

AP Calculus BC

AP Exam Problems

Chapters 1 - 3

Precalculus Review

1. If f is a continuous function defined for all real numbers x and if the maximum value of $f(x)$ is 5 and the minimum value of $f(x)$ is -7 , then which of the following must be true?

 - I. The maximum value of $f(|x|)$ is 5.
 - II. The maximum value of $|f(x)|$ is 7.
 - III. The minimum value of $f(|x|)$ is 0.

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

2. If $f(g(x)) = \ln(x^2 + 4)$, $f(x) = \ln(x^2)$, and $g(x) > 0$ for all real x , then $g(x) =$

A) $\frac{1}{\sqrt{x^2 + 4}}$ B) $\frac{1}{x^2 + 4}$ C) $\sqrt{x^2 + 4}$ D) $x^2 + 4$ E) $x + 2$

3. What is the domain of the function f given by $f(x) = \frac{\sqrt{x^2 - 4}}{x - 3}$?

A) $\{x : x \neq 3\}$ C) $\{x : |x| \geq 2\}$ E) $\{x : x \geq 2 \text{ and } x \neq 3\}$
 B) $\{x : |x| \leq 2\}$ D) $\{x : |x| \geq 2 \text{ and } x \neq 3\}$

4. If $\ln x - \ln\left(\frac{1}{x}\right) = 2$, then $x =$

A) $\frac{1}{e^2}$ B) $\frac{1}{e}$ C) e D) $2e$ E) e^2

5. If $f(x) = \frac{x}{x+1}$, then the inverse function, f^{-1} , is given by $f^{-1}(x) =$

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

6. Which of the following does **NOT** have a period of π ?

A) $f(x) = \sin\left(\frac{1}{2}x\right)$ C) $f(x) = \sin^2 x$ E) $f(x) = \tan^2 x$
 B) $f(x) = \frac{|\sin x|}{x}$ D) $f(x) = \tan x$

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7. The graph of which of the following equations has $y = 1$ as an asymptote?

A) $y = \ln x$ B) $y = \sin x$ C) $y = \frac{x}{x+1}$ D) $y = \frac{x^2}{x-1}$ E) $y = e^{-x}$

8. Which of the following is continuous for all real numbers x ?

I. $y = x^{\frac{2}{3}}$ II. $y = e^x$ III. $y = \tan x$

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

9. If $f(x)$ is continuous for all real numbers and if $f(x) = \frac{x^2 - 4}{x + 2}$ when $x \neq -2$, then $f(-2) =$

- A) -4 B) -2 C) -1 D) 0 E) 2

10. If $h(x) = f(g(x))$, where $f(x) = 3x^2 - 1$ and $g(x) = |x|$, then $h(x) =$

- A) $3x^2 - |x|$ C) $3x^2|x| - 1$ E) $3x^2 - 1$
 B) $|3x^2 - 1|$ D) $3|x| - 1$

11. The fundamental period of $2\cos(3x)$ is

- A) $\frac{2\pi}{3}$ B) 2π C) 6π D) 2 E) 3

12. If the graph of $y = \frac{ax + b}{x + c}$ has a horizontal asymptote $y = 2$ and a vertical asymptote $x = -3$, then $a + c =$

- A) -5 B) -1 C) 0 D) 1 E) 5

x	0	1	2
$f(x)$	1	k	2

13. The function f is continuous on the closed interval $[0, 2]$ and has values given in the table above. The equation $f(x) = \frac{1}{2}$ must have at least two solutions in the interval $[0, 2]$ if $k =$

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

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14. Let f be the function defined by the following.

$$f(x) = \begin{cases} \sin x, & x < 0 \\ x^2, & 0 \leq x < 1 \\ 2-x, & 1 \leq x < 2 \\ x-3, & x \geq 2 \end{cases}$$

For what values of x is f NOT continuous?

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

15. Which of the following functions is continuous at $x = 1$?

I. $\ln x$ II. e^x III. $\ln(e^x - 1)$

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

16. Let f be the function given by $f(x) = \frac{(x-1)(x^2-4)}{x^2-a}$. For what positive values of a is f continuous for all real numbers x ?

