NON-CALCULATOR

1. Let f be the function given by $f(x) = (2x-1)^5(x+1)$. Which of the following is an equation for the line tangent to the graph of f at the point where $x = 1$.

a. $y = 21x + 2$

b. $y = 21x - 19$

c. $y = 11x - 9$

d. $y = 10x + 2$

e. $y = 10x - 8$

2. Which of the following is an equation of the line tangent to the graph of $x^2 - 3xy = 10$ at the point $(1, -3)$.

a. $y + 3 = -11(x - 1)$

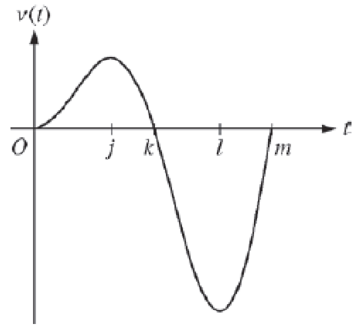
b. $y + 3 = -\frac{7}{3}(x - 1)$

c. $y + 3 = \frac{1}{3}(x - 1)$

d. $y + 3 = \frac{7}{3}(x - 1)$

e. $y + 3 = \frac{11}{3}(x - 1)$

3. A particle moves along a straight line. The graph of the particle's velocity $v(t)$ at time t is shown below for $0 \leq t \leq m$, where $j, k, l,$ and m are constants. The graph intersects the horizontal axis at $t = 0$, $t = k$, and $t = m$ and has horizontal tangents at $t = j$ and $t = l$. For what values of t is the speed of the particle decreasing?



a. $j \leq t \leq l$

b. $k \leq t \leq m$

c. $j \leq t \leq k$ and $l \leq t \leq m$

d. $0 \leq t \leq j$ and $k \leq t \leq l$

e. $0 \leq t \leq j$ and $l \leq t \leq m$

4. A particle moves along the x-axis with its position at time t given by $x(t) = (t - a)(t - b)$, where a and b are constants and $a \neq b$. For which of the following values of t is the particle at rest?

a. $t = ab$

b. $t = \frac{a+b}{2}$

c. $t = a + b$

d. $t = 2(a + b)$

e. $t = a$ and $t = b$

5. For $t \geq 0$, the position of a particle moving along the x-axis is given by $x(t) = \sin(t) - \cos(t)$. What is the acceleration of the particle at the point where the velocity is first equal to 0?

a. $-\sqrt{2}$

b. -1

c. 0

d. 1

e. $\sqrt{2}$

6. The line tangent to the curve $x^4 + 3xy^2 + 5y^3 = 9$ at the point $(1,1)$ is given by:

a. $y - 1 = 3(x - 1)$

b. $y - 1 = -\frac{1}{3}(x - 1)$

c. $y = -\frac{1}{3}(x - 1)$

d. $y = -3(x - 1) + 1$

e. $y = \frac{1}{3}(x - 1) + 1$

7. The position function of a moving particle on the x-axis is given as $s(t) = t^3 + t^2 - 8t$ for $0 \leq t \leq 10$. For what values of t is the particle moving to the right?

a. $(-\infty, -2)$

b. $(0,10]$

c. $\left(-\infty, \frac{4}{3}\right)$

d. $\left(0, \frac{4}{3}\right)$

e. $\left(\frac{4}{3}, 10\right]$

8. Given the equation $y = 3e^{-2x}$, what is the equation of the normal line to the graph at $x = \ln 2$

a. $y = \frac{2}{3}(x - \ln 2) + \frac{3}{4}$

b. $y = \frac{2}{3}(x + \ln 2) - \frac{3}{4}$

c. $y = -\frac{3}{2}(x - \ln 2) + \frac{3}{4}$

d. $y = -\frac{3}{2}(x - \ln 2) - \frac{3}{4}$

e. $y = 24(x - \ln 2) + 12$

9. The velocity function of a moving particle on the x-axis is given as $v(t) = t^2 - 3t - 10$. For what positive values of t is the particle's speed increasing?

