1. $\lim_{x \to 0} \dfrac{\cos(3x) - 1}{x^2} =$

(A) $\dfrac{9}{2}$ (B) $\dfrac{3}{2}$ (C) $-\dfrac{2}{3}$ (D) $-\dfrac{3}{2}$ (E) $-\dfrac{9}{2}$

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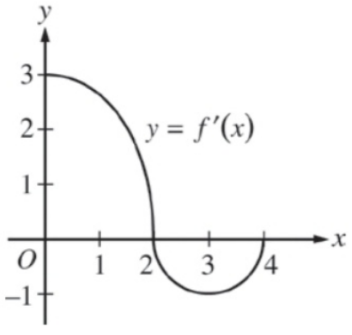
3. $\displaystyle\int_{e^{-3}}^{e^{-2}} \frac{1}{x \log x}\, dx =$

(A) 1 (B) $\dfrac{2}{3}$ (C) $\dfrac{3}{2}$ (D) $\log\left(\dfrac{2}{3}\right)$ (E) $\log\left(\dfrac{3}{2}\right)$



7. The figure above shows the graph of the derivative f' of a function f, where f is continuous on the interval $[0, 4]$ and differentiable on the interval $(0, 4)$. Which of the following gives the correct ordering of the values $f(0)$, $f(2)$, and $f(4)$?

(A) $f(0) < f(2) < f(4)$

(B) $f(0) < f(4) = f(2)$

(C) $f(0) < f(4) < f(2)$

(D) $f(4) = f(2) < f(0)$

(E) $f(4) < f(0) < f(2)$

9. Let g be a continuous real-valued function defined on $\mathbb{R}$ with the following properties.

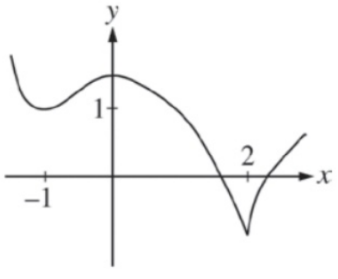
$$g'(0) = 0$$

$$g''(-1) > 0$$

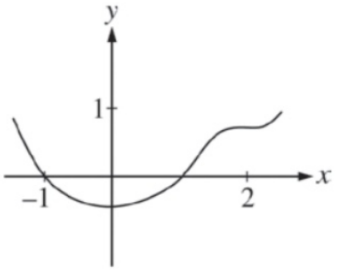
$$g''(x) < 0 \text{ if } 0 < x < 2.$$

Which of the following could be part of the graph of g?

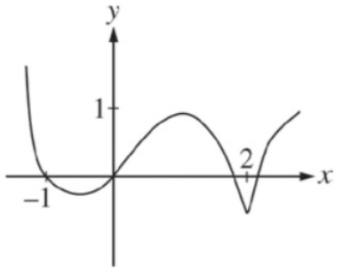
(A)



(B)

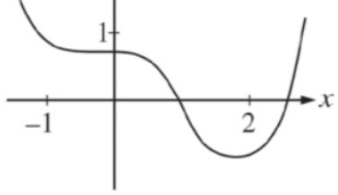


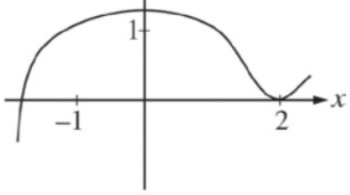
(C)



(D)

(E)





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13. If f is a continuously differentiable real-valued function defined on the open interval $(-1, 4)$ such that $f(3) = 5$ and $f'(x) \geq -1$ for all x, what is the greatest possible value of $f(0)$?

(A) 3 (B) 4 (C) 5 (D) 8 (E) 11

14. Suppose g is a continuous real-valued function such that $3x^5 + 96 = \int_c^x g(t)\,dt$ for each $x \in \mathbb{R}$, where c is a constant. What is the value of c ?

(A) –96 (B) –2 (C) 4 (D) 15 (E) 32

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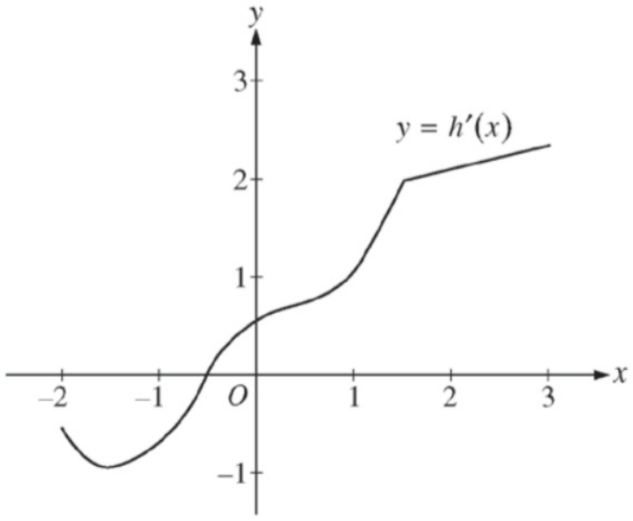
21. What is the value of $\int_{-\pi/4}^{\pi/4} \left(\cos t + \sqrt{1+t^2}\,\sin^3 t \cos^3 t\right) dt$?

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



25. The graph of the derivative h' is shown above, where h is a real-valued function. Which of the following open intervals contains a value c for which the point $(c, h(c))$ is an inflection point of h ?

(A) $(-2, -1)$ (B) $(-1, 0)$ (C) $(0, 1)$ (D) $(1, 2)$ (E) $(2, 3)$

---

32. $\frac{d}{dx}\int_{x^3}^{x^4} e^{t^2}\,dt =$

(A) $e^{x^6}\left(e^{x^8 - x^6} - 1\right)$ (B) $4x^3 e^{x^8}$ (C) $\frac{1}{\sqrt{1 - e^{x^2}}}$ (D) $\frac{e^{x^2}}{x^2} - 1$ (E) $x^2 e^{x^6}\left(4x e^{x^8 - x^6} - 3\right)$

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46. A ladder 9 meters in length is leaning against a vertical wall on level ground. As the bottom end of the ladder is

moved away from the wall at a constant rate of 2 meters per second, the top end slides downward along the wall. How fast, in meters per second, will the top end of the ladder be sliding downward at the moment the top end is 3 meters above the ground?

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