Physics Notes

by

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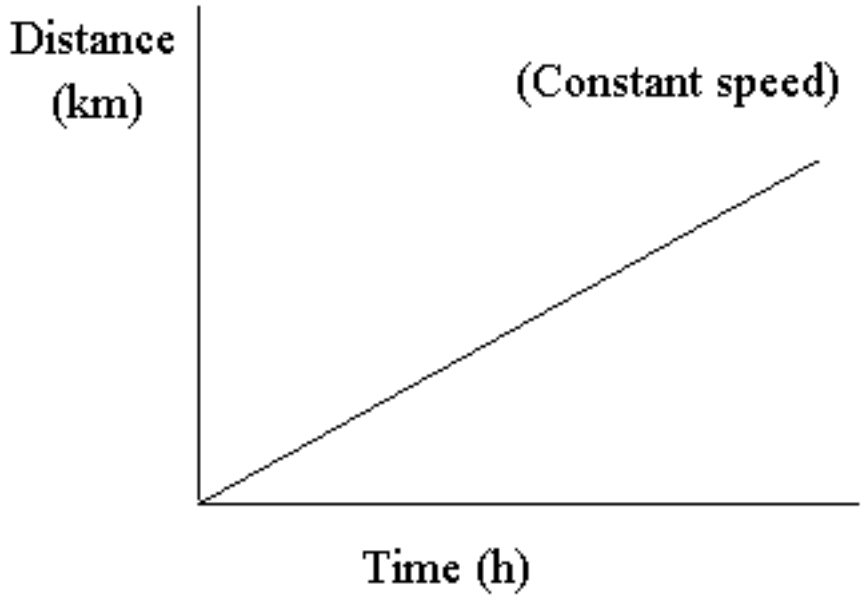
Week 4

Chapter 1. Simple Motion

1.6 Graphing Motion (P2.1C)

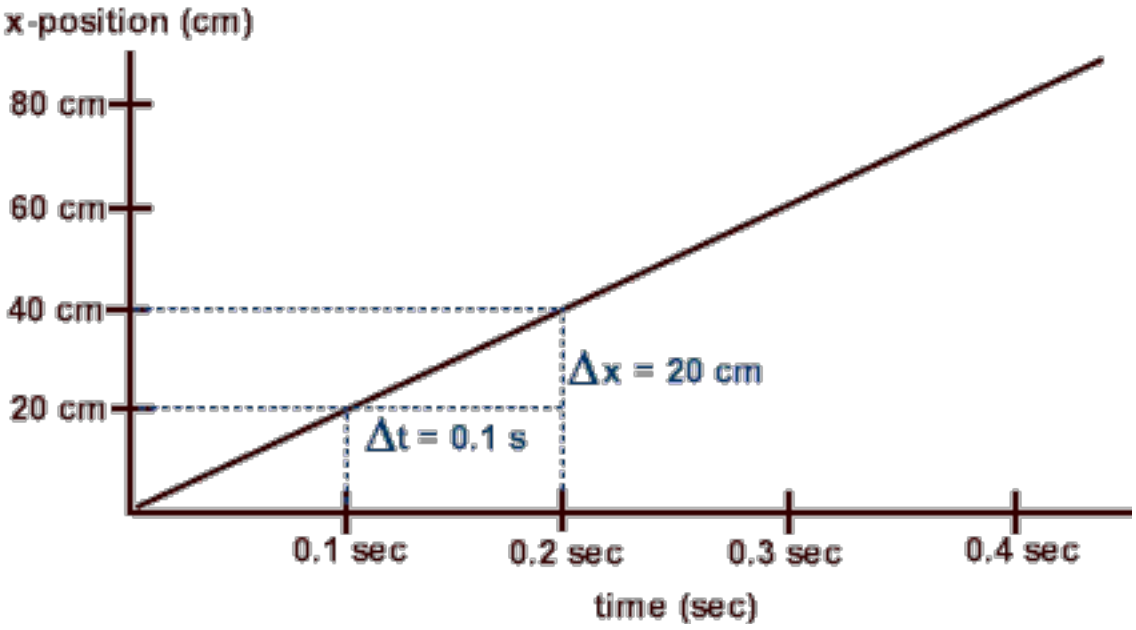
Position time graph and velocity
The position-time graph for an object moving with uniform motion is a straight line. The slope of the straight line (linear equation) gives the velocity of the object. Recall that linear equations have the general form: $y = mx$ (m is a constant and x is a variable). The number m is called the slope of the line (the vertical rise over the horizontal run). $m = y/x$



A **position-time graph** simply shows the relationship between time and position. This general graph represents the motion of a body traveling at constant velocity. The graph is linear (that is, a straight line).

