Determine the limit algebraically, if it exists.

1) $\lim_{x \to 2} \frac{x^2 + 4x - 12}{x - 2}$

A) 0 B) 4 C) 8 D) Does not exist

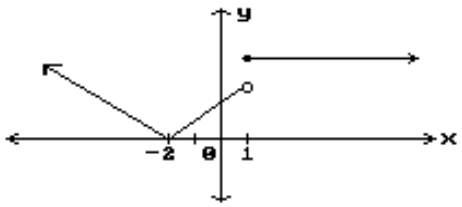
Find the limit.

2) $\lim_{x \to \infty} \frac{9x^3 - 5x^2 + 3x}{-x^3 - 2x + 7}$

A) ∞ B) $\frac{3}{2}$ C) -9 D) 9

Find all points where the function is discontinuous.

3)



A) x = −2 B) x = −2, x = 1 C) x = 1 D) None

Find the average rate of change of the function over the given interval.

4) $f(x) = 3 + \cos x, \quad [0, \pi]$

A) 0

B) $-\frac{2}{\pi} \approx -0.637$

C) $\frac{1}{\pi} \approx 0.318$

D) $\frac{3}{\pi} \approx 0.955$

slope $(0, 4)(\pi, 2)$

$3+\cos 0 \qquad 3+\cos\pi$

$3+1 \qquad 3+-1$

$m = \frac{2-4}{\pi-0} = \frac{-2}{\pi}$

Solve the problem.

5) Find an equation of the tangent line to the graph of $y = 6\sqrt{x} - x + 3$ at the point (36, 3).

A) $y = -\frac{1}{2}x + 3$ B) $y = \frac{1}{2}x - 21$ C) $y = -\frac{1}{2}x + 21$ D) $y = 3$

$y = 6x^{1/2} - x + 3$

$y' = 3x^{-1/2} - 1$

$y' = \frac{3}{\sqrt{x}} - 1$

$y' = \frac{3}{\sqrt{36}} - 1$

$\frac{3}{6} - 1$

$\frac{1}{2} - 1$

(36, 3)

$m = -\frac{1}{2}$

$y - 3 = -\frac{1}{2}(x - 36)$

$y = -\frac{1}{2}x + 18 + 3$

$y = -\frac{1}{2}x + 21$

6) Find the equation of the normal line to the curve $y = 5x - 2x^2$ at the point (5, -25).

A) $x - 15y - 1880 = 0$
B) ~~$x + 25y - 1880 = 0$~~
C) $x + 25y - 380 = 0$
D) $x - 15y - 380 = 0$

$m_{\perp} = \frac{1}{15}$

$y' = 5 - 4x$

$y' = 5 - 4(5)$

$5 - 20$

$m = -15$

$15(y + 25) = \frac{1}{15}(x - 5)$

$15y + 375 = x - 5$

-375

$0 = x - 15y - 380$

7) Find the points where the graph of the function has horizontal tangents. $m = 0$

$f(x) = 7x^2 + 6x - 1$

A) $(-20, 6739)$ B) $(0, 1)$ C) $\left(\frac{3}{7}, -\frac{104}{7}\right)$ D) $\left(-\frac{3}{7}, -\frac{16}{7}\right)$

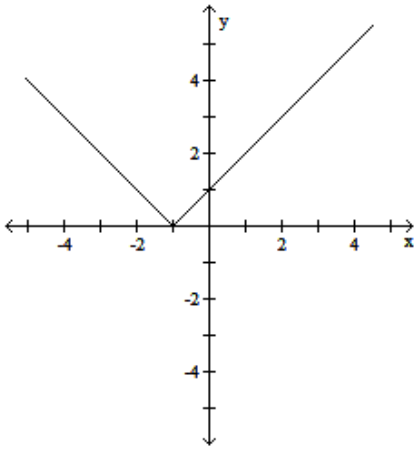
$f'(x) = 14x + 6 = 0$

$14x = -6$

$x = \frac{-6}{14} = \frac{-3}{7}$

The figure shows the graph of a function. At the given value of x, does the function appear to be differentiable, continuous but not differentiable, or neither continuous nor differentiable?