- A) None B) 1 only C) 2 only D) 4 only E) 1 and 4 only

Limits and Continuity

17. If $f(x) = 2x^2 + 1$, then $\lim_{x \rightarrow 0} \frac{f(x) - f(0)}{x^2}$ is

- A) 0 B) 1 C) 2 D) 4 E) nonexistent

18. If $f(x) = \begin{cases} \ln x & \text{for } 0 < x \leq 2 \\ x^2 \ln 2 & \text{for } 2 < x \leq 4 \end{cases}$ then $\lim_{x \rightarrow 2} f(x)$ is

- A) $\ln 2$ B) $\ln 8$ C) $\ln 16$ D) 4 E) nonexistent

19. Find $\lim_{n \rightarrow \infty} \frac{4n^2}{n^2 + 10,000n}$

- A) 0 B) $\frac{1}{2,500}$ C) 1 D) 4 E) nonexistent

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20. If $\lim_{x \rightarrow a} f(x) = L$, where L is a real number, which of the following must be true?

- | | |
|--------------------------------------|----------------------|
| A) $f'(a)$ exists. | D) $f(a) = L$ |
| B) $f(x)$ is continuous at $x = a$. | E) None of the above |
| C) $f(x)$ is defined at $x = a$. | |

21. Find $\lim_{n \rightarrow \infty} \frac{3n^3 - 5n}{n^3 - 2n^2 + 1}$

- | | | | |
|-------|-------|------|----------------|
| A) -5 | B) -2 | C) 1 | D) 3 |
| | | | E) nonexistent |

22. Find $\lim_{\theta \rightarrow 0} \frac{1 - \cos \theta}{2 \sin^2 \theta}$

- | | | | |
|------|------------------|------------------|----------------|
| A) 0 | B) $\frac{1}{8}$ | C) $\frac{1}{4}$ | D) 1 |
| | | | E) nonexistent |

23. If $a \neq 0$, then $\lim_{x \rightarrow a} \frac{x^2 - a^2}{x^4 - a^4}$ is

- | | | | |
|--------------------|---------------------|---------------------|----------------|
| A) $\frac{1}{a^2}$ | B) $\frac{1}{2a^2}$ | C) $\frac{1}{6a^2}$ | D) 0 |
| | | | E) nonexistent |

Derivatives

24. If $f(x) = e^x$, which of the following is equal to $f'(e)$?

- | | | |
|---|---|---|
| A) $\lim_{h \rightarrow 0} \frac{e^{x+h} - e^x}{h}$ | C) $\lim_{h \rightarrow 0} \frac{e^{e+h} - e^e}{h}$ | E) $\lim_{h \rightarrow 0} \frac{e^{e+h} - e^e}{h}$ |
| B) $\lim_{h \rightarrow 0} \frac{e^{x+h} - e^e}{h}$ | D) $\lim_{h \rightarrow 0} \frac{e^{x+h} - 1}{h}$ | |

25. The $\lim_{h \rightarrow 0} \frac{\tan 3(x+h) - \tan(3x)}{h}$ is

- | | | |
|------------------|-----------------|----------------|
| A) 0 | C) $\sec^2(3x)$ | E) nonexistent |
| B) $3\sec^2(3x)$ | D) $3\cot(3x)$ | |

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26. If f is a differentiable function, then $f'(a)$ is given by which of the following?

- I. $\lim_{h \rightarrow 0} \frac{f(a+h) - f(a)}{h}$ II. $\lim_{x \rightarrow a} \frac{f(x) - f(a)}{x - a}$ III. $\lim_{x \rightarrow a} \frac{f(x+h) - f(x)}{h}$
- A) I only B) II only C) I and II only D) I and III only E) I, II, and III

27. Find $\lim_{h \rightarrow 0} \frac{\sin(x+h) - \sin x}{h}$

- A) 0 B) 1 C) $\sin x$ D) $\cos x$ E) nonexistent

28. If $\lim_{x \rightarrow 3} f(x) = 7$, which of the following must be true?

- I. f is continuous at $x = 3$.
 II. f is differentiable at $x = 3$.
 III. $f(3) = 7$
- A) None B) II only C) III only D) I and III only E) I, II, and III

29. Which of the following functions shows that the statement “If a function is continuous at $x = 0$, then it is differentiable at $x = 0$ ” is false?