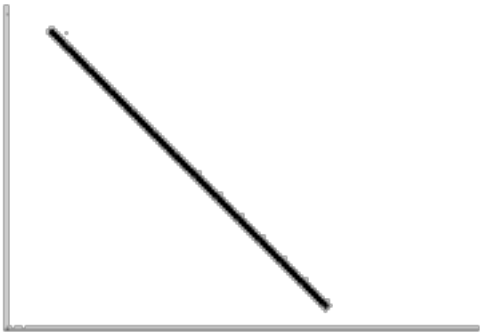
Example: Consider this ball moving across a table.

The slope of this Position-Time graph (below) represents a ball's average velocity as it moves across the table. Since the ball is moving in a positive direction its velocity is positive.



The slope of this line would equal 20 cm divided by 0.1 sec or 200 cm/sec. That is, the ball's velocity is a vector quantity possessing both magnitude (200 cm/sec) and direction (positive). v = 200 cm/sec

A negative slope on a straight line position-time graph indicates motion in a negative direction at constant velocity.



s vs t - this slope represents a constant **negative velocity** since the object is traveling in a negative direction at a constant rate. Notice that the locations of its position are becoming less and less positive.

1.

A straight line means that the object is standing still

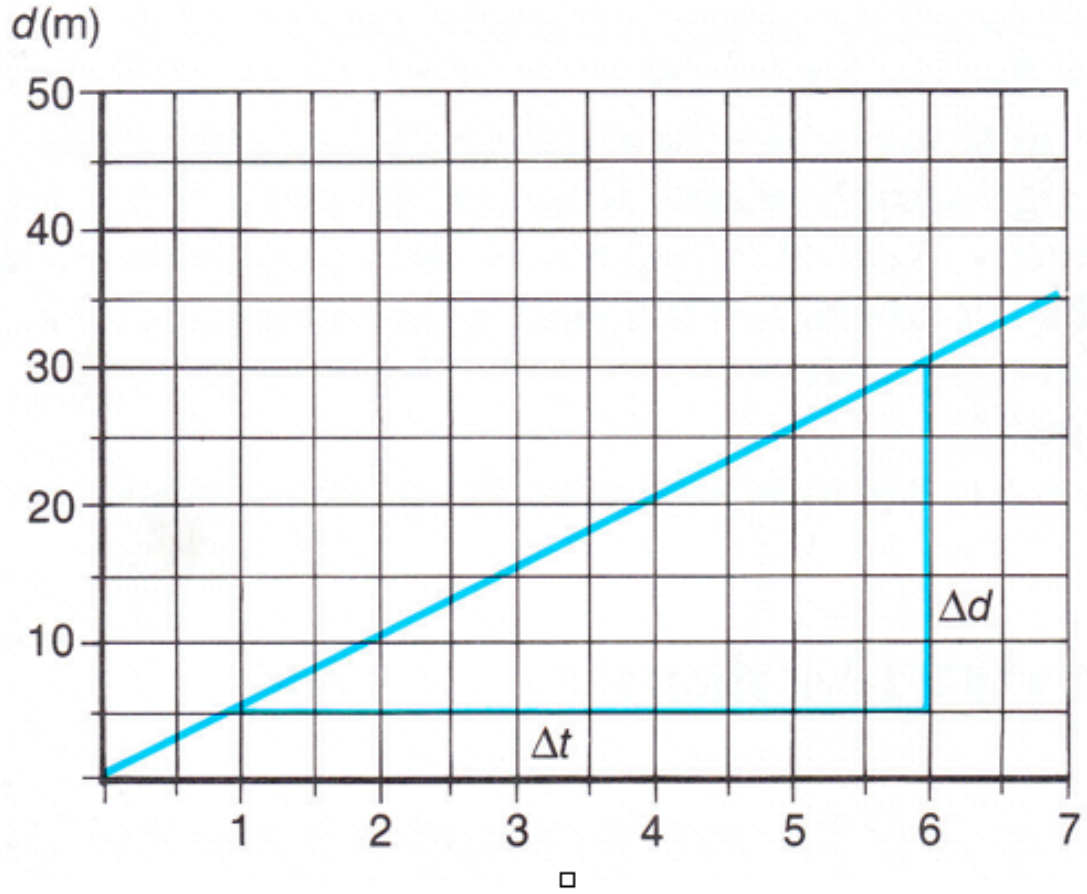
s vs t - the object is **standing still** at a positive location. Since the slope equals zero it has no movement.

What to do?

