

MT 1800 Calculus I
Module II, CA 6: The Second Derivative and Its Applications

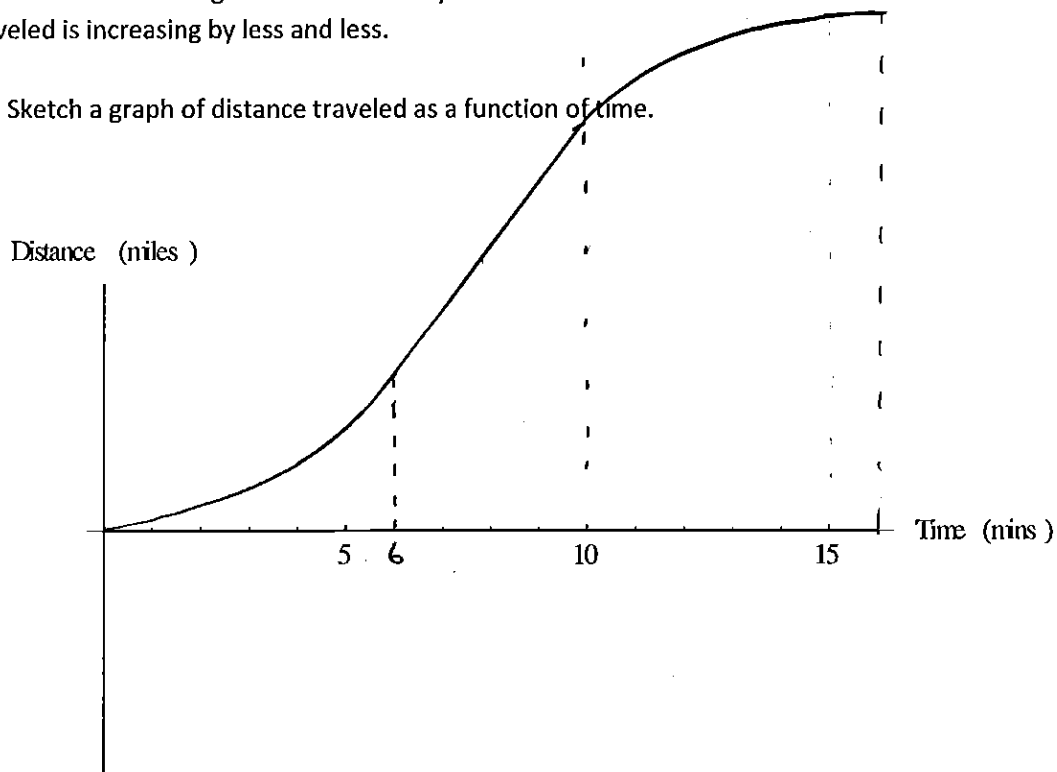
Name: Solution Key

In this activity we will think of velocity as the speed of an object in a given direction. The velocity is negative if the object travels in the opposite direction.

Definition: Acceleration is the instantaneous rate of change of velocity.

1. The following graph shows the distance (in miles) a car has travelled on a straight road over time (in minutes). The distance the car has travelled is increasing by more and more over the first 6 minutes. Then from minute 6 to minute 10 the distance the car has traveled is increasing at the same rate at which it was increasing at minute 6. Finally from minute 10 to minute 16 the distance the car has traveled is increasing by less and less.

- a. Sketch a graph of distance traveled as a function of time.



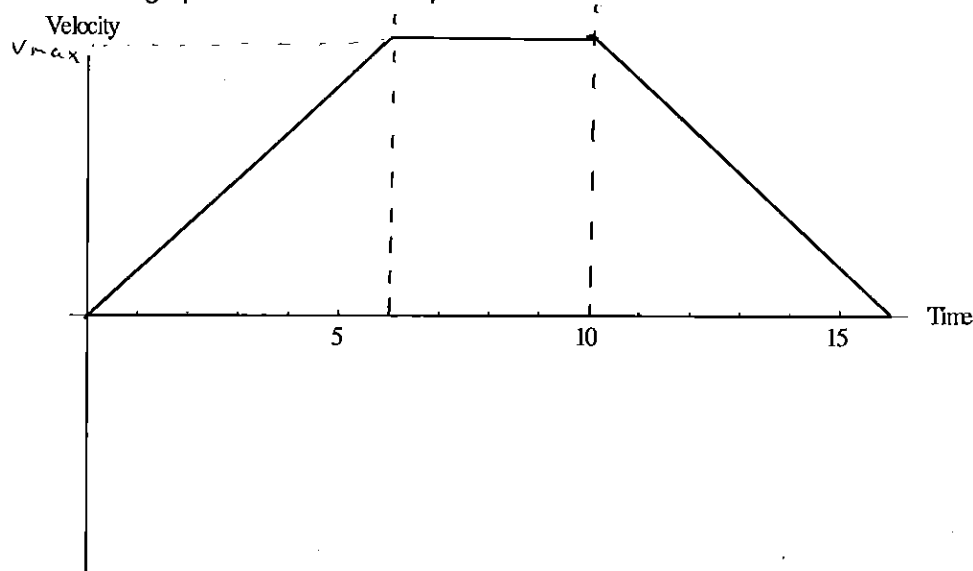
- b. Based on your graph above, when is the car driving fastest? Speeding up? Slowing down?

Driving fast - From the 6th to the 10th minute

Speeding Up - Over the first 6 minutes

Slowing Down - From the 10th to the 16th minute

- c. Sketch a graph of the car's velocity as a function of time.



