

Name _____ DUE DATE: _____

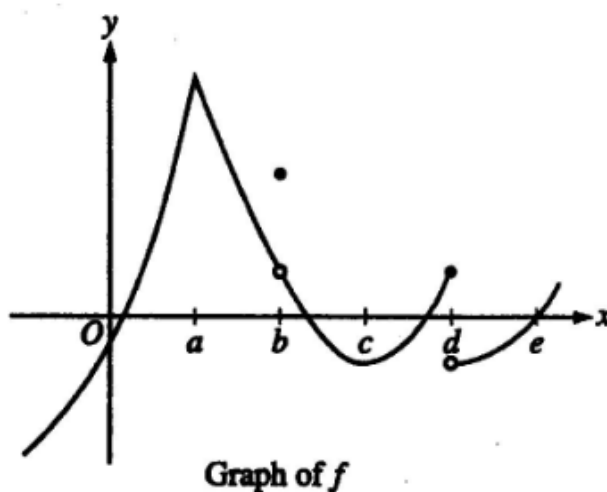
Directions:

- Read each problem carefully and use your knowledge of calculus to determine your answer.
- In order to receive FULL CREDIT you must either SHOW ALL WORK or EXPLAIN how you got your answer!! PLEASE NOTE: A multiple choice answer alone without any work will only receive half credit.

1) At $x = 3$, the function given by $f(x) = \begin{cases} x^2, & x < 3 \\ 6x - 9, & x \geq 3 \end{cases}$ is

- (A) undefined
- (B) continuous but not differentiable
- (C) differentiable but not continuous
- (D) neither continuous nor differentiable
- (E) both continuous and differentiable

2)



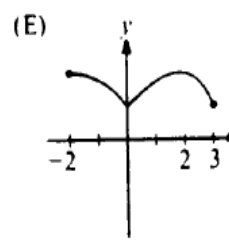
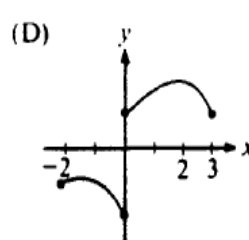
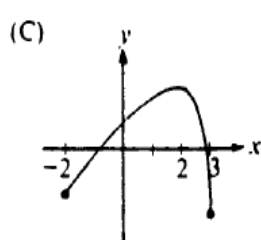
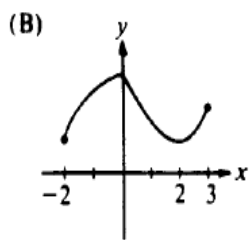
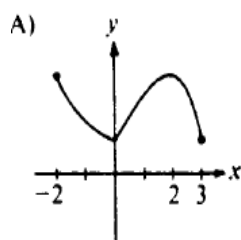
The graph of a function f is shown above. At which value of x is f continuous, but not differentiable?

- (A) a (B) b (C) c (D) d (E) e

3) At $x = 0$, which of the following is true of the function f defined by $f(x) = x^2 + e^{-2x}$?

- (A) f is increasing
- (B) f is decreasing
- (C) f is discontinuous
- (D) f has a relative minimum
- (E) f has a relative maximum

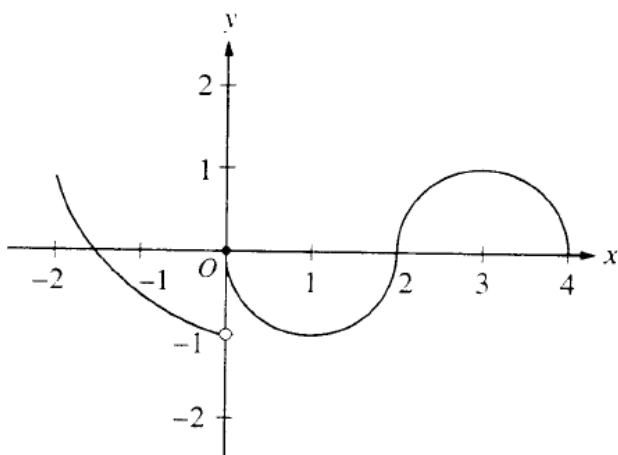
4) Let f be a function that is continuous on the closed interval $[-2, 3]$ such that $f'(0)$ does not exist, $f'(2) = 0$, and $f''(x) < 0$ for all x except $x = 0$. Which of the following could be the graph of f ?



