Choose NOTA if no other answer is correct.

1. Find the equation of a line perpendicular to the line tangent to the graph of $y = 2x^3 - 3x^2 + 2x - 2$ at $x = 1$.

a. $2x - y = 3$
b. $x - 2y = 3$
c. $2x + y = 1$
d. $x + 2y = -1$
e. NOTA

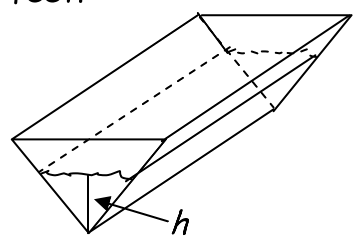
2. Find the point (a,b) on the graph of $f(x) = \sqrt{x-2}$, such that the slope of the tangent line is equal to half of the slope of the tangent line at $x = 3$. What is the value of ab?

a. 12
b. 18
c. 20
d. 24
e. NOTA

3. Function h is defined such that $h(x) = \begin{cases} k\sqrt[3]{x-1} \text{ on } (-\infty, 2] \\ mx - 4 \text{ on } (2, \infty) \end{cases}$. If h is differentiable at $x = 2$, find $k + m$.

a. -16
b. -12
c. 8
d. 16
e. NOTA

4. The trough shown has the shape of a regular triangular prism. Each edge of the triangular base measures 4 feet and the length of the trough is 10 feet. Water flows into the trough at 2 cubic feet per minute. At what rate in feet per minute is the height, h, of the water level increasing when the height of the water is 3 feet?



a. $\frac{5\sqrt{3}}{3}$
b. $\frac{\sqrt{3}}{30}$
c. $\frac{1}{20}$
d. $10\sqrt{3}$
e. NOTA

5. The cost in dollars, $C(x)$, to produce 50 notebooks is $105 and is defined by the formula $C(x) = 0.02x^2 + 0.4x + k$, where x is the number of notebooks produced. Use a linear approximation to estimate the cost of 51 notebooks.

a. $2.40
b. $105.24
c. $107.40
d. $129
e. NOTA

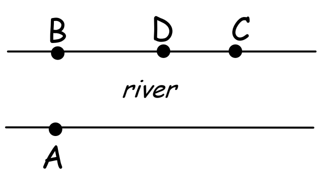
6. Evaluate $\int_{-1}^{2} \left(x^2 + x + \frac{1}{x^2} \right) dx$.

a. -1
b. 3
c. $\frac{20}{3} + \ln(4)$
d. 6
e. NOTA

7. Find $\frac{dy}{dx}$ if $xy + \cos(xy) = x^2$.

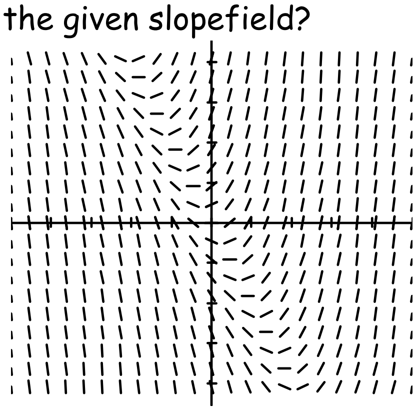
a. $\frac{2x}{1+\sin(xy)} - y$
b. $\frac{2}{1-\sin(xy)} - y$
c. $\frac{2x-y}{x(1+\sin(xy))}$
d. $\frac{2}{1-\sin(xy)} - \frac{y}{x}$
e. NOTA

8. An observer stands at point A on the bank of a river. He needs to get to point C in the least amount of time. He rows a boat at 4 mph to point D and then runs to point C at 6 mph. If point B is directly across the river 2 miles from point A, and C is 8 miles from B, how many miles is point D from point B?



a. $\frac{\sqrt{2}}{4}$
b. $\frac{4\sqrt{5}}{5}$
c. $4\sqrt{2}$
d. $\frac{2\sqrt{5}}{3}$
e. NOTA

9. Which differential equation could be used to create the given slopefield?



a. $y' = x - y$
b. $y' = x \cdot y$
c. $y' = 2x + y$
d. $y' = -\frac{x}{y}$
e. NOTA

10. The region bounded by $f(x) = x^2 + 1, x = 0, x = 1$, and $y = 0$ is rotated about the y-axis. Find the volume of the solid generated.

a. $\frac{3\pi}{2}$
b. $\frac{3\pi}{4}$
c. $\frac{8\pi}{3}$
d. $\frac{5\pi}{4}$
e. NOTA

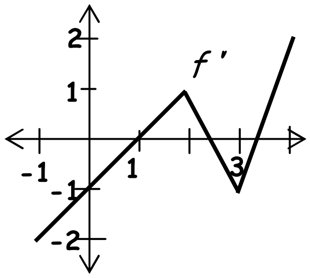
11. Evaluate $\int_0^2 \frac{x}{e^{x^2}}\,dx$.

a. $\frac{e^2-1}{2e^2}$
b. $\frac{e-1}{2e}$
c. $\frac{1}{2e^4}$
d. $\frac{e^4-1}{2e^4}$
e. NOTA

12. Which expression is equivalent to $\frac{d^2y}{dx^2}$ if $x^3 + y^3 = 8$?

a. $\frac{2xy^3 + 2x^4}{y^5}$
b. $\frac{-2xy^3 + 2x^4}{y^5}$
c. $\frac{-16x}{y^5}$
d. $-\frac{x^2}{y^2}$
e. NOTA

Use the given graph of f' to answer questions 13 and 14.



13. Function f is differentiable on $[-1,4]$ and $f(0) = 2$. The graph of f' is made up of line segments with endpoints $(-1,-2)$, $(2,1)$, $(3,-1)$ and $(4,2)$, as shown. How many of the following statements is(are) true?