- d. Where is the car's acceleration positive? Negative? Zero? State if any of these are not relevant and explain your reasoning in arriving at the answers.

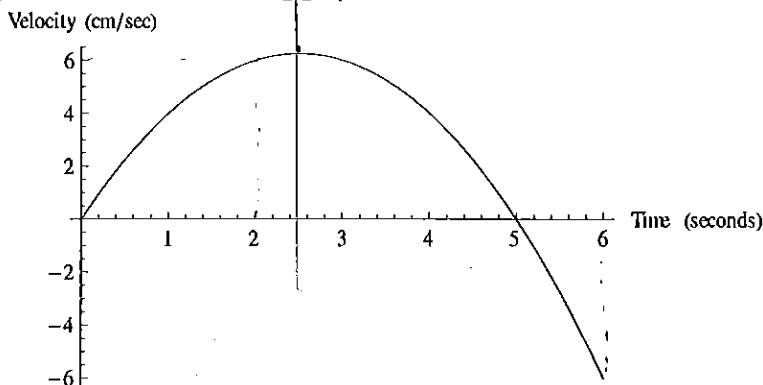
Positive - First 6 minutes

Negative - 10th to 16th minute

Zero - 6th to 10th minute

- e. Write a short scenario that describes a car behaving in this manner. Be creative! ☺

2. A particle is moving along a straight line from its starting point, S. Its velocity (in cm/second) over time (in seconds) is shown in the following graph.



Use the graph above to answer the following questions – explain your reasoning in each case:

- a. Notice that the point $(2,6)$ is on the graph sketched above. Explain the meaning of that point in this context.

In this context, the point $(2,6)$ means that at 2 seconds the particle is traveling at 6 cm/sec.

- b. Notice that the point $(5.5, -2.75)$ is on the graph sketched above. Explain the meaning of that point in this context.

In this context, the point $(5.5, -2.75)$ means that at 5.5 seconds the particle is traveling at -2.75 cm/sec. The negative sign indicates that the motion is occurring in the opposite direction (Backward).

- c. When is the particle's velocity positive between $t = 0$ and $t = 6$ seconds? Negative? Zero?

Positive - $[0, 5)$ sec

Zero - 5 sec

Negative - $(5, 6]$ sec

- d. When is the particle's acceleration positive between $t = 0$ and $t = 6$ seconds? Negative? Zero?

Positive - $[0, 2.5)$ sec

Zero - $[2.5]$ sec

Negative - $(2.5, 6]$ sec

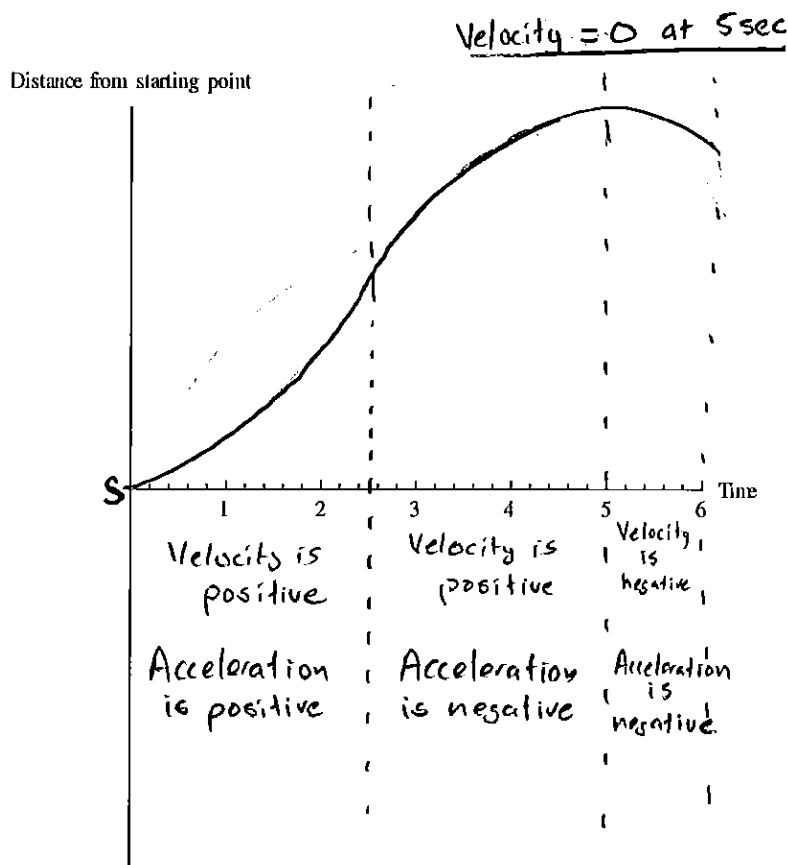
e. When is the particle furthest from its starting point between $t = 0$ and $t = 6$ seconds?

Particle is furthest at $t = 5$ sec

f. When is the particle travelling fastest between $t = 0$ and $t = 6$ seconds?

- Particle is travelling fastest in the forward direction at $t = 2.5$ sec
- Particle is travelling fastest in the backward direction at $t = 6$ sec

g. Plot the particle's distance from its starting point over time and explain in words what is happening in this graph. Mark on your graph where velocity is positive, negative or zero and similarly where acceleration is positive, negative or zero. Explain how you created your graph below.



Class Discussion: What Have We Learned/Recalled in this Activity?

Skills/Facts:

Methods:

Concepts to Understand:

