1. If $f(x) = \left(\frac{x^6 + 1}{x^3 + 1} \right)^2$, then $f'(1) = ?$

(A) 1 (B) 6 (C) 3 (D) 2 (E) 9

2. A curve called the Folium of Descartes is given by the equation $x^3 + y^3 - 9xy = 0$. Find the slope of this curve at the point (4,2).

(A) $-\frac{2}{3}$ (B) $3\sqrt{2}$ (C) $-\frac{1}{3}$ (D) $\frac{5}{4}$ (E) -6

3. A water tank has the shape of an inverted circular cone with base radius 2m and height 4m. If water is being pumped into the tank at a rate of $2m^3$/min, find the rate (in m/min) at which the level is rising when the water is 3m deep.

(A) $\frac{1}{4}$ (B) $\frac{8}{9\pi}$ (C) $\frac{\pi}{6\sqrt{3}}$ (D) $\frac{\sqrt{2}}{2\pi}$ (E) $\frac{\pi}{12}$

4. How many critical points does the function

$$f(x) = 1 + 2x^{5/3} - 5x^{2/3}$$

have?

(A) 2 (B) 4 (C) 1 (D) 3 (E) 0

5. Let f be a continuous function on the interval $[a,b]$ and differentiable on (a,b). Suppose that $f'(x) = 0$ for at most three distinct values of x where $a < x < b$. What is the maximum possible number of solutions of the equation $f(x) = 10$ in $[a,b]$?

(A) 3 (B) 1 (C) 4 (D) 0 (E) 2

6. The function $f(x) = 5 - 9x + 6x^2 - x^3$ is increasing

(A) on the interval $(-\infty, 3]$

(B) on the intervals $(-\infty, 1]$ and $[3, \infty)$

(C) on the interval $[1, \infty)$

(D) on the interval $[1, 3]$

(E) on the intervals $(-\infty, -1]$ and $[0, 3]$

7. If $f(x)$ is defined on the interval $[0, 4]$ by

$$f(x) = (x - 1)^2 (x - 3)^2$$

then $f(2)$ is a

(A) global minimum

(B) local but not global minimum

(C) global maximum

(D) y-coordinate of a point of inflection

(E) local but not global maximum

8. The graph of $y = x^5 + 5x^4 - 7x + 8$

(A) is concave down on the interval $(0, \infty)$

(B) has a point of inflection at $x = -3$ only

(C) is concave up on the interval $(-\infty, -3)$

(D) has points of inflection at $x = 0$ and $x = -3$

(E) has a point of inflection at $x = 0$ only

9. The graph of the function

$$g(x) = \frac{x^2 - x}{x^2 + x - 2}$$

has

(A) 1 vertical asymptote and no horizontal asymptotes

(B) 2 vertical asymptotes and 1 horizontal asymptote

(C) 1 vertical asymptote and 2 horizontal asymptote

(D) 2 vertical asymptotes and 2 horizontal asymptotes

(E) 1 vertical asymptote and 1 horizontal asymptote

10. The graph of $y = \frac{x}{(x + 1)^2}$ most closely resembles which of the following?