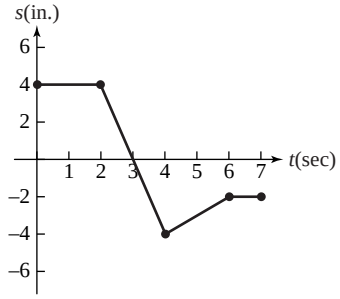
DATE

3.4 Concepts Worksheet

NAME

Velocity, Speed, and Acceleration

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

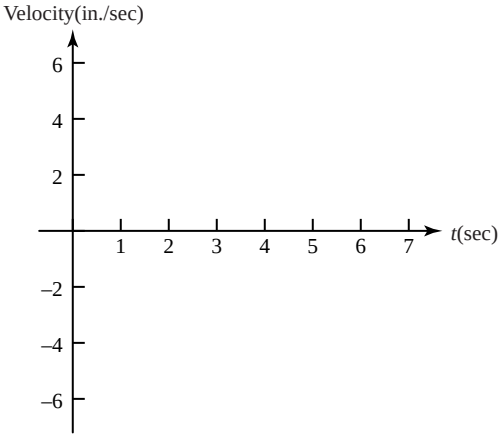


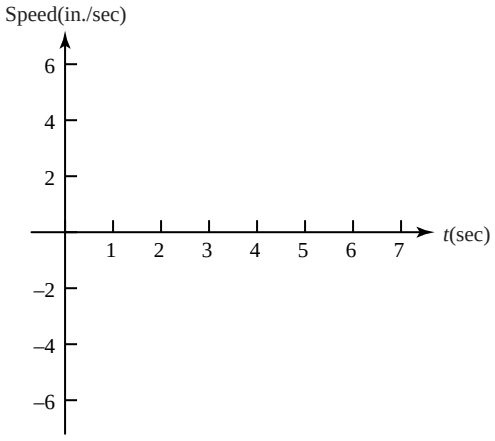
(a) When is the particle moving to the left? _____

(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).

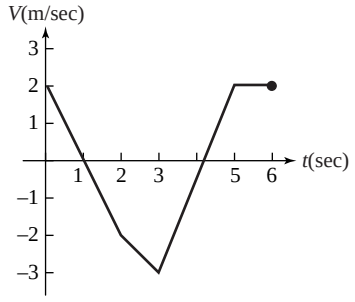




(e) When is the particle moving fastest? _____

Continued

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

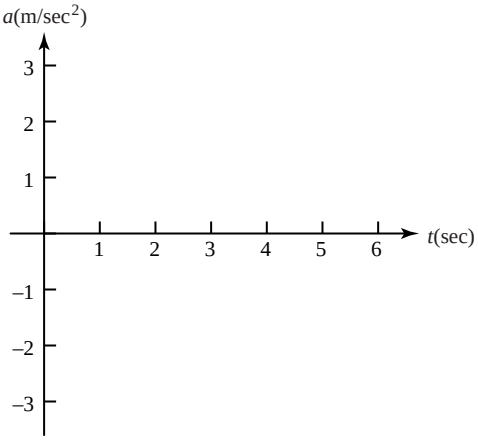


(a) When does the particle reverse direction? _____

(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?

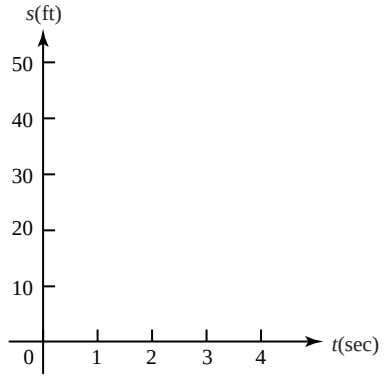
_____

Continued

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

t(sec)	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
s(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?

_____

Continued

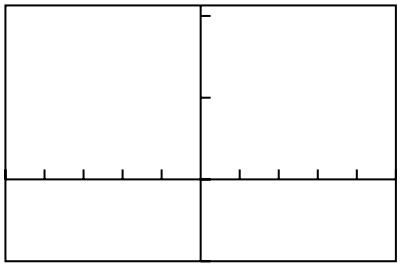
Concept Connector

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 $x(t) = t^3 - 15t^2 + 63t - 45$, $y(t) = 1$, 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]