5) If $y = 2 \cos\left(\frac{x}{2}\right)$, then $\frac{d^2y}{dx^2} =$

6) If $y = x^2 e^x$, then $\frac{dy}{dx} =$

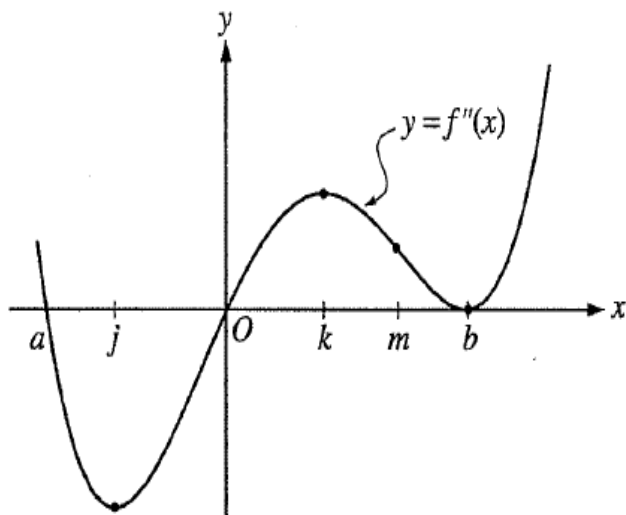
7)



The graph of the function f shown in the figure above has a vertical tangent at the point $(2, 0)$ and horizontal tangents at the points $(1, -1)$ and $(3, 1)$. For what values of x , $-2 < x < 4$, is f not differentiable?

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

8)

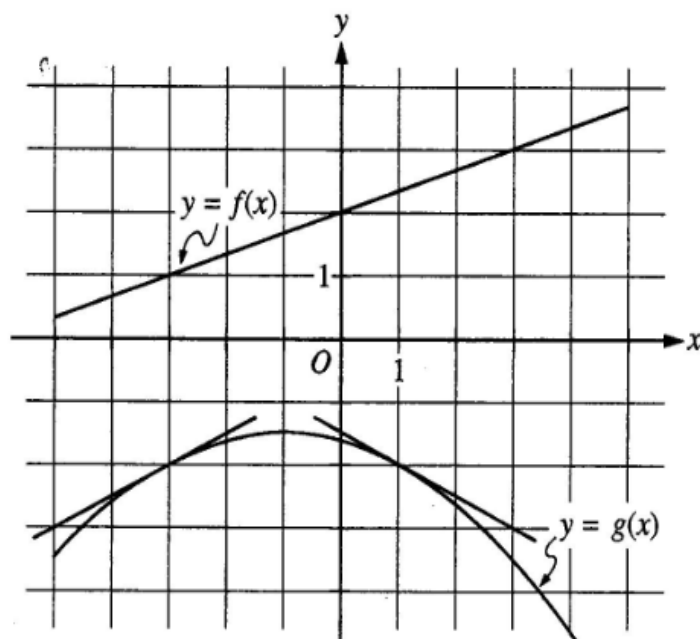


The second derivative of the function f is given by $f''(x) = x(x - a)(x - b)^2$. The graph of f'' is shown above. For what values of x does the graph of f have a point of inflection?

- (A) 0 and a only (B) 0 and m only (C) b and j only (D) 0, a , and b (E) b , j , and k

- 9) Find a value of c that satisfies the conclusion of the Mean Value Theorem for the function $f(x) = x^2 - x - 1$ on the interval $[1, 3]$.

10)



The figure above shows the graphs of the functions f and g . The graphs of the lines tangent to the graph of g at $x = -3$ and $x = 1$ are also shown. If $B(x) = g(f(x))$, what is $B'(-3)$?

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

- 11) A particle moves along the x-axis in such a way that at time $t > 0$ its position coordinate is $x = \sin(e^t)$.
- Find the velocity and acceleration of the particle at time t .
 - At what time does the particle first have zero velocity?
 - What is the acceleration of the particle at the time determined in part (b)?

- 12) Traffic flow is defined as the rate at which cars pass through an intersection, measured in cars per minute. The traffic flow at a particular intersection is modeled by the function F defined by $F(t) = 82 + 4\sin\left(\frac{t}{2}\right)$ for $0 \leq t \leq 30$, where $F(t)$ is measured in cars per minute and t is measured in minutes.
- To the nearest whole number, how many cars pass through the intersection over the 30-minute period?
 - Is the traffic flow increasing or decreasing at $t = 7$? Give a reason for your answer.
 - What is the average value of the traffic flow over the time interval $10 \leq t \leq 15$? Indicate units of measure.
 - What is the average rate of change of the traffic flow over the time interval $10 \leq t \leq 15$? Indicate units of measure.

