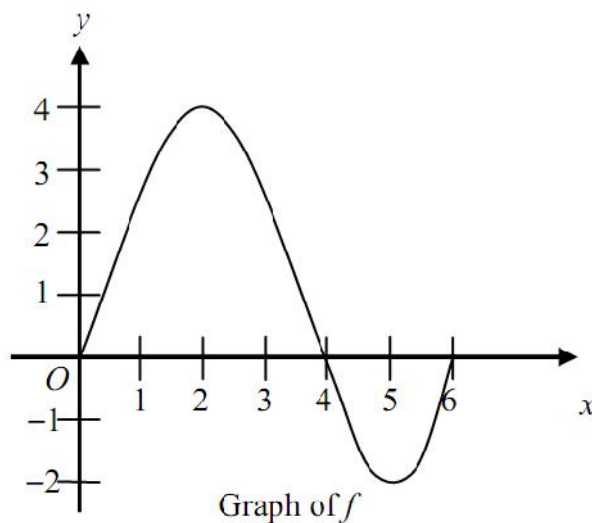


1.

If  $f(x) = (\ln x)^2$ , then  $f''(\sqrt{e}) =$

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

2.



The graph of the function  $f$  shown above has horizontal tangents at  $x = 2$  and  $x = 5$ . Let  $g$  be the function defined by  $g(x) = \int_0^x f(t) dt$ . For what values of  $x$  does the graph of  $g$  have a point of inflection?

- (A) 2 only      (B) 4 only      (C) 2 and 5 only      (D) 2, 4, and 5      (E) 0, 4, and 6

3.

Which of the following is the solution to the differential equation  $\frac{dy}{dx} = \frac{x^2}{y}$  with the initial condition  $y(3) = -2$ ?

(A)  $y = 2e^{-9+x^3/3}$

(B)  $y = -2e^{-9+x^3/3}$

(C)  $y = \sqrt{\frac{2x^3}{3}}$

(D)  $y = \sqrt{\frac{2x^3}{3} - 14}$

(E)  $y = -\sqrt{\frac{2x^3}{3} - 14}$

4.

The function  $f$  is twice differentiable with  $f(2) = 1$ ,  $f'(2) = 4$ , and  $f''(2) = 3$ . What is the value of the approximation of  $f(1.9)$  using the line tangent to the graph of  $f$  at  $x = 2$ ?

(A) 0.4

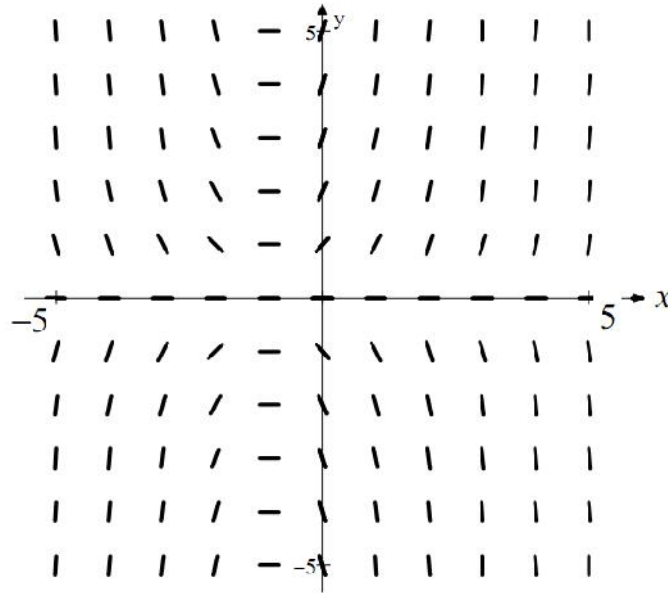
(B) 0.6

(C) 0.7

(D) 1.3

(E) 1.4

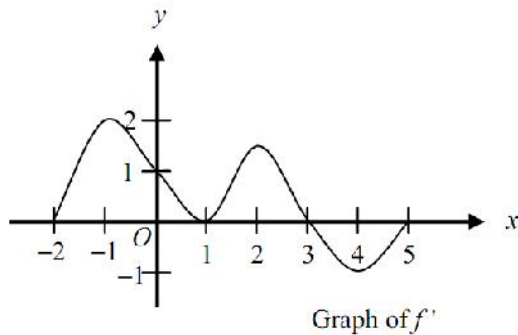
5.



Shown above is a slope field for which of the following differential equations?

- (A)  $\frac{dy}{dx} = xy$
- (B)  $\frac{dy}{dx} = xy - y$
- (C)  $\frac{dy}{dx} = xy + y$
- (D)  $\frac{dy}{dx} = xy + x$
- (E)  $\frac{dy}{dx} = (x + 1)^3$

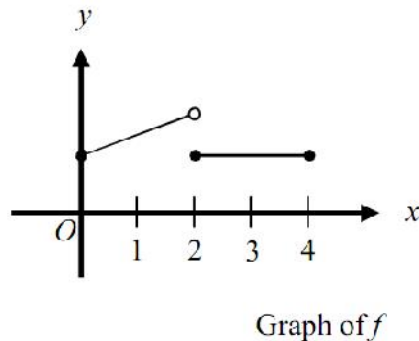
6.



