1. A ball is thrown in the air with position (at t seconds) given by $s(t) = 2t^3 + t^2$. Let v_a be the average velocity from time t=1 to time t=3 and v_i be the instantaneous velocity at time t=3. Then

   (A) $v_a = 30, v_i = 60$

   (B) $v_a = 33, v_i = 63$

   (C) $v_a = 48, v_i = 60$

   (D) $v_a = 48, v_i = 63$

   (E) $v_a = 120, v_i = 60$

2. If f is a differentiable function with $f(4) = 1$ and $f'(4) = 2$, the derivative of $\frac{1 + e^x f(x)}{\sqrt{x}}$ at x=4 is:.

   (A) $12e^4$

   (B) $\frac{3e^4}{4}$

   (C) $\frac{23e^4+1}{16}$

   (D) $\frac{23e^4-1}{16}$

   (E) $\frac{6e^4-1}{4}$

3. If $g(x) = x + 2\cos x$, find all values of a in $[-\frac{\pi}{2}, \frac{\pi}{2}]$ at which the tangent line through $(a, g(a))$ is parallel to $y = 2x - 3$.

(A) $-\frac{\pi}{6}$

(B) $-\frac{\pi}{3}$

(C) $-\frac{\pi}{4}$

(D) $\frac{\pi}{6}$

(E) $\frac{\pi}{3}$

4. Find $\frac{dy}{dx}$ at $x = \frac{\pi}{2}$ for $y = e^{\sin 2t}$.

(A) 2

(B) -2

(C) 0

(D) e

(E) -e

5. The tangent line to $h(t) = (2t - \frac{1}{t})^{3/2}$ at the point (1,1) is:

(A) $y - 1 = \frac{-2}{9}(x - 1)$

(B) $y - 1 = \frac{9}{2}(x - 1)$

(C) $y - 1 = \frac{3}{2}(x - 1)$

(D) $y - 1 = \frac{2}{9}(x - 1)$

(E) $y - 1 = 3(x - 1)$

6. Find $g'(t)$ if $g(t) = \sin^{-1}(\frac{2}{t})$.

(A) $\frac{-1}{\sqrt{t^2-4}}$

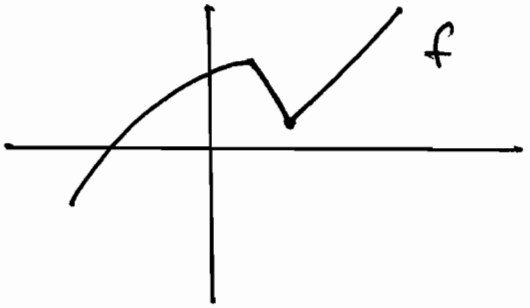
(B) $\frac{2}{\sqrt{t^2-4}}$

(C) $\frac{1}{\sqrt{t^2-4}}$

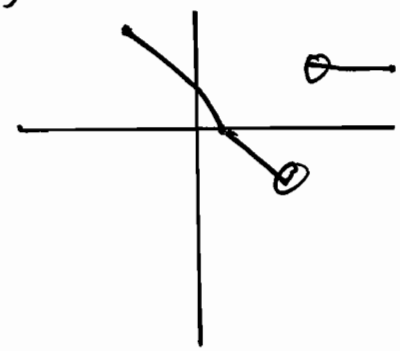
(D) $\frac{-2}{t\sqrt{t^2-4}}$

(E) $\frac{2}{t\sqrt{t^2-4}}$

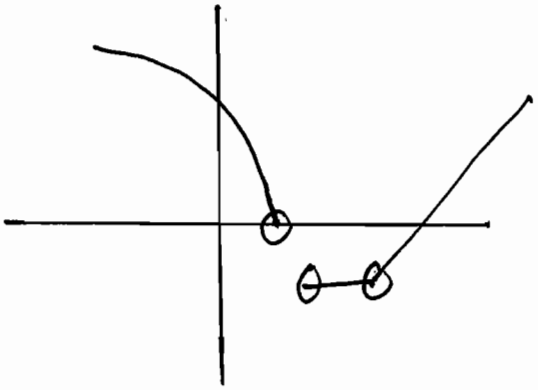
7. If $f(x)$ is as sketched, which graph represents the graph of f' ?