- A) $f(x) = x^{-\frac{4}{3}}$ C) $f(x) = x^{\frac{1}{3}}$ E) $f(x) = x^3$
 B) $f(x) = x^{-\frac{1}{3}}$ D) $f(x) = x^{\frac{4}{3}}$

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

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

31. If $f(x) = x$, then $f'(5) =$

- A) 0 B) $\frac{1}{5}$ C) 1 D) 5 E) $\frac{25}{2}$

32. Find $\frac{d}{dx} \left(\frac{1}{x^3} - \frac{1}{x} + x^2 \right)$ at $x = -1$

- A) -6 B) -4 C) 0 D) 2 E) 6

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33. If $f(x) = \sqrt{2x}$, then $f'(2) =$

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

34. If $f(x) = x^{\frac{3}{2}}$, then $f'(4) =$

- A) -6 B) -3 C) 3 D) 6 E) 8

35. If $y = \cos^2 x - \sin^2 x$, then $y' =$

- A) -1 C) $-2\sin(2x)$ E) $2(\cos x - \sin x)$
 B) 0 D) $-2(\cos x + \sin x)$

36. If $f(x) = \sin x$, then $f'\left(\frac{\pi}{3}\right) =$

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

37. If $y = \tan x - \cot x$, then $\frac{dy}{dx} =$

- A) $\sec x \csc x$ C) $\sec x + \csc x$ E) $\sec^2 x + \csc^2 x$
 B) $\sec x - \csc x$ D) $\sec^2 x - \csc^2 x$

38. If $y = \tan^{-1}(e^{2x})$, then $\frac{dy}{dx} =$

- A) $\frac{2e^{2x}}{\sqrt{1-e^{4x}}}$ C) $\frac{e^{2x}}{1+e^{4x}}$ E) $\frac{1}{1+e^{4x}}$
 B) $\frac{2e^{2x}}{1+e^{4x}}$ D) $\frac{1}{\sqrt{1-e^{4x}}}$

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39. If $y = \tan^{-1}(\cos x)$, then $\frac{dy}{dx} =$

- | | | |
|------------------------------------|------------------------------------|-----------------------------|
| A) $\frac{-\sin x}{1 + \cos^2 x}$ | C) $(\sec^{-1}(\cos x))^2$ | E) $\frac{1}{1 + \cos^2 x}$ |
| B) $-(\sec^{-1}(\cos x))^2 \sin x$ | D) $\frac{1}{(\cos^{-1} x)^2 + 1}$ | |

40. If $y = \frac{3}{4+x^2}$, then $\frac{dy}{dx} =$

- | | | |
|----------------------------|---------------------------|-------------------|
| A) $\frac{-6x}{(4+x^2)^2}$ | C) $\frac{6x}{(4+x^2)^2}$ | E) $\frac{3}{2x}$ |
| B) $\frac{3x}{(4+x^2)^2}$ | D) $\frac{-3}{(4+x^2)^2}$ | |

41. The value of the derivative of $y = \frac{\sqrt[3]{x^2+8}}{\sqrt[4]{2x+1}}$ at $x = 0$ is

- | | | |
|------------------|-------------------|------|
| A) -1 | B) $-\frac{1}{2}$ | C) 0 |
| D) $\frac{1}{2}$ | E) 1 | |

42. What is the instantaneous rate of change at $x = 2$ of the function f given by $f(x) = \frac{x^2 - 2}{x - 1}$?

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

43. If $f(x) = \frac{x}{\tan x}$, then $f' \left(\frac{\pi}{4} \right) =$

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

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

- | | | |
|------------------|--------------------|-------------|
| A) $2x e^x$ | C) $x e^x (x + 2)$ | E) $2x + e$ |
| B) $x(x + 2e^x)$ | D) $2x + e^x$ | |