The graph of  $f'$ , the derivative of  $f$ , is shown above for  $-2 \leq x \leq 5$ . On what intervals is  $f$  increasing?

- (A)  $[-2, 1]$  only
- (B)  $[-2, 3]$
- (C)  $[3, 5]$  only
- (D)  $[0, 1.5]$  and  $[3, 5]$
- (E)  $[-2, -1]$ ,  $[1, 2]$ , and  $[4, 5]$

7.



The figure above shows the graph of a function  $f$  with domain  $0 \leq x \leq 4$ . Which of the following statements are true?

I.  $\lim_{x \rightarrow 2^-} f(x)$  exists.

II.  $\lim_{x \rightarrow 2^+} f(x)$  exists.

III.  $\lim_{x \rightarrow 2} f(x)$  exists.

- (A) I only      (B) II only      (C) I and II only      (D) I and III only      (E) I, II, and III

8.

If  $\int_{-5}^2 f(x) dx = -17$  and  $\int_5^2 f(x) dx = -4$ , what is the value of  $\int_{-5}^5 f(x) dx$ ?

- (A) -21      (B) -13      (C) 0      (D) 13      (E) 21

9.

If  $G(x)$  is an antiderivative for  $f(x)$  and  $G(2) = -7$ , then  $G(4) =$

(A)  $f'(4)$

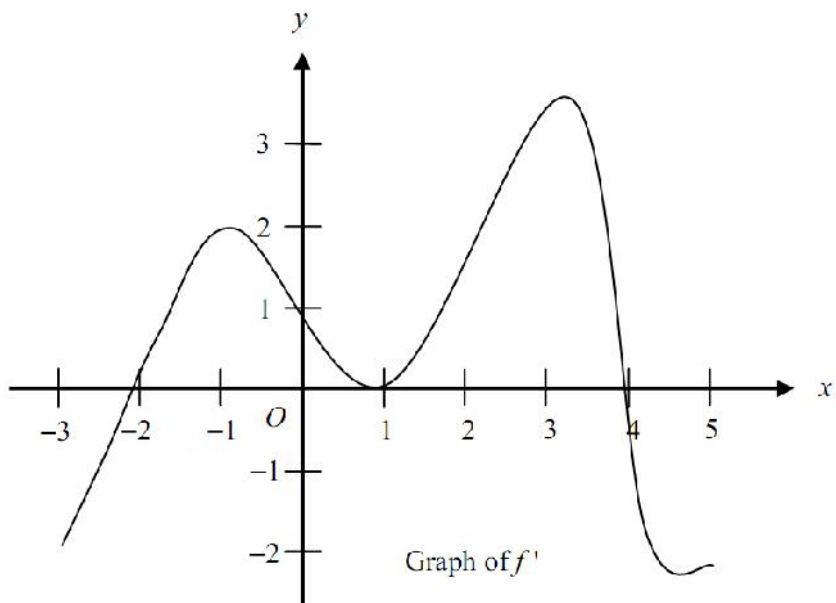
(B)  $-7 + f'(4)$

(C)  $\int_2^4 f(t) dt$

(D)  $\int_2^4 (-7 + f(t)) dt$

(E)  $-7 + \int_2^4 f(t) dt$

10.



The graph of the derivative of a function  $f$  is shown in the figure above. The graph has horizontal tangent lines at  $x = -1$ ,  $x = 1$ , and  $x = 3$ . At which of the following values of  $x$  does  $f$  have a relative maximum?

- (A)  $-2$  only
- (B)  $1$  only
- (C)  $4$  only
- (D)  $-1$  and  $3$  only
- (E)  $-2$ ,  $1$ , and  $4$

11. (2013, AB-6)

Consider the differential equation  $\frac{dy}{dx} = e^y(3x^2 - 6x)$ . Let  $y = f(x)$  be the particular solution to the differential equation that passes through  $(1, 0)$ .

- (a) Write an equation for the line tangent to the graph of  $f$  at the point  $(1, 0)$ . Use the tangent line to approximate  $f(1.2)$ .
- (b) Find  $y = f(x)$ , the particular solution to the differential equation that passes through  $(1, 0)$ .

12. (2012, AB-4)

The function  $f$  is defined by  $f(x) = \sqrt{25 - x^2}$  for  $-5 \leq x \leq 5$ .

(a) Find  $f'(x)$ .

(b) Write an equation for the line tangent to the graph of  $f$  at  $x = -3$ .

(c) Let  $g$  be the function defined by  $g(x) = \begin{cases} f(x) & \text{for } -5 \leq x \leq -3 \\ x + 7 & \text{for } -3 < x \leq 5. \end{cases}$

Is  $g$  continuous at  $x = -3$ ? Use the definition of continuity to explain your answer.

(d) Find the value of  $\int_0^5 x\sqrt{25 - x^2} dx$ .