I. $f(-1) > 2$

II. f has inflection points at x = 2 and x = 3.

III. f has a local maximum between x = 2 and x = 3.

IV. $\int_{-1}^{2} f'(x)dx < 0$

a. 1
b. 2
c. 3
d. 4
e. NOTA

14. Find an equation of the line tangent to the graph of f at x = 2. (Use f' above.)

a. $x - y = 2$
b. $x - y = 0$
c. $x + y = -2$
d. $x - y = 1$
e. NOTA

15. Evaluate $\int_{0}^{\pi/3} \tan x \cdot \sec^2 x \, dx$.

a. 3/2
b. $\sqrt{3}/2$
c. 1
d. $\frac{1}{2}$
e. NOTA

16. If $f(x)=\sin(2x)+\cos^2 x$, which of the following is(are) true at $x = \frac{\pi}{6}$?

I. f is decreasing.
II. f is concave down
III. f is continuous

a. I and III only
b. I and II only
c. II and III only
d. I, II, and III
e. NOTA

17. If $f(x) = ax^3 + bx^2 + cx + d, f'(1) = 12,$ $f''(1) = 30, f'''(x) = 24,$ and $f(0) = -2,$ find $a + b + c + d$.

a. -1
b. 1
c. 2
d. 6
e. NOTA

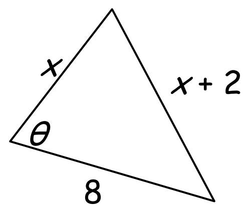
18. What is the value of $\sum_{n=0}^{\infty} \frac{3^{n+1}}{5^n}$?

a. 15/2
b. 3/2
c. 1/2
d. 10/3
e. NOTA

19. Evaluate $\lim_{x \to 0} \frac{\tan x \cdot \sec x - x}{2x^3 + \sin x - x}$.

a. 7/10
b. 3/10
c. 3/11
d. 5/11
e. NOTA

20. The given triangle is changing such that $\frac{dx}{dt} = 3$ ft/sec for x>3. Find $\frac{d\theta}{dt}$ in radians per second when $x = 6$.



a. $\frac{\sqrt{73}}{22}$
b. $\frac{\sqrt{55}}{8}$
c. $\frac{5\sqrt{55}}{8}$
d. $\frac{\sqrt{55}}{22}$
e. NOTA

21. A cone is inscribed in a sphere with a diameter of 6. What is the maximum possible volume of the cone?

a. $\frac{32\pi}{3}$
b. $\frac{16\pi}{3}$
c. 10π
d. 12π
e. NOTA

22. A semicircle of radius 10 miles with center on the shoreline represents a city in Florida. At r miles from the city center, the population density can be approximated by $f(r) = \frac{5000}{1+r}$ people per square mile. Find the population of the city using $\ln 11 \approx 2$ and $\pi \approx 3$.

a. 240,000
b. 180,000
c. 120,000
d. 115,000
e. NOTA

23. If f' is continuous and differentiable on $[a,b]$, which of the following MUST be true.

I. f has at least one inflection point on (a,b).
II. f is continuous and differentiable on $[a,b]$.
III. There exists a c in (a,b) such that $f'(b) - f'(a) = f''(c)(b-a)$.

a. II only
b. III only
c. II and III only
d. I, II, and III
e. NOTA

24. A triangle has its vertices at $(x,3),(-2,x+2)$, and $(x-4,x)$. The value of x that maximizes the area of the triangle is written in the form $\frac{m}{n}$ where m and n are relatively prime. Find $|m+n|$.

a. 7
b. 5
c. 9
d. 8
e. NOTA

25. Find the area bounded by $f(x) = \arctan(x)$, $x = 0$, and $y = \frac{\pi}{4}$.

a. $\frac{\pi}{4} - \ln 2$
b. $\ln 2$
c. $\frac{\pi}{4} - \ln\sqrt{2}$
d. $\ln\sqrt{2}$
e. NOTA

26. The rate of change of a population of bacteria is directly proportional to $\sqrt{y}$, where y is the number of bacteria present at time t. If 1 bacteria is present at $t = 0$ and 25 bacteria are present at $t = 2$, how many bacteria are present at $t = 5$?

a. 110
b. 115
c. 118
d. 121
e. NOTA

27. A particle moves on the x-axis so that its velocity at time t is given by $v(t) = t^2 - 3t$ on $[0,4]$. If $s(t)$ describes its position at time t and $s(0) = 4$, what is the greatest distance between the particle and the origin?

a. 4/3
b. 9/2
c. 17/2
d. 4
e. NOTA

28. The length of a curve from $x = 2$ to $x = 4$ is given by $\int_2^4 \sqrt{4x^2 - 4x + 2}\, dx$.
Which of the following could be an equation for this curve?

a. $y = 4x^2 - 4x + 1$
b. $y = x^2 - x + 5$
c. $y = x^2 + x + 4$
d. $y = 2x - 1$
e. NOTA

29. A curve C is defined by the parametric equations $x = -t^2 - 6t + 2$ and $y = t^3 - 3$.
Which of the following are characteristics of the graph of C at the point $(-5,-2)$?

I. The line tangent has a negative slope.
II. The graph of C is concave up.
III. The x-coordinate is decreasing.

a. I, II, and III
b. I and III only
c. III only
d. I and II only
e. NOTA

30. Which of the following series diverge?

I. $\sum_{n=0}^{\infty} \left(\frac{e}{\cos 3} \right)^n$
II. $\sum_{n=1}^{\infty} \frac{n}{\sqrt{n^2 + n}}$
III. $\sum_{n=0}^{\infty} \frac{2^n}{n!}$

a. I, II and III
b. I and II only
c. I only
d. II and III only
e. NOTA