1. If $f(x) = \sec x + \tan x$, then $f'\left(\frac{\pi}{4}\right) = ?$

(a) 0 (b) $4 + 2\sqrt{3}$ (c) does not exist (d) $\frac{1 + 2\sqrt{3}}{3}$ (e) $2 + \sqrt{2}$

2. If $f(x) = \left(\frac{x^3 + 1}{x^2 + 1}\right)^4$ then $f'(1) = ?$

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

3. Given that $y^2 + 2y = 2x + 1$, $\frac{d^2y}{dx^2}$ is

(a) $\frac{1}{y+1}$ (b) $\frac{y + 1}{x^2}$ (c) $-\frac{1}{(y + 1)^3}$ (d) $\frac{2y}{(x + 1)^2}$ (e) $\frac{x + 2}{y^3}$

4. The point $(1, -1)$ lies on the Cissoid of Diocles, the curve whose equation is given by $y^2(2 - x) = x^3$. What is the slope of the Cissoid at that point?

(a) 1 (b) -2 (c) 0 (d) 2 (e) -1

5. A leprechaun watching the return of the opening kickoff of a ND football game is standing 5 yds. from the west edge of the field and in line with the goal line. Clint Johnson received the kickoff and is running down the west edge (just in bounds) at 10.6 yd/sec for a TD. When he is 12 yds from the goal line, how fast, in yd/sec, is his distance from the leprechaun changing?

(a) 9.7 (b) 10.1 (c) 9.9 (d) 9.8 (e) 10.0

6. The global maximum and the global minimum for the function

$$f(x) = \cos^2 x + \sin x$$

on the interval $\left[0, \frac{3\pi}{2}\right]$ are

(a) glmax = 1, glmin = 0

(b) glmax = 1, glmin = – 1

(c) glmax = $\frac{5}{4}$, glmin = – 1

(d) glmax = $\frac{3}{2}$, glmin = $-\frac{1}{4}$

(e) glmax = 2, glmin = $-\frac{1}{2}$

7. Suppose the 1st derivative of $y = f(x)$ is

$$\frac{dy}{dx} = (x - 1)^2 (x - 2) (x - 4).$$

Which of the following is true?

(a) f has 3 local extrema. Local maxima at x =1 and x = 4 and a local minimum at x = 2

(b) f has 2 local extrema. A local minimum at x = 2 and a local maximum at x =4.

(c) f has no local extrema.

(d) f has 3 local extrema. A local maximum at x = 1 and local minima at x = 2 and 4.

(e) f has 2 local extrema. A local minimum at x = 4 and a local maximum at x =2.

8. The function

$$f(x) = x^3 - 3x^2 - 9x + 4$$

is increasing on the interval(s)

(a) $(-\infty, -1)$ and $(3, \infty)$

(b) $(-1, \infty)$

(c) $(-\infty, 3)$

(d) $(-1,3)$

(e) $(-\infty, -1)$ and $(0,3)$

9. The function

$$f(x) = x^3 - 6x^2 + 9x - 3$$

is concave down on the interval(s)

(a) $(-\infty,1)$ and $(3, \infty)$ (b) $(-\infty,2)$ (c) $(2,\infty)$

(d) $(1,3)$ (e) never concave down

10. Given below is the graph of the position function $y = s(t)$ of a particle moving back and forth on a line. In which time intervals given below is the particle's velocity positive while its acceleration is negative?

(a) (0,1), (3,5) and (7,8)
(b) (2,4) and (6,8)
(c) (3,4) and (7,8)
(d) (1,3) and (5,7)
(e) (2,3) and (6,7)

11. How many points of inflection does the function $f(x) = x^6 - 10x^4 + 5x - 6$ have?

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