1) Find the derivative of the function *f* below.

$$f(x) = 4x^4 e^{x^2-1}$$

A. $8x^3 e^{x^2-1}(x+2)$

B. $8x^3 e^{x^2-1}(x^2+2)$

C. $8x^3 e^{x^2-1}(x+4)$

D. $4x^3 e^{x^2-1}(x+4)$

E. None of the above.

2) Which statement(s) is(are) true?

I	$\log_2\left(\frac{1}{32}\right) = -5$
II	$\log_b 12 = m+1 \Leftrightarrow (m+1)^{12} = b$
III	$\ln 8251 \approx 3.9165$ (to 4 decimal places)

A. II only

B. I and III only

C. I and II only

D. I only

E. II and III only

3) Solve this logarithmic equation and select the solution or solutions.

$$\log_3(x-2) + \log_3(x+6) = 2$$

A. $x = 3$

B. $x = -2-3\sqrt{2},\ -2+3\sqrt{2}$

C. $x = -7,\ x = 3$

D. $x = -3,\ x = 7$

E. $x = 2-3\sqrt{2},\ 2+3\sqrt{2}$

4) Which expression is equivalent to $\ln \dfrac{3(5^2)}{\sqrt[3]{6}}$?

A. $\ln 3 + \frac{1}{2}\ln 5 - 3\ln 6$

B. $(\ln 3)(2\ln 5) - \frac{1}{3}\ln 6$

C. $\ln(3 \cdot 5^2) - \ln \sqrt[3]{6}$

D. $\dfrac{(\ln 3)(2\ln 5)}{\frac{1}{3}\ln 6}$

E. $\ln 3 + 2\ln 5 - \frac{1}{3}\ln 6$

5) Find the derivative of the function, $f(t) = \ln\left(\dfrac{3t^2}{\sqrt{t}}\right)$. Hint: I suggest you use the properties or rules of logarithms to re-write function *f* first.

A. $f'(t) = \dfrac{\sqrt{t}(2-t)}{t^2}$

B. $f'(t) = \dfrac{1}{3t^{3/2}}$

C. $f'(t) = \ln 3 + \dfrac{3}{2t}$

D. $f'(t) = \dfrac{3}{2t}$

E. None of the above.

6) Find all intervals where the graph of $f(x)$ is concave upward. (I have given you the first and second derivatives of function *f* as well.)

$$f(x) = \left(\frac{x}{x+1}\right)^3, \quad f'(x) = \frac{-3x^2}{(x+1)^4}, \quad f''(x) = \frac{-6x(x-1)}{(x+1)^5}$$

A. $(0,1) \cup (1,\infty)$

B. $(-1,0) \cup (1,\infty)$

C. $(-1,0) \cup (0,1)$

D. $(-\infty,-1) \cup (1,\infty)$

E. $(-\infty,-1) \cup (0,1)$

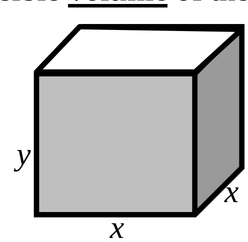
7) Amy is a quality control expert for a clothing factory. She conducts a study of the morning shift, from 8:00 AM to 12:00 PM (noon) at the factory and find that the average worker who arrives at the job at 8:00 AM will have produced Q garments t hours later, where $Q(t) = -2t^3 + 8t^2 + 2$. At what clock time during the morning shift does the average worker produce the maximum number of garments?

A. $10:40\ AM$
B. $8:00\ AM$
C. $12:00\ PM$ (noon)
D. $9:00\ AM$
E. $9:20\ AM$

8) Which function has **only one** vertical asymptote , $x = 2$; and a horizontal asymptote at $y = \frac{1}{3}$.

A. $f(x) = \dfrac{6x^2 - 13x + 6}{6x^2 - 7x + 18}$
B. $g(x) = \dfrac{x^2 + 3x + 2}{3x^2 - 9x + 6}$
C. $h(x) = \dfrac{x^2 - 4x + 4}{3x^2 - 9x + 6}$
D. $j(x) = \dfrac{x^2 - x - 2}{3x^2 - 12x + 12}$
E. $k(x) = \dfrac{2x^2 + 3x - 2}{6x^2 - 13x + 2}$

9) A box with a square base and an **open top** will be made using 1200 square millimeters of material (surface area). What is the largest possible **volume** of the box? Hint: $V = Lwh$ See the picture.



A. 400 m^3
B. 3000 m^3
C. 4000 m^3
D. 4200 m^3
E. 8600 m^3

10) Find all open intervals where function g is increasing?

$$g(x) = 5x^7 - 28x^5$$

A. $(-\infty, -2),\ (0, 2)$

B. $(-2, 0),\ (2, \infty)$

C. $(-2, 0),\ (0, 2)$

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

E. $(-\infty, 0),\ (0, \infty)$

11) A bowling ball is launched off of the top of a 300 foot tall building. The height s of the bowling ball above the ground t seconds after launched is given by $s(t) = -16t^2 + 20t + 300$ feet. What is the **<u>velocity</u>** of the ball as <u>it hits the ground?</u> Hint: You must first find the time when it hits the ground by solving the equation $0 = -16t^2 + 20t + 300$.

