AP Calculus 2003 Multiple Choice Test (non-calculator)

1. If $y = (x^4 + 1)^3$, then $\frac{\partial y}{\partial x} =$

A) $(4x^3)^2$

B) $3(4x^3)^2$

C) $3(x^4 + 1)^2$

D) $3x^3(x^4 + 1)^2$

E) $12x^3(x^4 + 1)^2$

2. $\int_0^1 e^{-6x}\, dx =$

A) $\frac{-e^{-6}}{6}$

B) $-6e^{-6}$

C) $-e^{-6} - 1$

D) $\frac{1}{6} - \frac{e^{-6}}{6}$

E) $6 - 6e^{-6}$

3. **For $x \geq 0$, the horizontal line $y = 3$ is an asymptote for the graph of the function f. Which of the following statements must be true?**

A) $f(0) = 3$

B) $f(x) \neq 3$ **for all** $x \geq 0$

C) $f(3)$ **is undefined.**

D) $\lim_{n\to 3} f(x) = \infty$

E) $\lim_{n\to\infty} f(x) = 3$

4. If $y = \frac{3x+4}{4x+3}$, then $\frac{\partial y}{\partial x} =$

A) $\frac{28x+25}{(4x+3)^2}$

B) $\frac{28x-25}{(4x+3)^2}$

C) $\frac{7}{(4x+3)^2}$

D) $\frac{-7}{(4x+3)^2}$

E) $\frac{3}{4}$

5. $\int_0^{\pi/4} cos(x)\, dx =$

A) $-\frac{\sqrt{2}}{2}$

B) $\frac{\sqrt{2}}{2}$

C) $-\frac{\sqrt{2}}{2} - 1$

D) $-\frac{\sqrt{2}}{2} + 1$

E) $\frac{\sqrt{2}}{2} - 1$

6. $\lim_{x\to\infty} \frac{x^3-3x^2+4x-5}{5x^3-3x^2+2x-3} =$

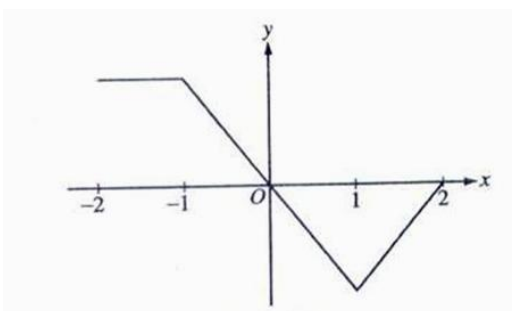
A) 5

B) 1

C) $\frac{1}{5}$

D) 0

E) $\frac{5}{3}$



Graph of f'

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

A) $f\ is\ not\ differentiable\ at\ x = -1\ and\ x = 1.$

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

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

D) $f\ has\ a\ local\ maximum\ at\ x = 0.$

E) $f\ has\ a\ local\ minimum\ at\ x = 0.$

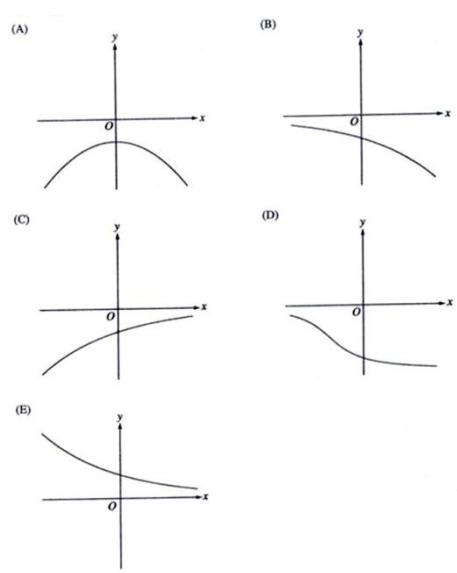
8. $\int x^3 cos(x^4)dx$

A) $-\frac{1}{4}cos(x^4) + C$
B) $\frac{1}{4}sin(x^4) + C$
C) $-\frac{x^4}{4}sin(x^4) + C$
D) $\frac{x^4}{4}sin(x^4) + C$
E) $\frac{x^4}{4}sin\left(\frac{x^4}{4}\right) + C$

