1. The accompanying graph shows the position $s = f(t)$ of a body moving on a coordinate line.

When is the body moving backward but speeding up?

(A) (0,3) (B) (9,12) (C) (6,9) (D) (3,6) (E) (3,9)

2. If $f(x) = \frac{\sin x}{1 - \cos x}$, then $f'(x) = ?$

(A) $\frac{2 \sin x \cos x}{(1 - \cos x)^2}$ (B) $\frac{1}{\cos x - 1}$

(C) $\frac{\cos x}{(1 - \cos x)^2}$ (D) $\cot x$

(E) $\frac{\cos^2 x - \sin^2 x}{(1 - \cos x)^2}$

3. If $s = \left[(t^2 - 3)^2 + (2t - 3)^2 \right]^2$, then $\left. \frac{ds}{dt} \right|_{t = 2} =$

(A) 48 (B) 12 (C) 32 (D) 16 (E) 24

4. If $g(x) = (\sec x + \tan x)^{-1}$, then $g'\left(\frac{\pi}{6} \right) = ?$

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

5. The slope of the curve $y^4 = y^2 - x^2$ at the point $\left(\frac{\sqrt{3}}{4}, \frac{1}{2} \right)$ is

(A) 0 (B) $\sqrt{2}$ (C) $-\frac{1}{2}$ (D) $\sqrt{3}$ (E) -1

6. Two parallel sides of a rectangle are being lengthened at the rate of 2 in/sec while the other two sides are shortened in such a way that the figure remains a rectangle with constant area 50 in^2. What is the rate of change of the perimeter of the rectangle when the length of an increasing side is 10 in?

(A) increasing at 5 in/sec
(B) decreasing at 4 in/sec
(C) neither increasing nor decreassing
(D) decreasing at 1 in/sec
(E) increasing at 2 in/sec

7. The global maximum and the global minimum of the function

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

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

(A) g. max = 1, g. min = 0
(B) g. max = 1, g. min = – 1
(C) g. max = $\frac{5}{4}$, g. min = – 1
(D) g. max = $\frac{3}{2}$, g. min = $-\frac{1}{4}$
(E) g. max = – 2, g. min = $-\frac{1}{2}$

8. Let $y = f(x)$ be differentiable on the interval $[1,3]$ with $f(1) = 0$ and $f(3) = 2$. What value must $f'(x)$ have at some point in the open interval $(1,3)$?

(A) 2 (B) $\frac{1}{2}$ (C) 3 (D) $\frac{1}{3}$ (E) 1

9. Suppose that the first derivative of $y = f(x)$ is

$$\frac{dy}{dx} = 6(x-1)(x-2)^2(x-3)^3 .$$

Which of the following is true?

(A) f has one local extreme. A local minimum at $x = 2$.
(B) f has two local extrema. A local maximum at $x = 1$ and a local minimum at $x = 3$.
(C) f has three local extrema. Local maxima at $x = 1$ and $x = 3$ and a local minimum at $x = 2$.
(D) f has no local extrema.
(E) f has 2 local extrema. A local maximum at $x = 3$ and a local minimum at $x = 1$.

10. The function $y = x + \frac{9}{x - 2}$

is increasing on the intervals

(A) $(-\infty, -1)$ and $(5, \infty)$
(B) $(-1, 2)$ and $(2, 5)$
(C) $(-1, 2)$ and $(5, \infty)$
(D) $(-\infty, -1)$ and $(2, 5)$
(E) $(2, 5)$ and $(5, \infty)$

11. The graph of $y = 2x^5 - 10x^4 + 5x - 3$

(A) has a point of inflection at $x = 0$ only
(B) has a point of inflection at $x = 0$ and $x = 3$
(C) is concave up on the interval $(-\infty, 0)$
(D) has a point of inflection at $x = 3$ only
(E) is concave down on the interval $(3, \infty)$