8) x = −1 8) _____



A) Differentiable
B) Continuous but not differentiable
C) Neither continuous nor differentiable

Find dy/dx.

9) $y = \frac{x^2}{9 - 7x}$

Quotient Rule

A) $\frac{-7x^2 + 18x}{(9 - 7x)^2}$

B) $\frac{9x}{(9 - 7x)^2}$

C) $\frac{-21x^2 + 18x}{(9 - 7x)^2}$

D) $\frac{7x^3 - 14x^2 + 18x}{(9 - 7x)^2}$

$$y' = \frac{2x(9-7x) - x^2(-7)}{(9-7x)^2}$$

$$\frac{18x - 14x^2 + 7x^2}{(9-7x)^2} = \frac{-7x^2 + 18x}{(9-7x)^2}$$

Suppose u and v are differentiable functions of x. Use the given values of the functions and their derivatives to find the value of the indicated derivative.

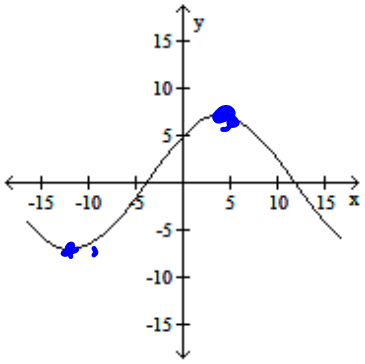
10) $u(2) = 6, u'(2) = 3, v(2) = -2, v'(2) = -4.$ 10) _____

$\frac{d}{dx}(uv)$ at $x = 2$

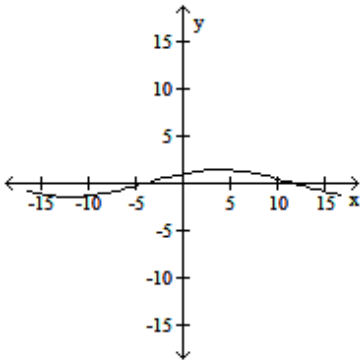
A) 26 B) 30 C) −18 D) −30

The graph of a function is given. Choose the answer that represents the graph of its derivative.

11)



A)



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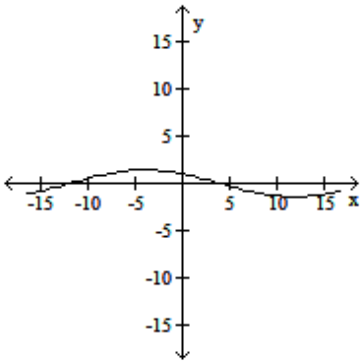

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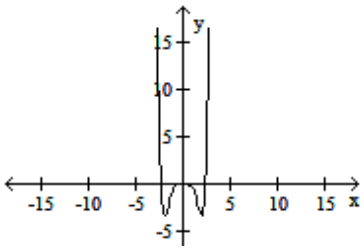
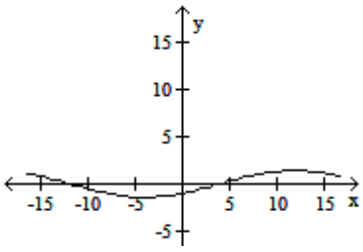


D)



Find the slope of the line tangent to the curve at the given value of x.

12) $y = x^3 + 5; x = 5$

A) −75 B) 76 C) 80 D) 75

$y' = 3x^2$

$3(5)^2$

75

$m = 0$

Solve the problem.

13) Find the points on the curve $y = 5x^2 + 6x + 3$ where the tangent is parallel to the x-axis.

