

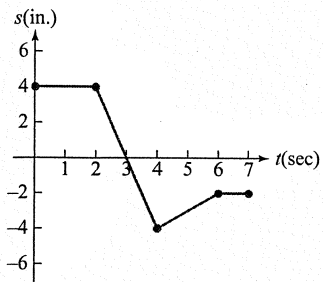
3.4 Concepts Worksheet

DATE _____

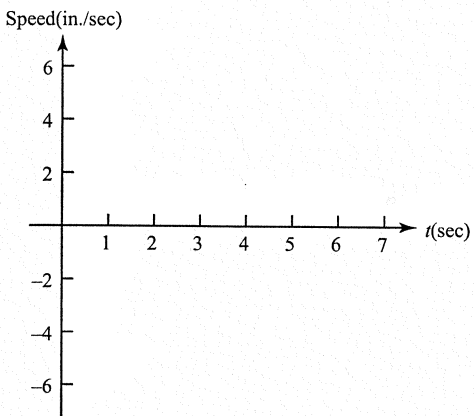
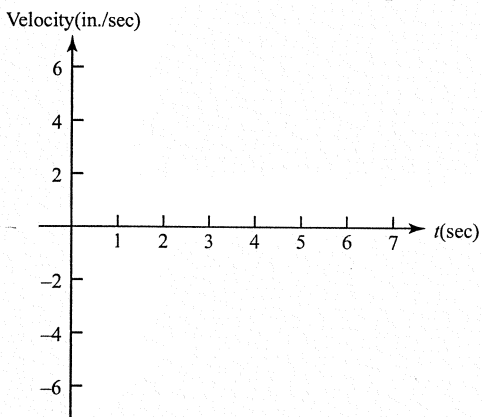
NAME _____

Velocity, Speed, and Acceleration

1. The graph shows the position $s(t)$ of a particle moving along a horizontal coordinate axis.



- (a) When is the particle moving to the left? _____
- (b) When is the particle moving to the right? _____
- (c) When is the particle standing still? _____
- (d) Graph the particle's velocity and speed (where defined).



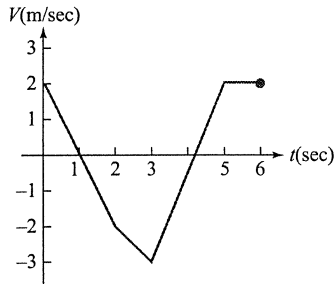
- (e) When is the particle moving fastest? _____

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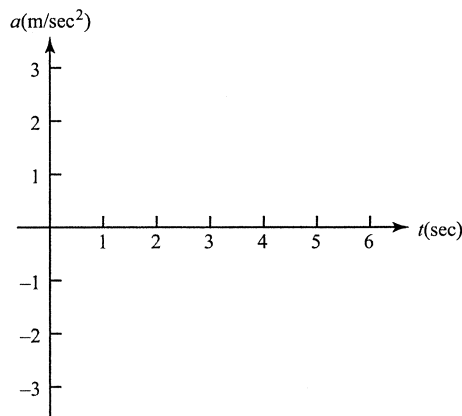
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2. The graph shows the velocity $v = f(t)$ of a particle moving along a horizontal coordinate axis.



- (a) When does the particle reverse direction? _____
- (b) When is the particle moving at a constant speed? _____
- (c) When is the particle moving at its greatest speed? _____
- (d) Graph the acceleration (where defined).



3. A particle moves along a vertical coordinate axis so that its position at any time $t \geq 0$ is given by the function $s(t) = \frac{1}{3}t^3 - 3t^2 + 8t - 4$, where s is measured in centimeters and t is measured in seconds.

- (a) Find the displacement during the first 6 seconds.

- (b) Find the average velocity during the first 6 seconds.

- (c) Find expressions for the velocity and acceleration at time t .
 $v(t) =$ _____ $a(t) =$ _____
- (d) For what values of t is the particle moving downward?

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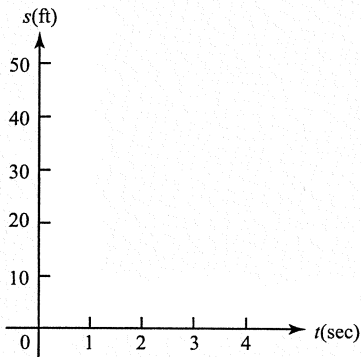
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4. The values of the coordinate s of a moving body for various values of t are given below.

$t(\text{sec})$	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
$s(\text{ft})$	40.0	35.0	30.2	36.0	48.2	45.0	38.2	16.0	0.2

- (a) Plot s versus t , and sketch a smooth curve through the given points.



- (b) Estimate the velocity at each of the following times.

At $t = 0.5$ sec, $v \approx$ _____.

At $t = 2.5$ sec, $v \approx$ _____.

At $t = 3$ sec, $v \approx$ _____.

- (c) At what approximate values of t does the particle change direction?

- (d) At what approximate value of t is the particle moving at the greatest speed?

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Concept Connector

5. The position (x -coordinate) of a particle moving on the horizontal line $x = 1$ is given by $x(t) = t^3 - 15t^2 + 63t - 45$ for $t \geq 0$.

- (a) Use analytic methods to determine when the particle changes its direction of motion and its position at each of these times.

At $t =$ _____, $x =$ _____.

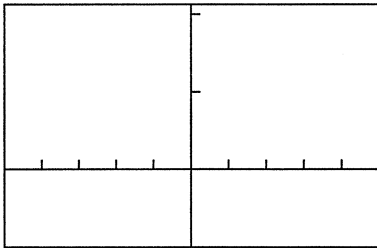
At $t =$ _____, $x =$ _____.

Now graph the parametric equations

$$x(t) = t^3 - 15t^2 + 63t - 45, y(t) = 1, \text{ in a}$$

$[-50, 50]$ by $[-1, 2.1]$ viewing window for $0 \leq t \leq 10$. Use TRACE to confirm the results you found analytically.

- (b) When graphing parametric equations for horizontal motion on a graphing calculator, you can see the motion better if you let the y -coordinate increase slightly every time the particle changes direction. Instead of $y(t) = 1$, let $y(t) = 1 + 0.1(t \geq A) + 0.1(t \geq B)$, where A and B are the t -values you found in part (a). Sketch the resulting graph below.



$[-50, 50]$ by $[-1, 2.1]$