1) The slope of the curve $y^3 - xy^2 = 4$ at the point where $y = 2$ is

(A) -2 (B) $\frac{1}{4}$ (C) $-\frac{1}{2}$ (D) $\frac{1}{2}$ (E) 2

2) The tangent to the curve $y^2 - xy + 9 = 0$ is vertical when

(A) $y = 0$ (B) $y = \pm\sqrt{3}$ (C) $y = \frac{1}{2}$

(D) $y = \pm 3$ (E) none of these

3) The tangent to the curve $y = xe^{-x}$ is horizontal when x is equal to

(A) 0 (B) 1 (C) -1

(D) $\frac{1}{e}$ (E) none of these

4) The point on the curve $y = \sqrt{2x+1}$ at which the normal is parallel to the line $y = -3x + 6$ is

(A) (4,3) (B) (0,1) (C) $(1, \sqrt{3})$ (D) (4, —3) (E) $(2, \sqrt{5})$

5) The minimum value of the slope of the curve $y = x^5 + x^3 - 2x$ is

(A) 0 (B) 2 (C) 6

(D) -2 (E) none of these

6) The maximum value of the function $y = -4\sqrt{2-x}$ is

(A) 0 (B) -4 (C) 2

(D) -2 (E) none of these

For questions 7 – 9, consider a particle moving along a horizontal line with its position *s* at time *t* described by:

$$s(t) = t^4 - 6t^3 + 12t^2 + 3$$

7) The particle is at rest when t is equal to

(A) 1 or 2 (B) 0 (C) $\frac{9}{4}$

(D) 0, 2, or 3 (E) none of these

8) The velocity $v(t)$ is increasing when

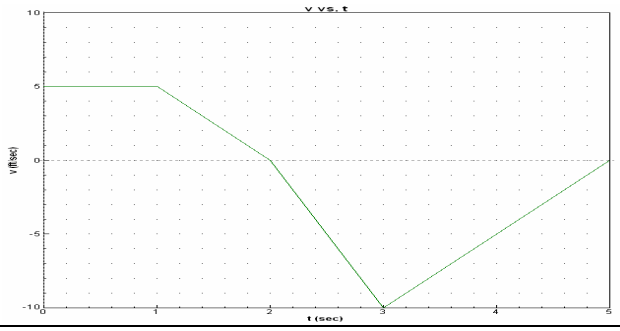
(A) $t > 1$ (B) $1 < t < 2$ (C) $t < 2$ (D) $t < 1$ or $t > 2$ (E) $t > 0$

9) The speed of the particle is increasing for

(A) $0 < t < 1$ or $t > 2$ (B) $1 < t < 2$ (C) $t < 2$

(D) $t < 0$ or $t > 2$ (E) $t < 0$

The graph below shows the velocity of an object moving along a straight line during the time interval $0 \le t \le 5$. Use the graph to answer questions 10—16.



10) The object obtains its maximum speed when $t =$

(A) 0 (B) 1 (C) 2 (D) 3 (E) 5

11) The speed of the object is increasing during the time interval

(A) (0,1) (B) (1,2) (C) (0,2) (D) (2,3) (E) (3,5)

12) The acceleration of the object is positive during the time interval

(A) (0,1) (B) (1,2) (C) (0,2) (D) (2,3) (E) (3,5)

13) How many times on $0 < t < 5$ is the object's acceleration undefined?

(A) none (B) 1 (C) 2 (D) 3 (E) more than 3

14) During $2 < t < 3$ the object's acceleration in ft/sec^2 is

(A) -10 (B) -5 (C) 0 (D) 5 (E) 10

15) The object is furthest to the right when $t =$

(A) 0 (B) 1 (C) 2 (D) 3 (E) 5

16) The object's average acceleration for the interval $0 \le t \le 3$ in ft/s^2 is

(A) -15 (B) -5 (C) -3

(D) -1 (E) none of these

17) The two tangents that can be drawn from the point (3,5) to the parabola $y = x^2$ have slopes

(A) 1 and 5 (B) 0 and 4 (C) 2 and 10

(D) 2 and $-\frac{1}{2}$ (E) 2 and 4

For questions 18 and 19, $f'(x) = x\sin(x) - \cos(x)$ for $0 < x < 4$. Use your calculator.