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45. If $f(x) = (x-1)^2 \sin x$, then $f'(0) =$

- A) -2 B) -1 C) 0 D) 1 E) 2

46. If f and g are differentiable functions such that $g(x) = e^{f(x)}$ and $g''(x) = h(x)e^{f(x)}$, then $h(x) =$

- A) $f'(x) + f''(x)$ C) $(f'(x) + f''(x))^2$ E) $2f'(x) + f''(x)$
 B) $f'(x) + (f''(x))^2$ D) $(f'(x))^2 + f''(x)$

47. If u , v , and w are nonzero differentiable functions, then the derivative of $\frac{uv}{w}$ is

- A) $\frac{uv' + u'v}{w'}$ C) $\frac{uvw' - uv'w - u'vw}{w^2}$ E) $\frac{uv'w + u'vw - uvw'}{w^2}$
 B) $\frac{u'v'w + uvw'}{w^2}$ D) $\frac{u'vw + uv'w + uvw'}{w^2}$

48. If $f(x) = (2x+1)^4$, then the fourth derivative of $f(x)$ at $x=0$ is

- A) 0 B) 24 C) 48 D) 240 E) 384

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

- A) $-8\cos\left(\frac{x}{2}\right)$ C) $-\sin\left(\frac{x}{2}\right)$ E) $-\frac{1}{2}\cos\left(\frac{x}{2}\right)$
 B) $-2\cos\left(\frac{x}{2}\right)$ D) $-\cos\left(\frac{x}{2}\right)$

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

- A) $\frac{4}{3}$ B) 0 C) $-\frac{2}{3}$ D) $-\frac{4}{3}$ E) -2

51. If $f(x) = \sin(e^{-x})$, then $f'(x) =$

- A) $-\cos(e^{-x})$ C) $\cos(e^{-x}) - e^{-x}$ E) $-e^{-x} \cos(e^{-x})$
 B) $\cos(e^{-x}) + e^{-x}$ D) $e^{-x} \cos(e^{-x})$

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52. If $f(x) = \tan(2x)$, then $f'\left(\frac{\pi}{6}\right) =$

- A) $\sqrt{3}$ B) $2\sqrt{3}$ C) 4 D) $4\sqrt{3}$ E) 8

53. If f and g are twice differentiable functions and if $h(x) = f(g(x))$, then $h''(x) =$

- A) $f''(g(x)) [g'(x)]^2 + f'(g(x))g''(x)$ D) $f''(g(x))g''(x)$
 B) $f''(g(x))g'(x) + f'(g(x))g''(x)$ E) $f''(g(x))$
 C) $f''(g(x)) [g'(x)]^2$

54. Find $\frac{d}{dx}(2^x) =$

- A) 2^{x-1} B) $(2^{x-1})x$ C) $(2^x)\ln 2$ D) $(2^{x-1})\ln 2$ E) $\frac{2x}{\ln 2}$

55. Find $\frac{d}{dx} \ln\left(\frac{1}{1-x}\right) =$

- A) $\frac{1}{1-x}$ B) $\frac{1}{x-1}$ C) $1-x$ D) $x-1$ E) $(1-x)^2$

56. If $f(x) = x \ln(x^2)$, then $f'(x) =$

- A) $\ln(x^2) + 1$ B) $\ln(x^2) + 2$ C) $\ln(x^2) + \frac{1}{x}$ D) $\frac{1}{x^2}$ E) $\frac{1}{x}$

57. If $f(x) = \ln(\sqrt{x})$, then $f''(x) =$

- A) $-\frac{2}{x^2}$ B) $-\frac{1}{2x^2}$ C) $-\frac{1}{2x}$ D) $-\frac{1}{2x^{3/2}}$ E) $\frac{2}{x^2}$

58. If $f(x) = e^x$, then $\ln[f'(2)] =$

- A) 2 B) 0 C) $\frac{1}{e^2}$ D) $2e$ E) e^2

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59. Find $\frac{d}{dx} \ln \left| \cos\left(\frac{\pi}{x}\right) \right|$