a. $0 < t < \frac{3}{2}$ only

b. $t > \frac{3}{2}$ only

c. $t > 5$ only

d. $0 < t < \frac{3}{2}$ and $t > 5$

e. $\frac{3}{2} < t < 5$ only

10. The tangent to the parabola $y = ax^2$ at $x = p$ intersects the y-axis at

a. $(-ap^2, 0)$

b. $(-2a, 0)$

c. $(0, -ap^2)$

d. $(0, ap^2)$

e. $(0, -ap)$

11. An equation of the line tangent to $y = 4x^3 - 7x^2$ at $x = 3$ is

a. $y + 45 = 66(x + 3)$

b. $y - 45 = 66(x - 3)$

c. $y = 66x$

d. $y = 66(x - 3)$

e. $y + 45 = -\frac{1}{66}(x - 3)$

12. Find the equation of the tangent line to $9x^2 + 16y^2 = 52$ through $(2, -1)$

a. $-9x + 8y - 26 = 0$

b. $9x - 8y - 26 = 0$

c. $9x - 8y - 106 = 0$

d. $8x + 9y - 17 = 0$

e. $9x + 16y - 2 = 0$

13. A particle's position is given by $s = t^3 - 6t^2 + 9t$. What is its acceleration at time $t = 4$?

a. 0

b. 9

c. -9

d. -12

e. 12

14. Let f be the function $f(x) = -x^3 + 75x$. On which of the following intervals is the function decreasing?

a. $(0, \infty)$

b. $(-\infty, -5] \cup [5, \infty)$

c. $(-\infty, 0)$

d. $[-5,5]$

e. $\left(5\sqrt{3}, \infty\right)$

15. $\lim_{x \to \frac{\pi}{4}} \frac{2\tan(2x)}{1+3\sec(2x)} =$

a. 0

b. 1

c. $\frac{2}{3}$

d. $\frac{3}{2}$

e. Does not exist

16. Let f be the function $f(x) = \frac{x}{\ln x}$. Which of the following are the coordinates of the point at which a local minimum occurs?

a. $(1,0)$

b. $(0,0)$

c. $\left(\frac{1}{e}, 1\right)$

d. (e, e)

e. $(e,1)$

17. Let g be the function defined by $g(x) = xe^{kx}$ with k as a constant. For what value of k does g have a critical point at $x = 2$.

a. $k = 2$

b. $k = -\frac{1}{2}$

c. $k = 1$

d. $k = 0$

e. There is no such value of k

18. Let h be the function defined by $h(x) = \frac{1}{4}x^4 - 3x^2$. On which of the following intervals is h concave up?

a. $\left(-\infty, -\sqrt{2}\right) \cup \left(\sqrt{2}, \infty\right)$

b. $\left(-\infty, -\sqrt{6}\right) \cup \left(0, \sqrt{6}\right)$

c. $\left(-\sqrt{2}, \sqrt{2}\right)$

d. $\left(-\sqrt{6}, 0\right) \cup \left(\sqrt{6}, \infty\right)$

e. h is never concave up

19. What is the height of the cylinder with a volume of 250π cubic feet and minimum surface area?

a. 5 feet

b. 10 feet

c. 150π square feet

d. $5\sqrt[3]{\pi}$ feet

e. 5π feet

20. Approximate the change in the volume of a tetrahedron (a regular geometric solid in the shape of a triangular pyramid made of four equilateral triangles) if the side length of each triangle increases from 10 inches to 10.1 inches. $V = \frac{a^3}{6\sqrt{2}}$ where a is the length of the side of each triangles.

a. 5 cubic inches

b. $5\sqrt{2}$ cubic inches

c. $\frac{5}{\sqrt{2}}$ cubic inches

d. 10 cubic inches

e. $10\sqrt{2}$ cubic inches

21. A particle moves along the x-axis with a position of $x(t) = 6t^3 - 2t$ for $t \geq 0$. Find the particle's acceleration at $t = 6$.

a. 656

b. 646

c. 216

d. 214

e. 36

22. Suppose that the function $f(x)$ is continuous and differentiable on the interval $[0,10]$. The table below gives values of the function, its derivative, and its second derivative for selected values of x.

x	2	3	4
$f(x)$	1	7	12
$f'(x)$	3	0	-3
$f''(x)$	0	1	-2

Which of the following is true?