A) $\left(\frac{3}{5}, -12\right)$ B) $(0, -3)$ C) $(-16, 1907)$ D) $\left(-\frac{3}{5}, \frac{6}{5}\right)$

$y' = 10x + 6 = 0$

$10x = -6$

$x = \frac{-6}{10}$

$x = -\frac{3}{5}$

14) The function $V = 6\pi r^2$ describes the volume of a right circular cylinder of height 6 feet and radius r feet. Find the (instantaneous) rate of change of the volume with respect to the radius when r = 10. Leave answer in terms of π.

A) 120π ft^3/ft B) 60π ft^3/ft C) 20π ft^3/ft D) 12π ft^3/ft

$V = \pi r^2 h$

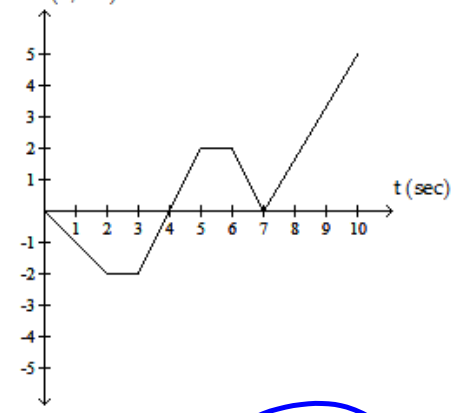
$V = 6\pi r^2$

$V' = 12\pi r$

$12\pi \cdot 10$

120π

The figure shows the velocity v of a body moving along a coordinate line as a function of time t. Use the figure to answer the question.

15) 

15) _____

What is the body's greatest velocity?

A) 3 ft/sec B) 5 ft/sec C) 2 ft/sec D) 4 ft/sec

16) Given the distance function $s(t) = t^2 + 9t + 10$, where s is in feet and t is in seconds, find the velocity function, v(t), and the acceleration function, a(t).

A) $v(t) = 2t + 9$; $a(t) = 0$

B) $v(t) = 2t + 9$; $a(t) = 2t$

C) $v(t) = 2t + 9$; $a(t) = 2$

D) $v(t) = 2t + 19$; $a(t) = 2$

17) Find the equations for the lines that are tangent and normal to $y = 2 - \sin x$ at $x = \pi$.

A) tangent: $y = -x + \pi - 2$;
normal: $y = x + \pi + 2$

B) tangent: $y = -x + 2$;
normal: $y = x - 2$

C) tangent: $y = x - \pi + 2$;
normal: $y = -x + \pi + 2$

D) tangent: $y = x - 2$;
normal: $y = -x + 2$

$y' = -\cos x$

$y' = -\cos\pi$

$= -(-1)$

$= 1$

$(\pi, 2)$

$y = 2 - \sin\pi$

$2 - 0$

2

$m = 1$

$m_\perp = -1$

$T: \; y - 2 = 1(x - \pi)$

$y = x - \pi + 2$

Find dy/dx.

18) $y = 6\tan^4 x$

A) $24\tan^5 x$ B) $24\tan^3 x \sec^2 x$ C) $24\tan^4 x \sec x$ D) $24\tan^3 x$

$y = 6(\tan x)^4$

$y' = 24(\tan x)^3 \cdot \sec^2 x$

An object moves along the x–axis so that its position at any time $t \geq 0$ is given by $x(t) = s(t)$. Find the velocity of the object as a function of t.

19) $s = \sin\left(\frac{\pi}{6} - 10t\right)$ 19) _____

A) $v = -10\cos\left(\frac{\pi}{6} - 10t\right)$

B) $v = -10t\cos\left(\frac{\pi}{6} - 10t\right)$

C) $v = \cos\left(\frac{\pi}{6} - 10t\right)$

D) $v = 10\cos\left(\frac{\pi}{6} - 10t\right)$

$s' = \cos\left(\frac{\pi}{6} - 10t\right) \cdot -10$

$-10\cos\left(\frac{\pi}{6} - 10t\right)$

Find y″.