1. Study sample problem below
2. Do practice exercises numbers 1, 2.
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 1.6 (Graphing Motion) Exercises numbers 1, 2.
6. Do number 3 and 4 for Bonus Mathematic Proficiencies.

Sample Problem;



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

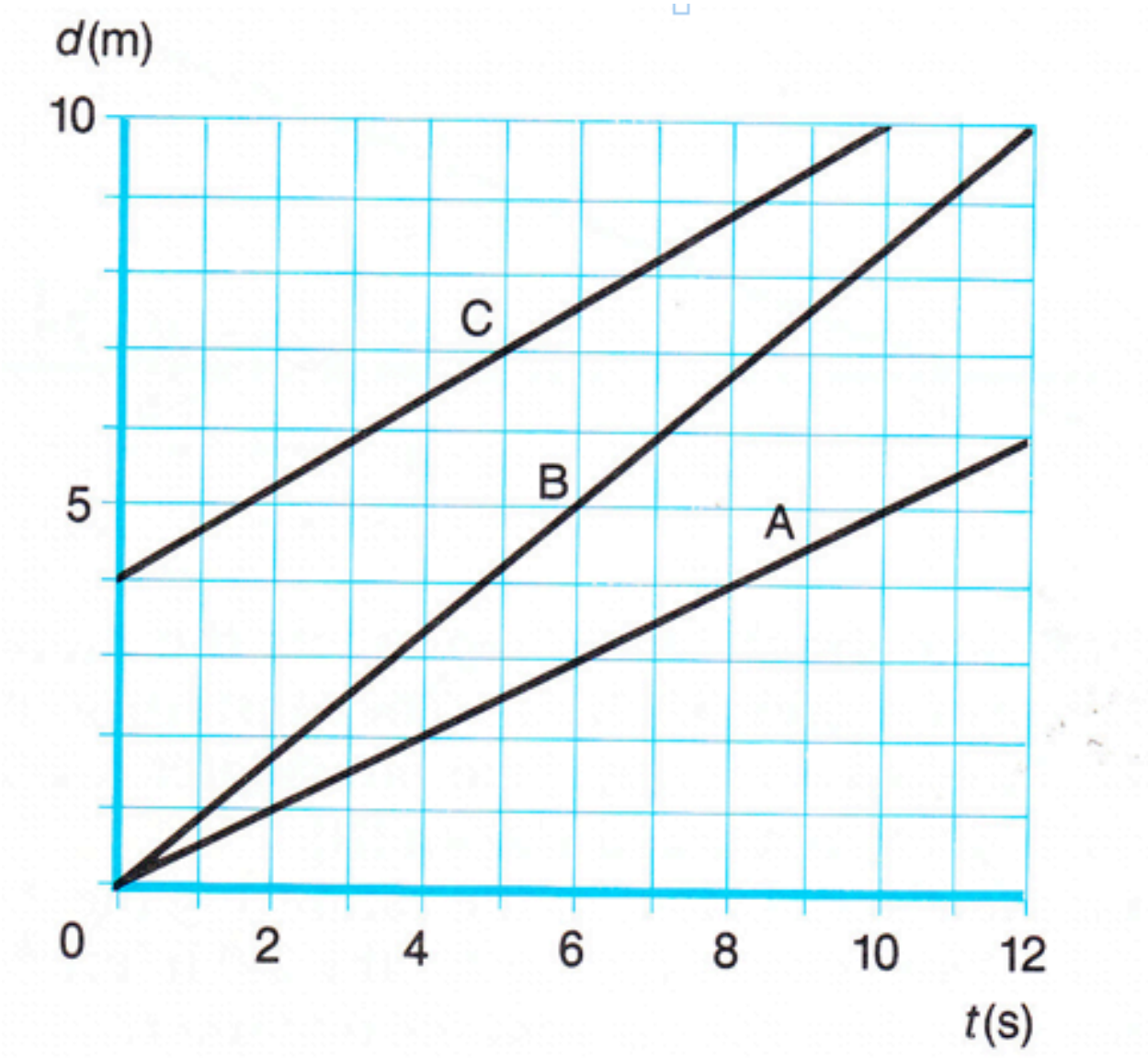
$$= \frac{30\ \text{m} - 5.0\ \text{m}}{6.0\ \text{s} - 1.0\ \text{s}}$$

$$= \frac{25\ \text{m}}{5.0\ \text{s}}$$

$$= 5.0\ \text{m/s}$$

Practice Exercise:

1. This position-Time Graph shows the position of several runners at various times. Determine the velocity of each of the runners.