A. -140 ft./sec.

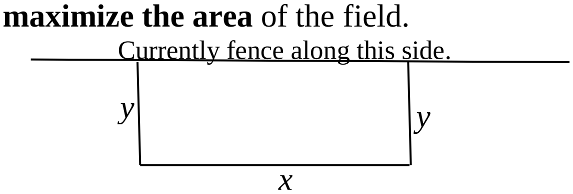
B. -120 ft./sec.

C. -100 ft./sec.

D. -80 ft./sec.

E. -60 ft./sec.

12) Larry needs to enclose a rectangular field with fencing. Currently, there is fence along one side of the field that he can keep. He has 480 feet of fence for the other three sides. (See the picture.) Find the dimensions that will **maximize the area** of the field.



A. $x = 180$ feet, $y = 120$ feet

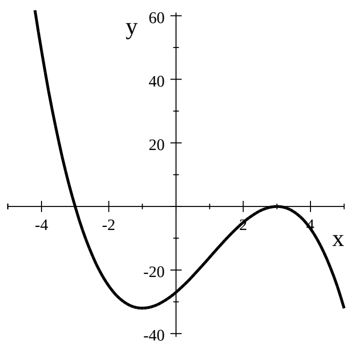
B. $x = 240$ feet, $y = 120$ feet

C. $x = 200$ feet, $y = 80$ feet

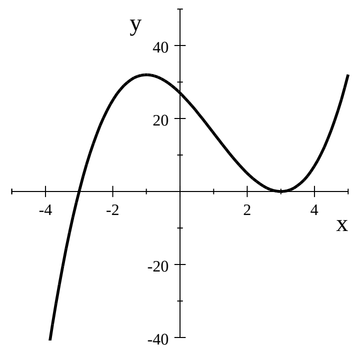
D. $x = 320$ feet, $y = 80$ feet

E. $x = 160$ feet, $y = 160$ feet

13) Select the graph of $f(x) = -x^3 + 3x^2 + 9x - 27$. Use information about intercepts, intervals of increasing and decreasing, intervals of concavity, relative maximums or minimums, any inflection points, etc.



A.



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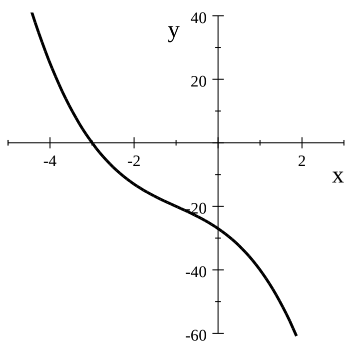

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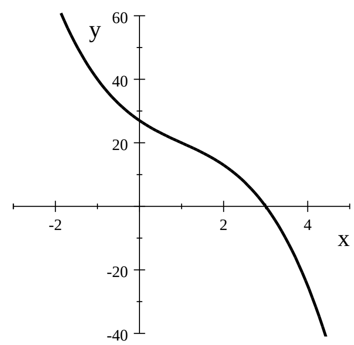

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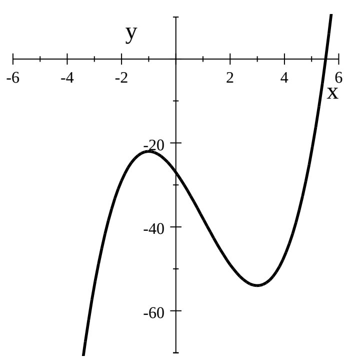

E.

14) The concentration of a drug in a patient's kidneys at time t (in seconds) is C grams per cubic centimeters (g/cm^3), where $C(t) = 0.35(1.5 - 0.48e^{-0.03t})$. How long will it take for the drug concentration to reach 0.5 g/cm^3?

Hints: You will have to convert the equation from an exponential function of base e to a natural logarithmic equation. Do not round until the final answer.

A. 182.4 seconds
B. 38.7 seconds
C. 27.6 seconds
D. 63.5 seconds
E. 98.5 seconds

15) Find the interval(s) where the graph of the function $g(t) = \left(\frac{t+2}{t+3}\right)^2$ is concave downward and find the value(s) of t where inflection point(s) occur.

A. $(-\infty, -3) \cup (-\frac{3}{2}, \infty)$; at $t = -3$ and $t = -\frac{3}{2}$
B. $(-3, -\frac{3}{2})$; at $t = -\frac{3}{2}$
C. $(-\infty, -3) \cup (-\frac{3}{2}, \infty)$; no inflection points
D. $(-\frac{3}{2}, \infty)$; at $t = -\frac{3}{2}$
E. $(-3, -\frac{3}{2})$; at $t = -3$