1.

$$\int_0^1 e^{-4x}\,dx =$$

A) $\dfrac{-e^{-4}}{4}$ B) $-4e^{-4}$ C) $e^{-4}-1$ D) $\dfrac{1}{4}-\dfrac{e^{-4}}{4}$ E) $4-4e^{-4}$

2.

For $x \geq 0$, the horizontal line y=2 is an asymptote for the graph of the function f. Which of the following statements must be true?

A) $f(0)=2$

B) $f(x) \neq 2$ for all $x \geq 0$

C) $f(2)$ is undefined

D) $\lim\limits_{x \to 2} f(x) = \infty$

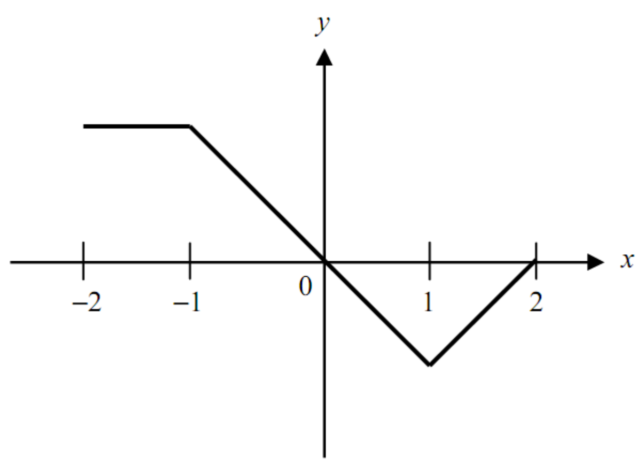
E) $\lim\limits_{x \to \infty} f(x) = 2$

3.

$$\int_0^{\frac{\pi}{4}} \sin(x)dx =$$

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

4.



Graph of f'

The graph of f', the derivative of the function f, is shown above. Which of the following statements is true about f?

A) f is decreasing for $-1 \le x \le 1$.

B) f is increasing for $-2 \le x \le 0$.

C) f is increasing for $1 \le x \le 2$.

D) f has a local minimum at x = 0.

E) f is not differentiable at x = -1 and x = 1.

5.

If $f(x) = \ln\left(x + 4 + e^{-3x}\right)$, then $f'(0)$ is

A) $-\frac{2}{5}$ B) $\frac{1}{5}$ C) $\frac{1}{4}$ D) $\frac{2}{5}$ E) nonexistent

6.

Using the substitution $u = 2x + 1$, $\int_0^2 \sqrt{2x+1}\,dx$ is equivalent to

A) $\frac{1}{2}\int_{-1/2}^{1/2} \sqrt{u}\,du$ B) $\frac{1}{2}\int_0^2 \sqrt{u}\,du$ C) $\frac{1}{2}\int_1^5 \sqrt{u}\,du$ D) $\int_0^2 \sqrt{u}\,du$ E) $\int_1^5 \sqrt{u}\,du$

7.

The rate of change of the volume, V, of water in a tank with respect to time, t, is directly proportional to the square root of the volume. Which of the following is a differential equation that describes this relationship?

A) $V(t) = k\sqrt{t}$

B) $V(t) = k\sqrt{V}$

C) $\frac{dV}{dt} = k\sqrt{t}$

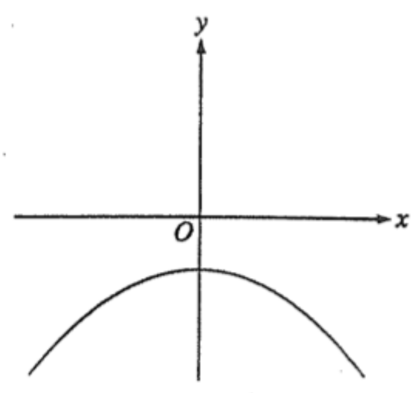
D) $\frac{dV}{dt} = \frac{k}{\sqrt{V}}$

E) $\frac{dV}{dt} = k\sqrt{V}$

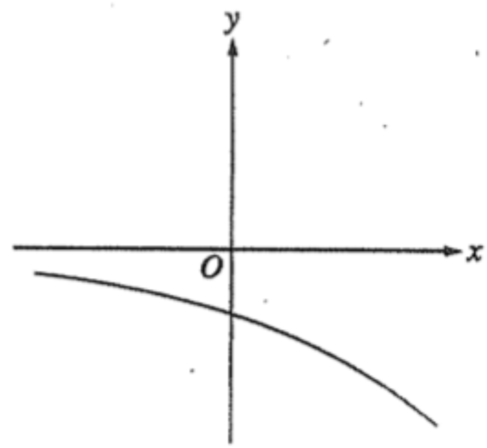
8.

The function f has the property that $f(x)$, $f'(x)$, $f''(x)$ and are negative for all real values x. Which of the following could be the graph of f ?

