1. Which of the following graphs represents a function f for which $f'(a) \neq 0$ and $f''(a) = 0$?
[The dotted lines are supposed to be tangent at the indicated point.]

I

II

III

IV

(a) I (b) II (c) III (d) IV (e) none of the above

2. For which value of x does $f(x) = -x^2 + 6x - 11$ have a relative maximum ?

(a) $x = -2$ (b) $x = 11$ (c) $x = 3$ (d) $x = 0$ (e) $f(x)$ has no relative maximum

3. Find the value(s) of x where $f(x) = x^3 + 3x^2 - 9x + 27$ has a relative extreme point.

(a) x = -1, 0   (b) x = 27   (c) x = 0   (d)   x = -3, 1

(e) f(x) has no relative extreme point

4. Which of the sketches below best represents the graph of $y = x^3 + 6x + 1$?

(a)   (b)   (c)

(d)   (e)

5. Find the minimum value of $f(x) = x + \dfrac{1}{x}$, for $x > 0$.

(a) 10   (b) 3   (c) 4   (d) 2   (e) there is no minimum value

6. Find the maximum value of $f(x) = 10 - x^4 + 2x^2$.

(a) 12   (b) 4   (c) 9   (d) 11   (e) 10

7. A rocket is fired in such a way that its height above the ground after t seconds is $h(t) = 320t - 16t^2$ feet. How many seconds does it take for the rocket to reach its maximum height ?

(a) 12   (b) 11 (c) 9   (d) 10   (e) 8

8. If $f(x) = (x^2+3)\sqrt{x+4}$, what is $f'(0)$?

(a) $\dfrac{1}{4}$ (b) $\dfrac{3}{4}$ (c) 2   (d) 4   (e) 0

9. If $f(x) = x^3 + x + 1$, what is the minimum value of $f(x)$ for $x \geq 0$?

(a) 1   (b) 2   (c) 3   (d) 0   (e) 4

10. For $f(x) = x^4 - 24x^2 + 7x + 3$, determine the interval(s) where the graph is concave down.

(a) $(-\infty,-3)$ and $(3,\infty)$ (b) $(-2,2)$ (c) $(0,7)$ (d) $(-\infty,-24)$ and $(24,\infty)$ (e) $(-3,3)$

On Problems 11-12, indicate whether the statement is true or false.

11. If $f(x) = \begin{cases} x+3 & \text{for } x \leq 1 \\ 2x+2 & \text{for } x > 1 \end{cases}$

then $f(x)$ is continuous at $x = 1$.

(a) true   (b) false

12. If $f(x) = \begin{cases} x + 1 & \text{for } x \leq 0 \\ x^2 & \text{for } x > 0 \end{cases}$

then $f(x)$ is differentiable at $x = 0$.

(a) true   (b) false

13. For which value(s) of x does $f(x) = x^8$ have an inflection point ?

(a) $x = 1$ (b) $x = 0$ (c) $x = -1, 0, 1$

(d) $x = -1, 1$ (e) $f(x)$ has no inflection point

14. For the curve $y = \dfrac{1}{x^2} + 2x - 1$, which lines are asymptotes ?

(a) $y = -1$ and $x = 2$

(b) $y = 0$ and $y = 2x$

(c) $x = 0$ and $y = 2x - 1$

(d) $y = 2$ and $y = -x + 2$

(e) there are no asymptotes

15. A rectangular garden is to have a fence on three sides, with the fourth side against a building. If there are 100 feet of fencing available, find the maximum area for the garden (in square feet).

(a) 1250   (b) 2500   (c) 1000   (d) 3300   (e) 5000

16. If $f(x) = \dfrac{x + 1}{x - 2}$, what is $f'(x)$?

(a) $\dfrac{2x}{(x - 1)^2}$

(b) 1

(c) $\dfrac{(x + 1)^2}{(x - 2)^2}$

(d) $\dfrac{1}{2}$

(e) $\dfrac{-3}{(x - 2)^2}$

17. If $f(2) = 0$, $g(2) = 1$, $f'(2) = 3$, and $g'(2) = 4$, what is $\dfrac{d}{dx}(f(x) \cdot g(x))$ at $x = 2$?

(a) 12   (b) 6   (c) 8   (d) 4   (e) 3

The following graphs are to be used in Problems 18, 19, and 20.

I   II   III

IV   V

18. Which graph has the property that the <u>slope</u> always decreases as x increases ?

(a) I   (b) II   (c) III   (d) IV   (e) V

19. Which are the graphs of increasing functions ?

(a) I, IV, V   (b) II, III   (c) I   (d) I, IV   (e) none of the
graphs

20. Which are the graphs of functions f such that f $'$ (x) < 0 thoughout the interval shown ?

(a) III   (b) I, IV, V   (c) II, III   (d) II   (e) none of the graphs