

Directions: Complete each problem below.

57. Find the rate of change at the (1,0) for the function $y = \frac{x^2 - x}{x^2}$

$$y = \frac{x^2 - x}{x^2} = 1 - \frac{1}{x}$$

$$y' = \frac{1}{x^2}$$

(1)

58. Given $f(x) = \begin{cases} 3x^2 - x, & x \leq 1 \\ 5x - 3, & x > 1 \end{cases}$

- A. Find any x-values of $f(x)$ where it is discontinuous.

$$\lim_{x \rightarrow 1^-} (3x^2 - x) = 2$$

$$\lim_{x \rightarrow 1^+} (5x - 3) = 2$$

$2 = 2$ so $(-\infty, \infty)$

- B. Differentiate $f(x)$

$$f'(x) = \begin{cases} 6x - 1, & x \leq 1 \\ 5, & x > 1 \end{cases}$$

- C. Find any values at which $f(x)$ is not differentiable.

continuous so none

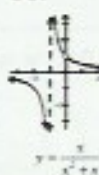
Directions: Find the x-values where the function is NOT differentiable. Give a reason for each value.

59.



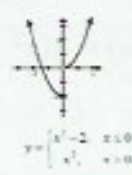
$x=1$
sharp
turn

60.



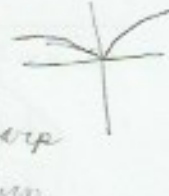
$x = -1$ VA
 $x = 0$ Hole

61.



$x=0$ cusp

62. $f(x) = x^{\frac{2}{3}}$



$x=0$, sharp
turn

Directions (You may use a calculator for these problems): Complete each problem below.

63. The position, in meters, of a particle moving in a straight line is given by $x(t) = 4t^3 + 6t + 2.5$.

- A. Find the velocity function.

$$v(t) = 12t^2 + 6$$

- B. Find the velocity at $t=2$ seconds

$$v(2) = 54$$

- C. Find the acceleration function

$$a(t) = 24t$$

- D. Find the acceleration at $t=3$ seconds

$$a(3) = 72$$

- E. When is the velocity of the particle 18 m/s?

$$0 = 12(t^2 - 1) \quad 18 \text{ m/s} = 12t^2 + 6 \quad (1s)$$

- F. Find the velocity when the position is 25 m

$$25 = 4t^3 + 6t + 2.5 \quad (t \approx 1.5)$$

- G. Find the initial position

$$x(0) = 2.5 \text{ m}$$

- H. Find the particle's displacement from 0 to 1.5s

$$x(1.5) = 25 \quad 25 - 2.5 = 22.5 \text{ m}$$

64. A helium balloon rises so that its height is given by $s(t) = t^2 + 3t + 5$, where height is in ft and time in seconds.

- A. When is the balloon 45 ft high?

$$45 = t^2 + 3t + 5 \quad t = -8, 5$$

- B. How fast is the balloon rising at 1 sec? 4 secs?

$$v(t) = 2t + 3 \quad 5 \text{ m/s}, 11 \text{ m/s}$$

- C. What is the balloon's velocity when it is 45 ft high?

$$13 \text{ m/s}$$

65. The graph below shows the position function of a car. Answer the questions below and explain.

- A. What was the car's initial position?

$$0 \quad t=0, s=0$$

- B. Was the car going faster at A or B?

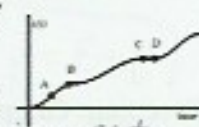
A b/c slope is greater

- C. Was the car speeding up or slowing down at B?

slowing b/c slope is decreasing

- D. What happened between C and D?

it was at rest b/c slope = 0



66. The graph to the right shows a velocity function of a particle moving horizontally.

- A. When does the particle move left?

$$(1, 7)$$

- B. When is the particle's acceleration positive?

$$(4, 8)$$

- C. When is the speed the greatest?

$$(1, 4)$$

- D. When does the particle stop for more than an instant?

$$(9, 10)$$