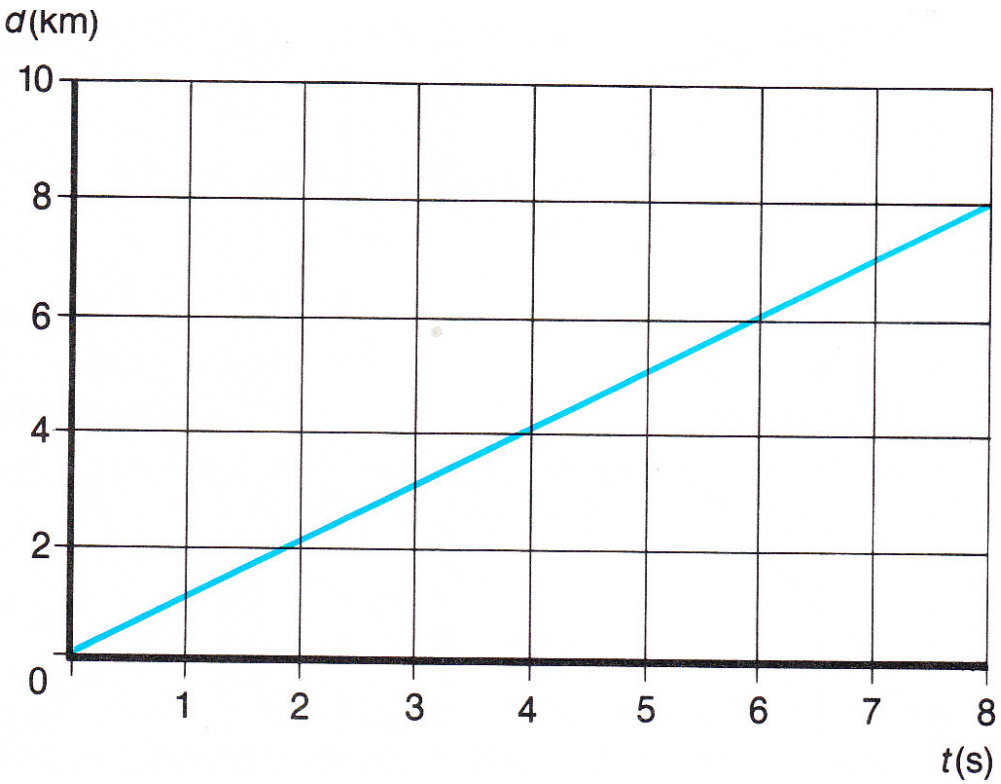


2. This position-Time graph represent the motion of a dog running along a railway track.

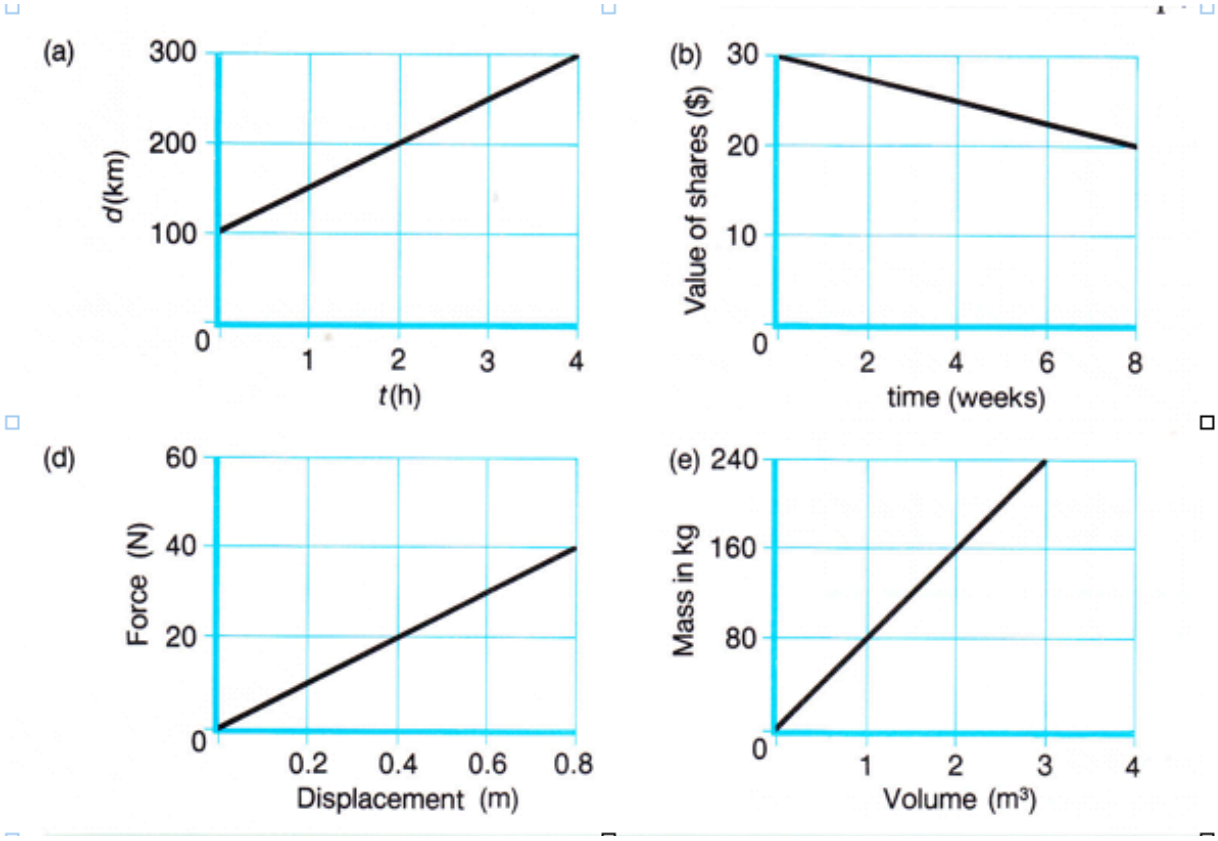
a. What is the dog's position at 4.0 s?

