

1. Let $y = x^4 + x^2 + 1$, $x = 1$, and $dx = 2$. Then $dy =$

- A. 4
- B. 8
- C. 12
- D. 16
- E. 20

2. The function $f(x) = x^3 + ax^2 + bx$ has critical numbers at $x = 1$ and $x = 3$. Find a and b

- A. $a = -9, b = 6$
- B. $a = -8, b = 7$
- C. $a = -7, b = 8$
- D. $a = -6, b = 9$
- E. $a = -6, b = 6$

3. The difference between the maximum and minimum values of the function $f(x) = x^3 - x^2 - x$ on the interval $[-1, 2]$ is

- A. $\frac{5}{27}$
- B. 1
- C. $\frac{22}{27}$
- D. 2
- E. 3

4. $f'(x) = (x - 2)x^2(x + 3)$. Which line of the following table describes the behavior of f at $x = -3, 0, 2$.

	-3	0	2
A	local max	neither local max nor local min	local min
B	local max	local min	local max
C	local min	local max	local min
D	local min	neither local max nor local min	local min
E	neither local max nor local min	local max	local min

5. $f(x) = x^7 - 7x + 17$ has exactly two critical points which are at $(-1, 23)$ and $(1, 11)$. The number of real zeros of f is

- A. 0
B. 1
C. 2
D. 6
E. 7

6. The largest interval on which the function $f(x) = x \sin x + \cos x$, $0 \leq x \leq \pi$ is increasing is

- A. $[\frac{\pi}{3}, \frac{\pi}{2}]$
B. $[0, \frac{\pi}{3}]$
C. $[\frac{\pi}{3}, \pi]$
D. $[0, \frac{\pi}{2}]$
E. $[\frac{\pi}{2}, \pi]$

7. What is the length of the largest interval on which the function $f(x) = \frac{x}{x^2 + 1}$ is increasing?

- A. 1
- B. 4
- C. $\sqrt{3}$
- D. 2
- E. ∞

8. On what interval is the graph of $f(x) = (1 - \frac{1}{x})^2$ concave downward?

- A. $(-\infty, 0)$
- B. $(\frac{3}{2}, \infty)$
- C. $(0, \infty)$
- D. $(-\infty, -1)$
- E. $(1, \frac{3}{2})$

9. $\lim_{x \rightarrow \frac{\pi}{2}} (\pi^2 - 4x^2) \tan x =$

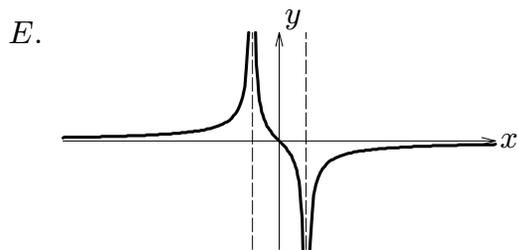
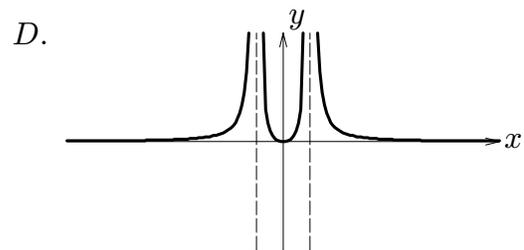
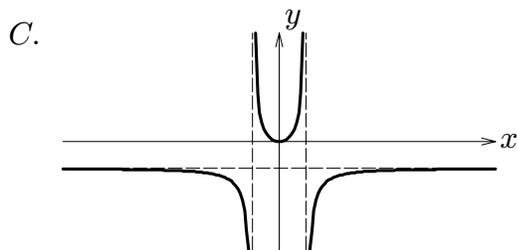
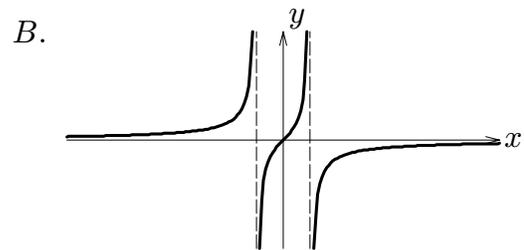
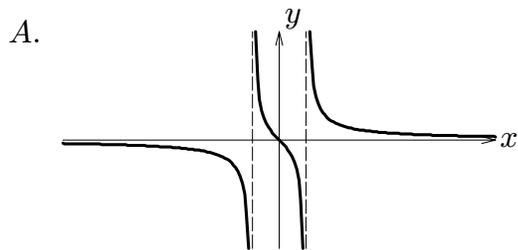
- A. 0
- B. 2π
- C. 4π
- D. ∞
- E. does not exist

10. Given the following information, select a graph that could be the graph of $y = f(x)$

$$\lim_{x \rightarrow \infty} f(x) = \lim_{x \rightarrow -\infty} f(x) = 0$$

$$\lim_{x \rightarrow -1^+} f(x) = \lim_{x \rightarrow 1^+} f(x) = \infty$$

$$\lim_{x \rightarrow -1^-} f(x) = \lim_{x \rightarrow 1^-} f(x) = -\infty$$



11. Positive real numbers x and y are to be chosen so that $x + y = 60$ and xy^2 is as large as possible. What is the value of x ?

- A. 16
- B. 18
- C. 20
- D. 24
- E. 60

12. A closed container is to be constructed in the shape of a right circular cylinder. If the volume is to be $24\pi \text{ cm}^3$ find the ratio of the height to the radius which will minimize the surface area.

- A. 2 to 1
- B. 3 to 1
- C. 3 to 2
- D. 5 to 3
- E. 2 to 3

13. If $f''(x) = 6x^2 - 1$, $f(0) = 1$, $f'(0) = \frac{3}{2}$ then $f(1) =$

- A. $\frac{1}{2}$
- B. 1
- C. $\frac{3}{2}$
- D. 2
- E. $\frac{5}{2}$

14. If $f''(x) = x^{-2}$ and $f(1) = 0$, $f(2) = 0$, then $f(\frac{1}{2}) =$

- A. $\frac{9}{2} \ln 2$
- B. $\frac{7}{2} \ln 2$
- C. $\frac{5}{2} \ln 2$
- D. $\frac{3}{2} \ln 2$
- E. $\frac{1}{2} \ln 2$