1. The function $f(x) = \frac{1}{3} x^3 - x + 1$ has an inflection point at

a. There are no inflection points. b. $x = 0$ c. $x = \pm 1$
d. $x = 2$ e. $x = -2$

2. Given that $f'(1) = 5$ and $f''(1) = -2$ one can say that the graph of f near $x = 1$ is

a. concave down but decreasing.
b. increasing with an inflection point at $x = 1$.
c. increasing but concave up.
d. concave down.
e. decreasing.

3. Find $\frac{dy}{dx}$ where $y = (x + 1)^{100} (x^2 + 1)$

a. $2x (x + 1)^{100} + 100(x + 1)^{99}(x^2 + 1)$
b. $200 x (x + 1)^{99}$
c. $100 (x + 1)^2 (x^2 + 1) + 99 (x^2 + 1)$
d. $100 x (x + 1) (x^2 + 1) + 200(x + 1) (x^2 + 1)$
e. $198 x(x + 1) (x^2 + 1)$

4. The derivative of $f(x) = \frac{x}{x^2 + 1}$ is

a. $\frac{1}{2x (x^2 + 1)^2}$ b. $\frac{1 - x^2}{(x^2 + 1)^2}$ c. $\frac{1 - x^2}{(x^2 + 1)^2(x + 1)}$

d. $\frac{1}{2x}$ e. $3 x^2 + 1$

5. The perimeter of a rectangle is 20. What are the dimensions of the sides of the rectangle if its area is to have the largest possible value?

a. 8 and 2 b. 5 and 15 c. 5 and 5

d. 4 and 5 e. 4 and 6

6. A cylindrical can (with top and bottom of course) of height h and radius r has volume 2π**.** The values of r and h that minimize the amount of metal needed to construct such a can are

a. $r = 3, h = 4$ b. $r = 2, h = 2$ c. $r = 1, h = 2$

d. $r = \pi, h = \pi$ e. $r = 2\pi, h = \pi$

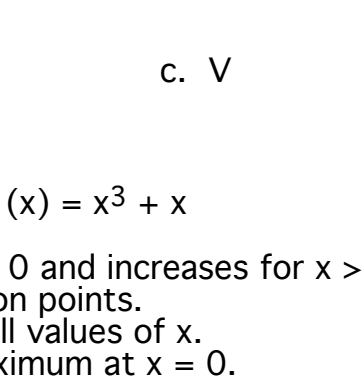
7. Which of the following best resembles the graph of $f(x) = x^3 - 3x + 2$?

I

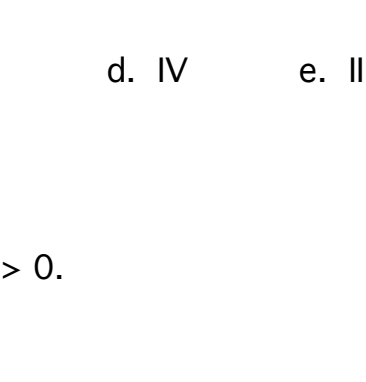
II

III

IV



V



a. III b. I c. V d. IV e. II

8. The function $f(x) = x^3 + x$

a. decreases for $x < 0$ and increases for $x > 0$.
b. has three inflection points.
c. is increasing for all values of x.
d. has a relative maximum at $x = 0$.
e. has a relative extreme point at $x = 1$.

9. Which of the graphs below has <u>one</u> relative minimum and <u>two</u> inflection points ?

I II III

IV V

a. V b. I c. IV d. II e. III

10. A helicopter is rising straight up into the air. Suppose that after t seconds its altitude is $h(t) = t^3 + t^2$ measured in feet. What is the altitude of the helicopter when its acceleration is 20 ?

a. 36 b. 42 c. 32 d. 100 e. 50

11. Which of the following might be false?

a. At a relative maximum a function changes from increasing to decreasing.

b. At a relative minimum a function changes from decreasing to increasing.

c. If $f'(a) = 0$ then $x = a$ is a relative maximum for the function f.

d. An inflection point is a point where the function changes concavity.

e. If $f'(a) = 0$ and $f''(a) > 0$ then $x = a$ is a relative minimum for the function f.

12. The second derivative of $y = (x + 1)(x + 10)$ at $x = 15$ is

a. 2 b. 15 c. 30 d. 10 e. 5

13. Where does the function $f(x) = x^6$ have an inflection point?

a. $x = 5$ b. $x = 1$ c. $x = 0$ d. $x = -2$ e. Nowhere

14. Which of the following functions has a relative maximum at $x = 5$?

a. $y = x^2 - 25$ b. $y = 5x$ c. $y = x^5 - 5x^4 + 5$

d. $y = -x^2 + 10x - 23$ e. $y = 5x^2 - 4x + 3$

15. Which of the following best describes the graph of the function $y = f(x)$ below?

a. f is concave up on $(-\infty, 2)$ and concave down on $(2, \infty)$.

b. $f'' > 0$ on $(-\infty, 2)$ and $f' < 0$ on $(2, \infty)$.

c. f is concave down on $(2, \infty)$ and decreasing on $(2, \infty)$.

d. $f'' < 0$ on $(-\infty, 2)$ and $f'' < 0$ on $(2, \infty)$.

e. f has two inflection points.

16. Which of the following is true if the graph of f looks like

a. $f'(2) = 0$ and $f''(2) > 0$

b. $f'(2) = 0$ and $f''(2) = 0$

c. $f'(2) > 0$ and $f''(2) < 0$

d. $f'(2) > 0$ and $f''(2) > 0$

e. The function is not defined at $x = 2$.

17. The function $f(x) = x^3 - x^2$ has the following relative extreme points:

a. $x = 0, \frac{2}{3}$ b. $x = 1, \frac{3}{2}$ c. $x = 0, \frac{3}{2}$ d. $x = 0, 1$ e. $x = 2, 3$

18. Given $y = (x^2 + 1)^3$, the second derivative $\frac{d^2 y}{dx^2}$ is

a. $24 x^2 (x^2 + 1) + (x^2 + 1)^2$

b. $12 x (x^2 + 1)$

c. $24 x^2 (x^2 + 1) + 6 (x^2 + 1)^2$

d. $18 (x^2 + 1)^2$

e. $6 (x^2 + 1) + 12 x (x^2 + 1)^2$

19. The absolute minimum value of the function $f(x) = x^2 - 6x + 5$ is

a. -4 b. 2 c. 5 d. -2 e. 4

20. A small orchard yields 30 bushels of apples per tree when planted with 20 trees. Due to overcrowding the yield per tree is reduced by one bushel for each additional tree planted. What is the number x of additional trees that must be planted in order to maximize the total yield of the orchard?

a. $x = 3$ b. $x = 4$ c. $x = 5$ d. $x = 2$ e. $x = 1$