18) f has a local maximum when x is approximately

(A) 0.9 (B) 1.2 (C) 2.3 (D) 3.4 (E) 3.7

19) f has a point of inflection when x is approximately

(A) 0.9 (B) 1.2 (C) 2.3 (D) 3.4 (E) 3.7

20) The point(s) on the curve $x^2 - y^2 = 4$ closest to the point (6,0) is (are)

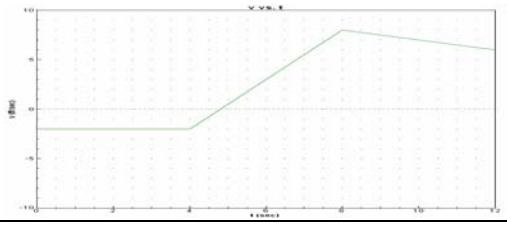
(A) (2,0) (B) $(\sqrt{5}, \pm 1)$ (C) $(3, \pm\sqrt{5})$

(D) $(\sqrt{13}, \pm\sqrt{3})$ (E) none of these

21) Two cars are traveling along perpendicular roads, car A at 40 mi/hr, car B at 60 mi/hr. At noon, when car A reaches the intersection, car B if 90 miles away and moving toward it. At 1 p.m. the distance between the cars is changing, in miles per hour, at the rate of :

(A) -40 (B) 68 (C) 4 (D) -4 (E) 40

The graph for questions 22 – 23 shows the velocity of an object moving along a straight line during the time interval $0 \le t \le 12$.



22) For what t does this object attain its maximum acceleration?

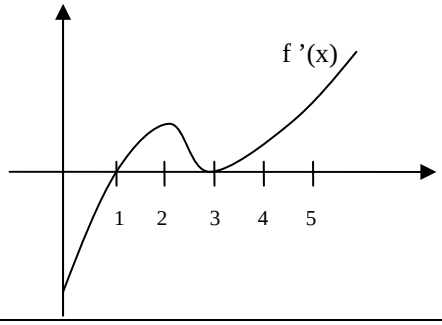
(A) $0 < t < 4$ (B) $4 < t < 8$ (C) $t = 5$ (D) $t = 8$ (E) $t = 12$

23) The object reverses direction at t equals

(A) 4 only (B) 5 only (C) 8 only

(D) 5 and 8 (E) none of these

Use the graph of $f'(x)$ on [0,5] for questions 24 and 25.



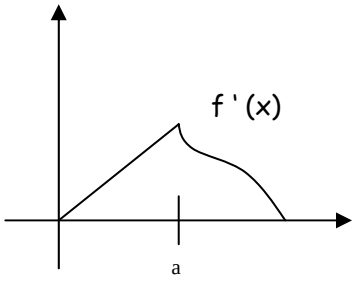
24) f has a local minimum at $x =$

(A) 0 (B) 1 (C) 2 (D) 3 (E) 5

25) f has a point of inflection at $x =$

(A) 1 only (B) 2 only (C) 3 only
(D) 2 and 3 only (E) none of these

26) It follows from the graph of $f'(x)$ shown at the right, that



(A) $f(x)$ is not continuous at x = a
(B) $f(x)$ continuous but not differentiable at x = a
(C) $f(x)$ has a relative maximum at x = a
(D) $f(x)$ has a point of inflection at x = a
(E) none of these

27) A balloon is being filled with helium at the rate of 4 ft^3/min . The rate (in ft^2/min) at which the surface area is increasing when the volume is $\frac{32\pi}{3}$ ft^3 is

(A) 4π (B) 2 (C) 4 (D) 1 (E) 2π

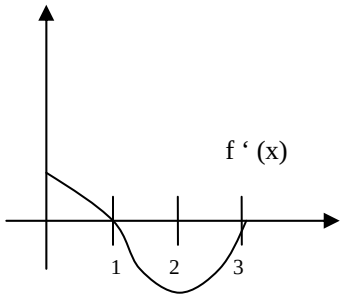
28) A circular conical reservoir (vertex down) has a depth of 20 ft and radius of the top 10 ft. Water is leaking out so that the surface is falling at the rate of $\frac{1}{2}$ ft/hr. The rate (in ft^3/hr) at which the water is leaving the reservoir when the water is 8 ft deep is:

(A) 4π (B) 8π (C) 16π (D) $\frac{1}{4\pi}$ (E) $\frac{1}{8\pi}$

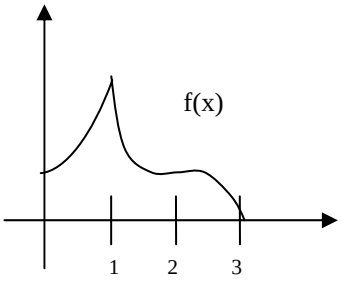
29) The area of the largest rectangle that can be drawn with one side along the x-axis and two vertices on the curve of $y = e^{-x^2}$ is

(A) $\sqrt{\frac{2}{e}}$ (B) $\sqrt{2e}$ (C) $\frac{2}{e}$ (D) $\frac{1}{\sqrt{2e}}$ (E) $\frac{2}{e^2}$

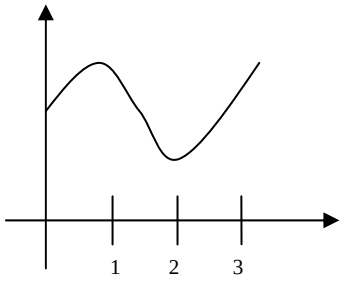
30) Given f '(x) as graphed, which graph below could be the graph of f(x) ?