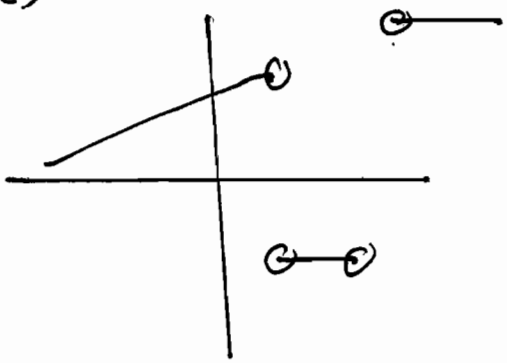
(A)



(B)



(C)



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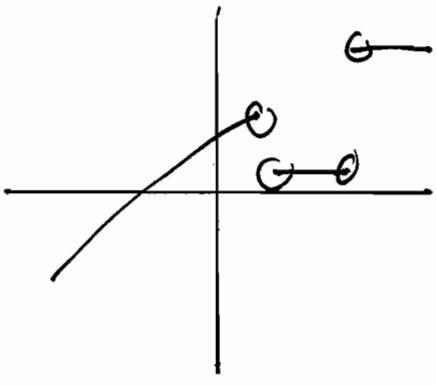
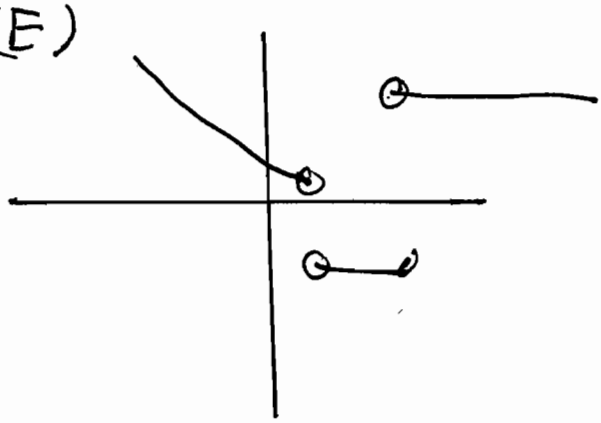


(E)



8. Find $\lim_{\theta \to 0} \left(\frac{\cos\theta - 1}{\theta \sin\theta} \right)$.

(A) -2

(B) -1

(C) $-\frac{1}{2}$

(D) 0

(E) The limit does not exist

9. Compute $\frac{d}{dx}(3^{x^2})$ when x = 2:

(A) $9 \ln 3$

(B) $81 \ln 3$

(C) $36 \ln 3$

(D) $324 \ln 3$

(E) $\frac{81}{\ln 3}$

10. Assume f and g are differentiable functions, $F(x) = f(g(x))$, $g(1) = 2$, $f(1) = -1$, $f(2) = 3$, $g'(1) = 10$, $f'(1) = 5$, and $f'(2) = 4$. Compute $F'(1)$.

(A) -10

(B) -8

(C) 8

(D) 30

(E) 40

11. Find $\frac{dy}{dx}$ at the point $(0, \frac{\pi}{4})$ for the curve given implicitly by $\tan(x-y) = xe^x - 1$.

(A) 0

(B) $\frac{1}{4}$

(C) $\frac{1}{2}$

(D) 1

(E) 2

12. A particle moves on a line with equation of motion $s(t) = \sin \pi t$ for $0 < t < 1$. Find the acceleration at the instant when the velocity is zero.

(A) π^2

(B) π

(C) 1

(D) $-\pi$

(E) $-\pi^2$

13. Find a formula for $f^{(3)}(-1)$ if $f(x) = \frac{1}{3x+1}$.

(A) $-\frac{81}{8}$

(B) $-\frac{9}{4}$

(C) $-\frac{3}{64}$

(D) $-\frac{1}{4}$

(E) 27

14. A cylinder of height 1 and radius r has value $V = 2\pi r^2$. If r is increasing at the rate of 3 cm./sec., how fast is the volume increasing when r = 2?

(A) 6π

(B) 12π

(C) 18π

(D) 24π

(E) 32π