1. If a function f is differentiable at a, then which is necessarily true?

   I. $\lim_{x \to a} \dfrac{f(x) - f(a)}{x - a}$ exists.

   II. $\lim_{x \to a} f(x)$ exists.

   III. $f(a)$ exists.

   A. Only I.
   B. Only II.
   C. Only III.
   D. Only I and III.
   E. All are true.

2. Let $f(x) = \begin{cases} cx - 2, & \text{if } x \leq 2 \\ 3 - cx^2, & \text{if } x > 2 \end{cases}$.

   What value(s) of c make(s) f continuous at $x = 2$?

   A. $c = \dfrac{-2 \pm \sqrt{44}}{4}$
   B. $c = 2$
   C. $c = \dfrac{5}{6}$
   D. $c = \dfrac{5}{2}$
   E. $c = \dfrac{1}{6}$

3. $\lim_{x\to\infty} \dfrac{2x^2-3x-6}{x-3} =$

A. 2
B. 3
C. 0
D. ∞
E. $-\infty$

4. $\lim_{x\to\infty} \sqrt{4x^2+2x}-2x =$

A. ∞
B. $-\infty$
C. 0
D. 1/2
E. 2/3

5. If $s(t) = t^3 - 2t + 4$ gives the position of a particle at time t, its average velocity between the times $t = 1$ and $t = 3$ is

A. 11

B. 12

C. 13

D. 14

E. 15

6. If $f(x) = \dfrac{1 - x^3}{x^2 + x}$, then $f'(x) =$

A. $\dfrac{-3x^2(2x+1) - (1-x^3)(x^2+x)}{(x^2+x)^2}$

B. $\dfrac{(1-x^3)(2x+1) + 3x^2(x^2+x)}{(x^2+x)^2}$

C. $\dfrac{(1-x^3)(x^2+x) + 3x^2(2x+1)}{(x^2+x)^2}$

D. $\dfrac{(-3x^2)(x^2+x) - (1-x^3)(2x+1)}{(x^2+x)^2}$

E. $-\dfrac{3x^2}{2x+1}$

7. $\frac{d}{dx}(x+\sqrt{x})(x^2+x) =$

A. $(x+\sqrt{x})(x^2+x)+\left(1+\frac{1}{2\sqrt{x}}\right)(2x+1)$

B. $3x^2+2x+5x^{3/2}/2+3x^{1/2}/2$

C. $2x+\sqrt{x}+1+1/(2\sqrt{x})$

D. $(x+\sqrt{x})\left(1+\frac{1}{2\sqrt{x}}\right)+(x^2+x)(2x+1)$

E. None of the above.

8. $\lim_{x\to 0}\frac{\tan 2x}{3x} =$

A. $2/3$

B. $4/3$

C. $\pi/6$

D. ∞

E. 0

9. Suppose that F is a differentiable function on $(-\infty, \infty)$, $G(x) = F(x^2)$, and $G'(1) = 1$. Which of the following statements must be true?

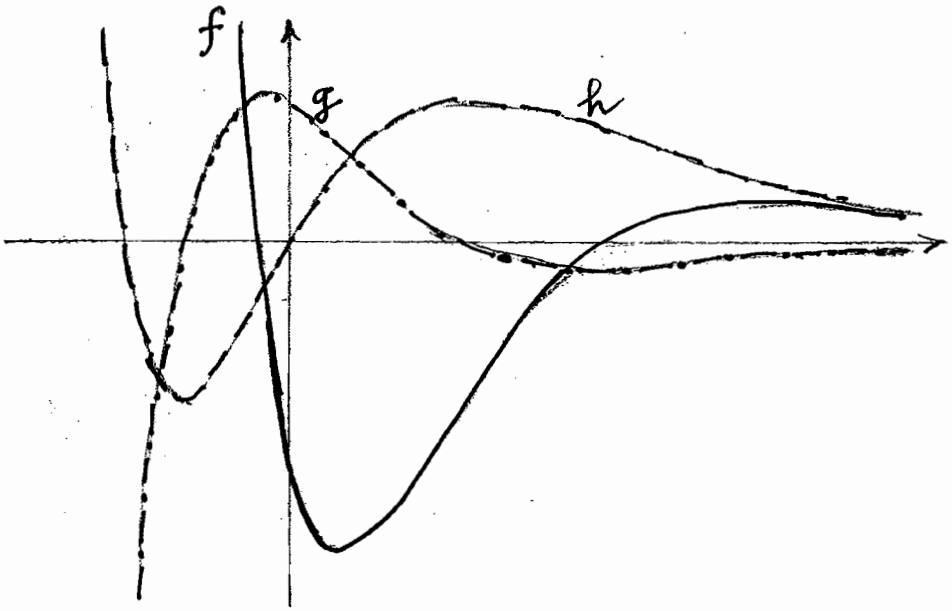
I. $F'(2) = 1/2$ II. $F'(1) = 1/2$ III. $F'(\sqrt{2}/2) = 2$

A. Only I.
B. Only II.
C. Only III.
D. Only I and III.
E. It is possible that none of the statements is true.

10. The equation of the tangent line drawn to the curve $x\cos\pi x + y\cos\pi y = 0$, at the point $(-1, 1)$, is

A. $x + y = 0$
B. $\pi x - y = -1 - \pi$
C. $\pi x + y = \pi$
D. $x + y = \pi$
E. $\pi y - x = \pi + 1$

11. For the three functions graphed below, which is true?



A. $f'' = h$
B. $f'' = g$
C. $g'' = f$
D. $h'' = g$
E. $h'' = f$

12. If the position of a particle at moment t is $s(t) = t^2 + 2^{-t}$, its acceleration when $t = 1$ is

A. $5/2$
B. $3/2$
C. $(\ln 2)/2$
D. $4 + (\ln 2)^2$
E. $2 + (\ln 2)^2/2$