9. **If $f(x) = ln(x + 5 + e^{-5x})$, then $f'(0)$ is**

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

10. **The function *f* has the property that $f(x) < 0, f'(x) > 0, f''(x) < 0$ for all real values x. Which of the following could be the graph of *f* ?**

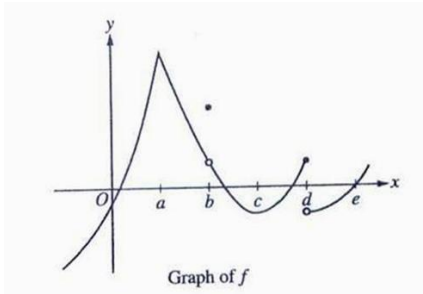


11. **Using the substitution $u = 3x + 2$, $\int_0^1 \sqrt{3x+2}\, dx$ is equivalent to**

A) $\frac{1}{3}\int_{-1/3}^{1/3} \sqrt{u}\, du$
B) $\frac{1}{3}\int_0^1 \sqrt{u}\, du$
C) $\frac{1}{3}\int_2^5 \sqrt{u}\, du$
D) $\int_0^1 \sqrt{u}\, du$
E) $\int_2^5 \sqrt{u}\, du$

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

A) $V(t) = k\sqrt[3]{t}$
B) $V(t) = k\sqrt[3]{V}$
C) $\frac{dV}{dt} = k\sqrt[3]{t}$
D) $\frac{dV}{dt} = \frac{k}{\sqrt[3]{V}}$
E) $\frac{dV}{dt} = k\sqrt[3]{V}$



Graph of *f*

13. **The graph of the function *f* is shown above. At which value(s) of *x* is f not differentiable?**

A) a
B) a and b
C) a and d
D) b and d
E) $a, b,$ and d

14. **If** $y = x^3 \sin(3x)$, **then** $\frac{dy}{dx} =$

A) $3x^2 cos(3x)$
B) $9x^2 cos(3x)$
C) $3x^2[sin(3x) + cos(3x)]$
D) $3x^2[sin(3x) - cos(3x)]$
E) $3x^2[sin(3x) + xcos(3x)]$

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

A) $(-\infty, 0)$ **only**
B) $(-\infty, 0)$ **and** $(0, 1]$
C) $[1, \infty)$ **only**
D) $(-\sqrt[3]{2}, 0)$ **only**
E) $(-\infty, -\sqrt[3]{2})$ **only**

16. **If the line tangent to the graph of the function *f* at the point (1,5) passes through the point (-3,-3) then *f'(1)* is**

A) **-2**
B) **-5**
C) **1**
D) **2**
E) **5**

17. Let *f* be the function given by $f(x) = 3xe^x$. The graph of *f* is concave down when

A) $x < -3$
B) $x > -3$
C) $x < -2$
D) $x > -2$
E) $x < 0$

x	-5	-4	-3	-2	-1	0	1	2	3
g'(x)	3	4	0	-4	-3	-2	-1	0	4

18. The derivative g' of a function g is continuous and has exactly two zeros. Selected values of g' are given in the table above. If the domain of g is the set of all real numbers, then g is decreasing on which of the following intervals?

A) $-3 \leq x \leq 2$ **only**
B) $-2 \leq x \leq 1$ **only**
C) $x \geq -3$
D) $x \geq -2$ **only**
E) $-3 \leq x \; or \; x \geq 2$

19. A curve has slope $4x + 2$ at each point (x, y) on the curve. Which of the following is an equation for the curve if it passes through the point $(1, 3)$?

