m}$$

iii) For the interval 300 s to 500 s

$$\overrightarrow{\Delta d} = 0 \text{ m} - 750 \text{ m}$$
$$= -750 \text{ m}$$

iv) For the interval 0 to 500 s

$$\overrightarrow{\Delta d} = 0 \text{ m} - 0 \text{ m}$$
$$= 0 \text{ m}$$

e) The slope of each section gives the velocity for that interval,
  or

$$\vec{v} = \frac{\overrightarrow{\Delta d}}{\Delta t}$$

For section A
$$\vec{v} = \frac{500 \text{ m}}{100 \text{ s}}$$
$$= 5.00 \text{ m/s}$$

For section B
$$\vec{v} = \frac{750 \text{ m} - 500 \text{ m}}{200 \text{ s} - 100 \text{ s}}$$
$$= \frac{250 \text{ m}}{100 \text{ s}}$$
$$= 2.50 \text{ m/s}$$

For section C
$$\vec{v} = \frac{750 \text{ m} - 750 \text{ m}}{300 \text{ s} - 200 \text{ s}}$$
$$= \frac{0 \text{ m}}{100 \text{ s}}$$
$$= 0 \text{ m/s}$$

For section D
$$\vec{v} = \frac{0 \text{ m} - 750 \text{ m}}{500 \text{ s} - 300 \text{ s}}$$
$$= \frac{-750 \text{ m}}{200 \text{ s}}$$
$$= -3.75 \text{ m/s}$$

The negative sign in this case means that the jogger is moving in the opposite direction to section A and B. In sections A and B, she moves away from her starting position. She rests in section C and returns to her starting position in section D.

f) To find the total distance travelled by the jogger, the distance travelled away from the starting point is added to the distance travelled on the return trip

$$\Delta d_{total} = \Delta d_A + \Delta d_B + \Delta d_C + \Delta d_D$$
$$= 500 \text{ m} + 250 \text{ m} + 0 + 750 \text{ m}$$
$$= 1500 \text{ m}$$

Practice

The position-Time graph shows the motion of a delivery truck whose driver is trying to find certain house on a long straight street.
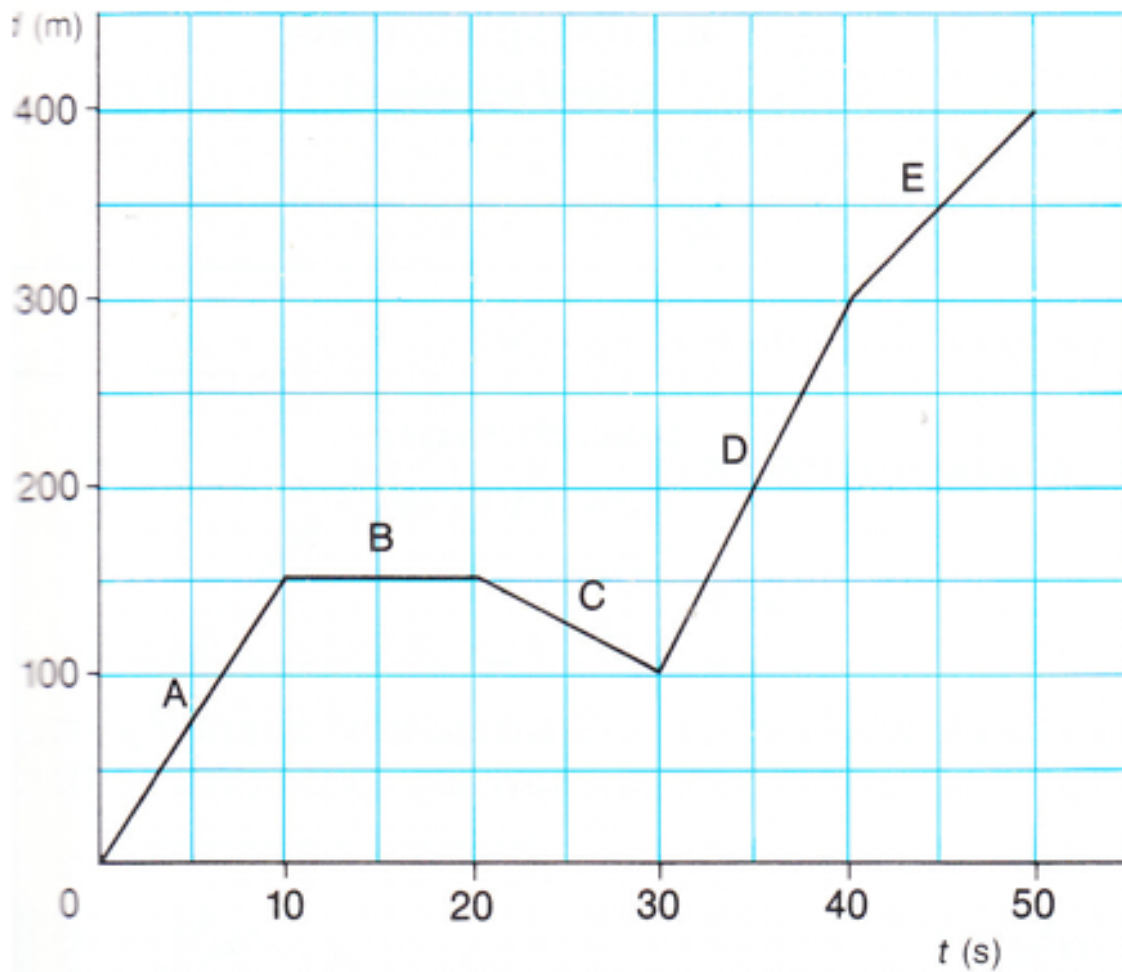
1. What is the truck's position at each of the following times?
a)10 s,   b) 15 s,   c) 30 s,   d) 45 s,   e) 50 s

2. What is the truck's velocity in each of the lettered intervals?

3. What is the displacement for the following time intervals?
a) 0 to 20 s
b) 0 to 30 s
c) 0 to 50 s

4. What is the distance travelled during the following intervals?
a) 0 to 20 s
b) 0 to 30 s
c) 0 to 50 s

Answers:

1. a) 150 m,   b) 150 m,   c) 100 m,   d) 350 m,
    e) 400 m
2. A 15 m/s, B 0,   C - 5.0 m/s,   D 20 m/s, E 10 m/s
3. a) 150 m, b) 100 m,   c) 400 m
4. a) 150 m, b) 200 m, c) 500 m.