

Show all work on a separate sheet of paper.

1) Given height, $h(t)$ in feet and $t(s)$ in seconds. The position and velocity graph are shown below.



(a) At what time in the simulation does the particle change direction? _____

(b) Describe the sign of the particle's velocity and acceleration during each time interval in the table below, and indicate whether the speed is increasing or decreasing. Circle the answer.

Time	0 seconds to 4 seconds	4 seconds to 10 seconds
Velocity is:	Positive or Negative	Positive or Negative
Acceleration is:	Positive or Negative	Positive or Negative
Speed is:	Increasing or Decreasing	Increasing or Decreasing

2) A particle moves according to the function $s(t) = t^3 - 12t^2 + 36t$, $t \geq 0$, where t is measured in seconds and s in meters.

- (a) Find the velocity at time t .
- (b) What is the velocity after 3 seconds?
- (c) When is the particle at rest?
- (d) When is the particle moving to the right?
- (e) Find the acceleration at time t and after 3 seconds.
- (f) When is the particle speeding up? When is it slowing down? Justify response.

3) A particle moves along the x -axis, its position in time t given by $x(t) = \frac{t}{1+t^2}$, $t \geq 0$ where t is measured in seconds and x in meters.

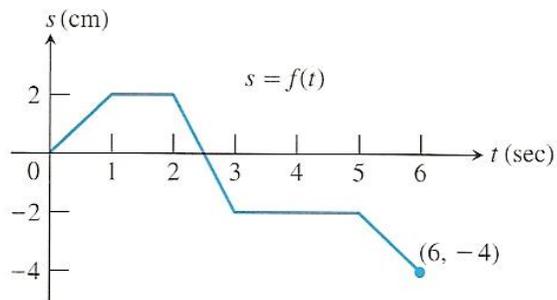
- (a) Find the velocity at time t .
- (b) When is the particle moving to the right? When is it moving to the left?
- (c) Find the acceleration at time t .
- (d) When is the particle speeding up? When is it slowing down? Justify response.

4) A particle moving along in a vertical line so its coordinate at time t is $y(t) = t^3 - 12t + 1$, $[0, \infty)$ where t is measured in seconds and x in meters.

- (a) Find the velocity and acceleration functions.
- (b) When the particle is moving to the right (known as upwards) and when is it moving to the left?
- (c) When is the particle speeding up and when is it slowing down? Justify response.

5) The figure on the right shows the position s of a particle moving along a horizontal line.

- (a) When is the particle moving to the left? Moving to the right? Standing still? Justify your answer.
- (b) For each of $v(1.5)$, $v(2.5)$, and $v(5)$, find the value or explain why it does not exist. Label accordingly.
- (c) Graph the particle's velocity on the given graph to the right.



Multiple Choice. For questions 6-8, do not use the calculator.

_____ 6) The maximum acceleration attained on the interval $[0, 3]$ by the particle whose velocity is given by $v(t) = t^3 - 3t^2 + 12t + 4$ is:

- (A) 9
- (B) 12
- (C) 14
- (D) 21

_____ 7) A particle moves along a line so that its velocity at time t is $v(t) = 2 \sin(2\pi t)$. What is the particle's acceleration at time $t = 3$?

- (F) 2
- (G) 4
- (H) 2π
- (J) 4π

_____ 8) The position of a particle moving along a line is given by $s(t) = 2t - 3 + \frac{7}{t+1}$. What is the velocity of the particle at time $t = 1$?

- (A) $-\frac{3}{4}$
- (B) $-\frac{1}{4}$
- (C) $\frac{1}{4}$
- (D) $\frac{19}{4}$

For questions 9 and 10, use a calculator.

_____ 9) A particle moves along the x -axis so that at any time $[0, \infty)$, its velocity is given by $v(t) = 3 + 4.1 \cos(0.9t)$. What is the acceleration of the particle at time, $t = 4$?

- (F) -2.016
- (G) -0.677
- (H) 1.633
- (J) 1.814

_____ 10) A particle moves along a line so that its velocity at time t is $v(t) = \sin(2t)$. Which of the following is true at time $t = 3$?

- (A) The particle is speeding up.
- (B) The particle is slowing down.
- (C) The particle is not moving.
- (D) The particle's speed is constant.