A) $y = 6x - 3$
B) $y = 2x^2 + 1$
C) $y = 2x^2 + 2x - 1$
D) $y = 2x^2 + 2x + 1$
E) $y = x^2 + x - 4$

$$f(x) = \begin{cases} x + 2 & \text{if } x \le 3 \\ 4x - 7 & \text{if } x > 3 \end{cases}$$

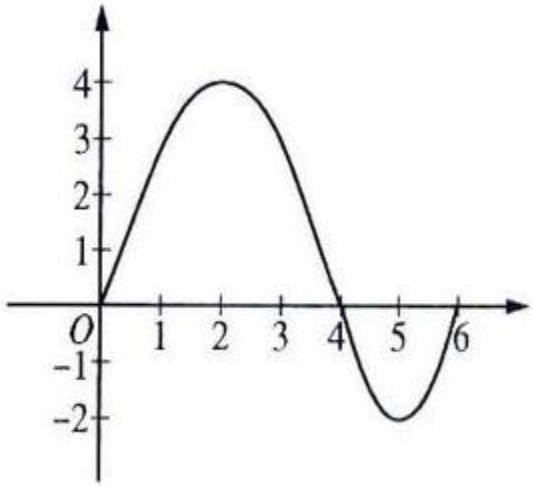
20. Let *f* be the function given above. Which of the following statements about *f is false*?

I. $\lim_{x \to 3} f(x)$ exists.

II. f is continuous at $x = 3$.

III. f is differentiable at $x = 3$.

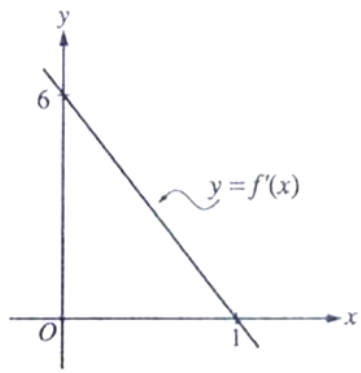
A) None
B) I only
C) II only
D) III only
E) I and II only



Graph of *f"*

21. The second derivative of the function *f* is given by $''(x) = x(x-4)(x-6)$. The graph of *f"* is shown above. For what values of *x* does the graph of *f* have a point of inflection?

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



22. The graph of f', the derivative of f, is the line shown in the figure above. If $f(0) = 4$, then $f(1) =$

A) 0
B) 3
C) 4
D) 7
E) 11

23. $\frac{d}{dx}\left(\int_0^{x^3} \cos(t^2)\, dt\right) =$

A) $-\sin(x^6)$
B) $\cos(x^2)$
C) $\cos(x^6)$
D) $x^3 \cos(x^6)$
E) $3x^2 \cos(x^6)$

24. Let the function defined by $f(x) = 6x^3 - 4x + 1$. Which of the following is an equation of the line tangent to the graph of *f* at the point where $= 1$?

A) $y = 14x + 2$
B) $y = 14x - 11$
C) $y = 14x - 17$
D) $y = 18x - 11$
E) $y = 18x - 15$

25. A particle moves along the x-axis so that at time $t \geq 0$ its position is given by $x(t) = 2t^3 - 15t^2 + 24t - 60$. At what time t is the particle at rest?

A) $t = 1$ only
B) $t = 4$ only
C) $t = \frac{5}{4}$ only
D) $t = 1 \; and \; \frac{7}{2}$
E) $t = 1 \; and \; 4$

26. What is the slope of the line normal to the curve $3y^2 - 2x^2 = 6 - 2xy$ at the point $(3, 2)$?

A) $\frac{-3}{5}$
B) $\frac{4}{9}$
C) $\frac{-9}{4}$
D) $\frac{7}{9}$
E) $\frac{6}{7}$

27. Let f be the function defined by $f(x) = x^3 + x$. If $g(x) = f^{-1}(x) \; and \; g(29) = 2$, what is the value of $g'(2)$?

A) 13
B) $\frac{1}{13}$
C) $\frac{2}{29}$
D) $\frac{1}{2}$
E) $\frac{29}{2}$

28. Let g be a twice-differentiable function with g'(x)<0 and g"(x)<0 for all real numbers x, such that g(4)=12 and g(5)=9. Of the following which is a possible value of g(6) ?

A) 15
B) 12
C) 9
D) 6
E) 3