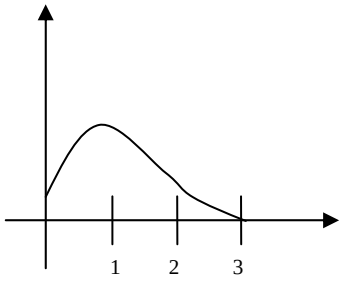
(A)



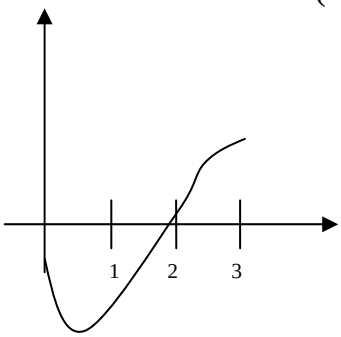
(B)



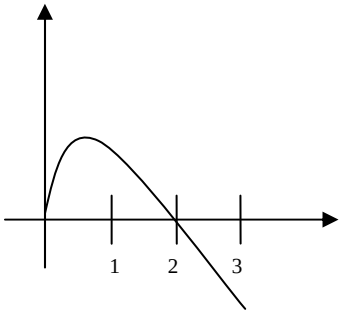
(C)



(D)



(E)



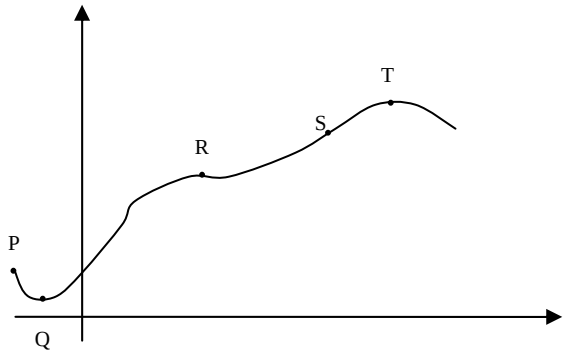
31) A function $f(x)$ has a derivative for each x such that $|x| < 2$ and $f(x)$ has a local minimum at (2, —5). Which statement below must be true?

(A) $f'(x) = 0$
(B) $f'(x)$ exists at $x = 2$
(C) The graph of $f(x)$ is concave up at $x = 2$
(D) $f'(x) < 0$ if $x < 2$ and $f'(x) > 0$ if $x > 2$
(E) none of the preceding is necessarily true

32) The tangent to the curve $x^3 + x^2 y + 4y = 1$ at the point (3, -2) has slope

(A) —3 (B) $-\frac{23}{9}$ (C) $-\frac{27}{13}$ (D) $-\frac{11}{9}$ (E) $-\frac{15}{13}$

Use the following graph for questions 33 – 35



33) At which labeled point do both $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ equal zero?

(A) P (B) Q (C) R (D) S (E) T

34) At which labeled point is $\frac{dy}{dx}$ positive and $\frac{d^2y}{dx^2}$ equal to zero?

(A) P (B) Q (C) R (D) S (E) T

35) At which labeled point is $\frac{dy}{dx}$ equal to zero and $\frac{d^2y}{dx^2}$ negative?

(A) P (B) Q (C) R (D) S (E) T

36) Which statement below is true about the curve $y = \frac{2x^2+4}{2+7x-4x^2}$?

(A) The line $x = -\frac{1}{4}$ is a vertical asymptote

(B) The line x = 1 is a vertical asymptote

(C) The line $y = -\frac{1}{4}$ is a horizontal asymptote

(D) The graph has no vertical or horizontal asymptotes

(E) The line $x = 2$ is a horizontal asymptote

37) The best linear approximation for $f(x) = \tan(x)$ near $x = \frac{\pi}{4}$ is

(A) $1+\frac{1}{2}\left(x-\frac{\pi}{4}\right)$ (B) $1+\left(x-\frac{\pi}{4}\right)$ (C) $1+\sqrt{2}\left(x-\frac{\pi}{4}\right)$

(D) $1+2\left(x-\frac{\pi}{4}\right)$ (E) $2+2\left(x-\frac{\pi}{4}\right)$

38) The tangent line approximation for $f(x) = \sqrt{x^2+16}$ near $x = -3$ is

(A) $5-\frac{3}{5}(x-3)$ (B) $5+\frac{3}{5}(x-3)$ (C) $5-\frac{3}{5}(x+3)$ (D) $3-\frac{5}{3}(x-3)$ (E) $3+\frac{3}{5}(x+3)$