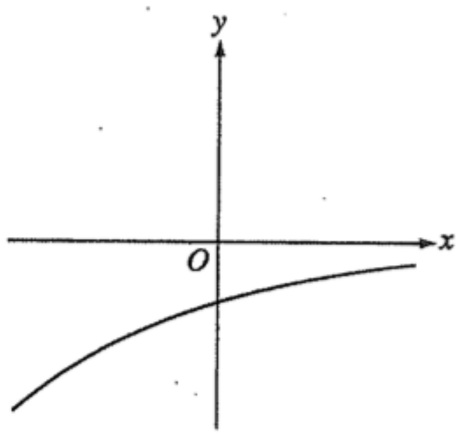
(A)



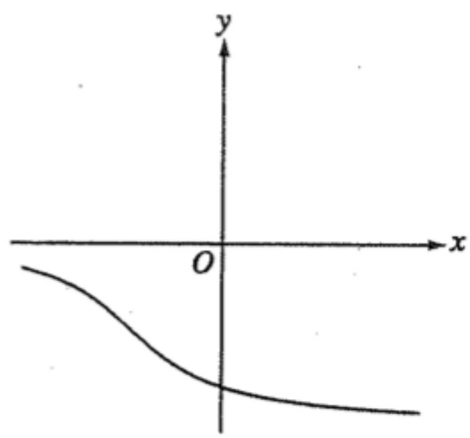
(B)



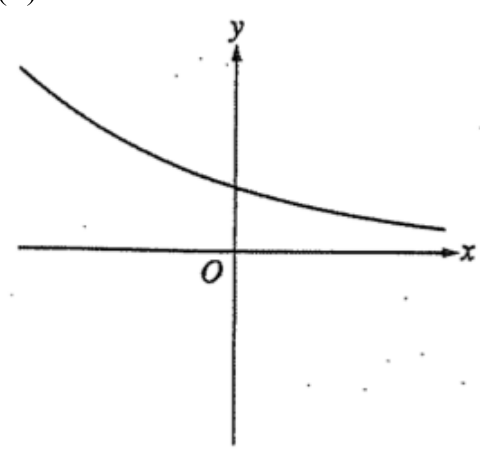
(C)



(D)



(E)



9.

Let f be the function with derivative given by $f'(x) = x^2 - \frac{2}{x}$. On which of the following intervals is f decreasing?

A) $(-\infty, -1]$ only

B) $(-\infty, 0)$

C) $[-1, 0)$ only

D) $\left(0, \sqrt[3]{2}\right]$

E) $\left[\sqrt[3]{2}, \infty\right)$

10.

If the line tangent to the graph of the function f at the point (1,7) passes through the point (-2, -2), then $f'(1)$ is

A)-5 B) 1 C) 3 D) 7 E) undefined

11. (2013, AB-3)

t (minutes)	0	1	2	3	4	5	6
$C(t)$ (ounces)	0	5.3	8.8	11.2	12.8	13.8	14.5

Hot water is dripping through a coffeemaker, filling a large cup with coffee. The amount of coffee in the cup at time t, $0 \le t \le 6$, is given by a differentiable function C, where t is measured in minutes. Selected values of $C(t)$, measured in ounces, are given in the table above.

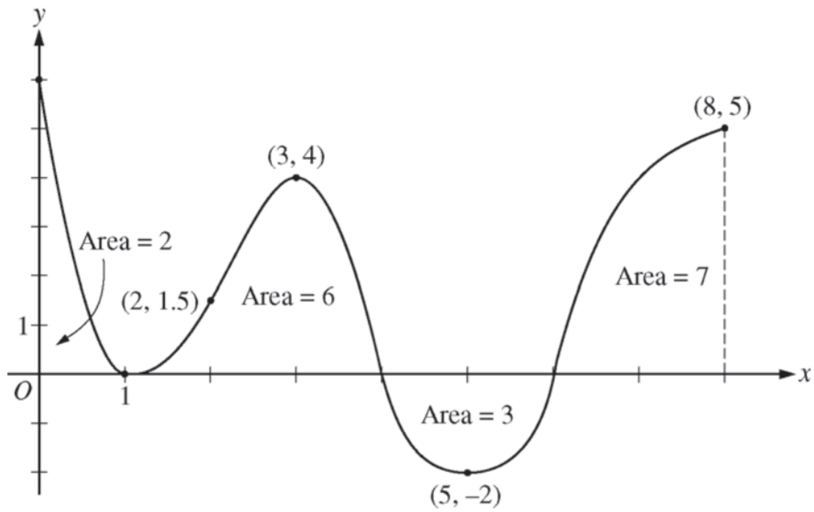
(a) Use the data in the table to approximate $C'(3.5)$. Show the computations that lead to your answer, and indicate units of measure.

(b) Is there a time t, $2 \le t \le 4$, at which $C'(t) = 2$? Justify your answer.

(c) Use a midpoint sum with three subintervals of equal length indicated by the data in the table to approximate the value of $\frac{1}{6}\int_0^6 C(t)\,dt$. Using correct units, explain the meaning of $\frac{1}{6}\int_0^6 C(t)\,dt$ in the context of the problem.

(d) The amount of coffee in the cup, in ounces, is modeled by $B(t) = 16 - 16e^{-0.4t}$. Using this model, find the rate at which the amount of coffee in the cup is changing when $t = 5$.

12. (2013, AB-4)



The figure above shows the graph of f', the derivative of a twice-differentiable function f, on the closed interval $0 \leq x \leq 8$. The graph of f' has horizontal tangent lines at $x = 1$, $x = 3$, and $x = 5$. The areas of the regions between the graph of f' and the x-axis are labeled in the figure. The function f is defined for all real numbers and satisfies $f(8) = 4$.

(a) Find all values of x on the open interval $0 < x < 8$ for which the function f has a local minimum. Justify your answer.

(b) Determine the absolute minimum value of f on the closed interval $0 \leq x \leq 8$. Justify your answer.

(c) On what open intervals contained in $0 < x < 8$ is the graph of f both concave down and increasing? Explain your reasoning.

(d) The function g is defined by $g(x) = (f(x))^3$. If $f(3) = -\frac{5}{2}$, find the slope of the line tangent to the graph of g at $x = 3$.