20) $y = 5\sin(2x + 9)$

A) $-10\sin(2x + 9)$ B) $-20\cos(2x + 9)$ C) $-20\sin(2x + 9)$ D) $10\cos(2x + 9)$

$y' = 5\cos(2x+9)\cdot 2$

$y' = 10\cos(2x+9)$

$y'' = -10\sin(2x+9)\cdot 2$

$-20\sin(2x+9)$

Suppose that the functions f and g and their derivatives with respect to x have the following values at the given values of x. Find the derivative with respect to x of the given combination at the given value of x.

	x	f(x)	g(x)	f '(x)	g '(x)
21)	3	1	16	8	7
	4	−3	3	2	−5

21) _____

f(g(x)) at x = 4

B) −10 C) 24 D) −40

$f(g(x))$

$f'(g(x)) \cdot g'(x)$

$f'(g(4)) \cdot g'(4)$

$f'(3) \cdot -5$

$8 \cdot -5$

-40

Find the extreme values of the function and where they occur. $y' = 0$

22) $y = x^3 - 3x^2 + 7x - 10$

A) The maximum is 6 at $x = 2$.

B) The maximum is 6 at $x = 1$.

C) The minimum is 6 at $x = -1$.

D) There are none.

$y' = 3x^2 - 6x + 7$ ( )( )

$a = 3$

$b = -6$

$c = 7$

$x = \frac{6 \pm \sqrt{36 - 4 \cdot 3 \cdot 7}}{6}$

$x = \frac{6 \pm \sqrt{-48}}{6}$ not a real #

$y' = 0$

Find the intervals on which the function is increasing and the intervals on which the function is decreasing.

23) $y = x^4 - 2x^2 + 1$

A) Increasing on $(-\infty, -1)$ and $(1, \infty)$, decreasing on $(-1, 1)$

B) Increasing on $(-1, 0)$, decreasing on $(-\infty, -1)$ and $(0, \infty)$

C) Increasing on $(-1, 0)$ and $(1, \infty)$, decreasing on $(-\infty, -1)$ and $(0, 1)$

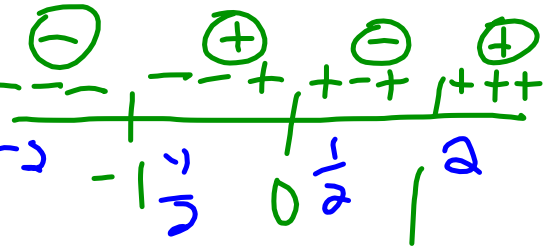
D) Increasing on $(-\infty, -1)$ and $(0, 1)$, decreasing on $(-1, 0)$ and $(1, \infty)$

$y' = 4x^3 - 4x = 0$

$4x(x^2 - 1) = 0$

$4x(x-1)(x+1) = 0$

$x = 0, 1, -1$



incr $(-1, 0) \cup (1, \infty)$

decr $(-\infty, -1) \cup (0, 1)$

Use the Concavity Test to find the intervals where the graph of the function is concave up.

24) $y = x^3 - 3x^2 - 9x + 3$

A) $(-\infty, 1)$ B) $(1, \infty)$ C) $(-\infty, 1), (1, \infty)$ D) None

$y' = 0$

$y' > 0$

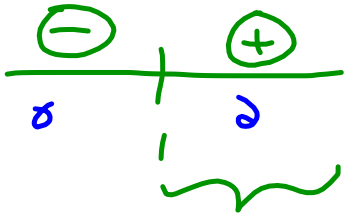
+

$y' = 3x^2 - 6x - 9$

$y'' = 6x - 6 = 0$

$6x = 6$

$x = 1$



Find dy/dx.

25) $f(x) = -8e^{3x}$

A) $-24e^{3x}$ B) $-8e^{3x}$ C) $-24e^{x}$ D) $3e^{3x}$

$f'(x) = -8e^{3x} \cdot 3$