I. $f(x)$ has a local maximum at $x = 2$

II. $f(x)$ has a local maximum at $x = 3$

III. The point $(2,1)$ is a possible point of inflection

IV. There must be a point of inflection on the interval $(3,4)$

V. $f(x)$ is increasing at $x = 2$

VI. $f(x)$ is decreasing at $x = 4$

a. II, III, V, and VI

b. V and VI

c. II, III, V, VI,

d. I, II, IV

e. III, IV, V, VI

23. On the interval $[0,2\pi]$, $f(x) = \sin(\cos x)$ is increasing on:

a. $[0, \pi]$

b. $[0,2\pi]$

c. $[\pi, 2\pi]$

d. $\left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$

e. $\left[0, \frac{\pi}{2}\right] \cup \left[\pi, \frac{3\pi}{2}\right]$

24. $\lim\limits_{x \to 4} \frac{\sin\frac{\pi}{2}x}{x^3 - 64} =$

a. $\frac{1}{48}$

b. $\frac{\pi}{96}$

c. 0

d. $\frac{\pi}{12}$

e. Does not exist

25. The graph of $f''(x)$, the second derivative of $f(x)$, is shown for $-2 \leq x \leq 4$. What are all intervals on which the graph of $f(x)$ is concave down?

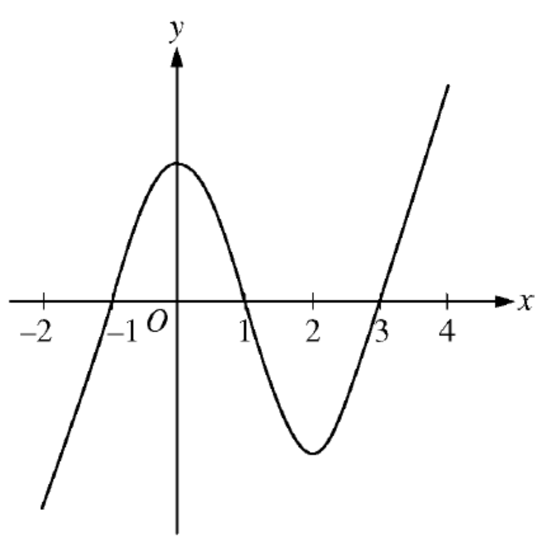
a. $-1 < x < 1$

b. $0 < x < 2$

c. $1 < x < 3$ only

d. $-2 < x < -1$ only

e. $-2 < x < -1$ and $1 < x < 3$



Graph of f''

CALCULATOR

26. The first derivative of the function f is given by $f'(x) = x - 4e^{-\sin(2x)}$. How many points of inflection does the graph of f have on the interval $(0,2\pi)$.

a. 3

b. 4

c. 5

d. 6

e. 7

27. If $f'(x) = \sqrt{x^4 + 1} + x^3 - 3x$, then f has a local maximum at $x =$

a. -2.314

b. -1.332

c. 0.350

d. 0.829

e. 1.234

28. Use Newton's Method to approximate (to 9 decimals) the solution to the equation $x^3 - 2x + 1 = x + 5$.

a. 2.195823300

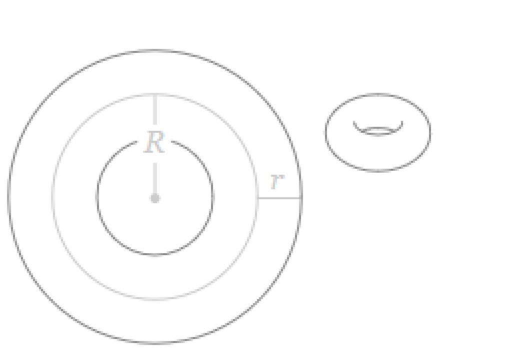
b. 2.195823434

c. 2.195823345

d. -1.618033989

e. -1.618034049

29. Use differentials to approximate the change in the surface area of a torus (three-dimensional solid in the shape of a donut) if its major axis R changes from 3 inches to 3.004 inches and its minor axis r changes from 2 inches to 2.004 inches. The surface area of a torus is $A = \pi^2(R^2 - r^2)$.



a. .0251327412

b. .0789568352

c. .008

d. .197392088

e. .0789568307

30. Use the linearization $L(x)$ of $f(x) = \sqrt[4]{x}$ to approximate $\sqrt[4]{16.003}$

a. 2.000093743

b. 2.00009375

c. 2

d. 2.0000938

e. 2.0000925