b. What is the dog's displacement between 2.0 s and 5.0 s?

c. What is the velocity of the dog?



3. The slope of a graph is an important characteristic of may types of graphs. For each graph below determine its slope. Include both the units and value of the slope in your answer.

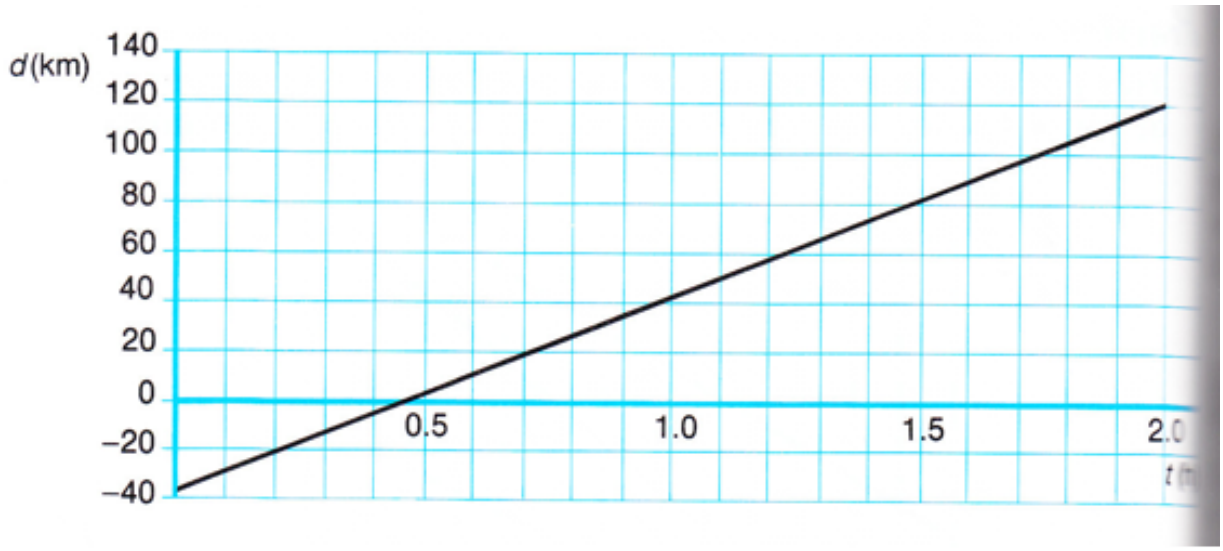


4. The position-time graph above represents the motion of a car along s section of straight highway. The car starts south of a town at a marker labelled 40 km[S]. Two hours later, it is located at a marker north 120 km [N].

a)What is the displacement of the car during the 2.0 h period?

b)What is the velocity of the car for the 2.0 h interval?

c)At what time does the car pass the 0 marker?



Answers;

1. 0.5 m/s, 0.83 m/s. 0.60 m/s
2. a) 4.0 m, b) 3.0 m, c) 1.0 m/s
3. 50 km/h [N], b) -$1.25 /week, d) 50 N/m, e) 80 kg/m^3
4. a) 160 km[N], b) 80 km/h [N], c) 0.5 h