- | | | |
|--|---|---|
| A) $\frac{-\pi}{x^2 \cos\left(\frac{\pi}{x}\right)}$ | C) $\frac{1}{\cos\left(\frac{\pi}{x}\right)}$ | E) $\frac{\pi}{x^2} \tan\left(\frac{\pi}{x}\right)$ |
| B) $-\tan\left(\frac{\pi}{x}\right)$ | D) $\frac{\pi}{x} \tan\left(\frac{\pi}{x}\right)$ | |

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

- A) 1 B) 2 C) $2x$ D) e^{-2x} E) $2e^{-2x}$

61. If $f(x) = e^{\tan^2 x}$, then $f'(x) =$

- | | | |
|----------------------------|-------------------------------------|----------------------------|
| A) $e^{\tan^2 x}$ | C) $\tan^2 x e^{\tan^2 x - 1}$ | E) $2 \tan x e^{\tan^2 x}$ |
| B) $\sec^2 x e^{\tan^2 x}$ | D) $2 \tan x \sec^2 x e^{\tan^2 x}$ | |

62. If $y = 10^{(x^2-1)}$, then $\frac{dy}{dx} =$

- | | | |
|----------------------------|-------------------------------|--------------------------------|
| A) $(\ln 10) 10^{(x^2-1)}$ | C) $(x^2-1) 10^{(x^2-2)}$ | E) $x^2 (\ln 10) 10^{(x^2-1)}$ |
| B) $(2x) 10^{(x^2-1)}$ | D) $2x (\ln 10) 10^{(x^2-1)}$ | |

63. If $y = \frac{\ln x}{x}$, then $\frac{dy}{dx} =$

- A) $\frac{1}{x}$ B) $\frac{1}{x^2}$ C) $\frac{\ln x - 1}{x^2}$ D) $\frac{1 - \ln x}{x^2}$ E) $\frac{1 + \ln x}{x^2}$

64. Find $\frac{d}{dx} (x^{\ln x}) =$

- | | | |
|----------------|-------------------------------------|---------------------------|
| A) $x^{\ln x}$ | C) $\frac{2}{x} (\ln x)(x^{\ln x})$ | E) $2 (\ln x)(x^{\ln x})$ |
| B) $(\ln x)^x$ | D) $(\ln x)(x^{\ln x - 1})$ | |

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65. If $f(x) = e^{3\ln(x^2)}$, then $f'(x) =$

- | | | |
|----------------------------------|----------------------------|-----------|
| A) $e^{3(\ln x^2)}$ | C) $6(\ln x)e^{3\ln(x^2)}$ | E) $6x^5$ |
| B) $\frac{3}{x^2}e^{3(\ln x^2)}$ | D) $5x^4$ | |

66. For $0 < x < \frac{\pi}{2}$, if $y = (\sin x)^x$, then $\frac{dy}{dx} =$

- | | | |
|------------------------|-------------------------------------|--|
| A) $x \ln(\sin x)$ | C) $x(\sin x)^{x-1}(\cos x)$ | E) $(\sin x)^x [x \cot x + \ln(\sin x)]$ |
| B) $(\sin x)^x \cot x$ | D) $(\sin x)^x (x \cos x + \sin x)$ | |

67. If $e^{f(x)} = 1 + x^2$, then $f'(x) =$

- | | | |
|-----------------------|--------------------|--------------------|
| A) $\frac{1}{1+x^2}$ | C) $2x(1+x^2)$ | E) $2x \ln(1+x^2)$ |
| B) $\frac{2x}{1+x^2}$ | D) $2x(e^{1+x^2})$ | |

68. If $x^2 + xy + y^3 = 0$, then, in terms of x and y , $\frac{dy}{dx} =$

- | | | |
|---------------------------|-------------------------|-----------------------------|
| A) $-\frac{2x+y}{x+3y^2}$ | C) $\frac{-2x}{1+3y^2}$ | E) $-\frac{2x+y}{x+3y^2-1}$ |
| B) $-\frac{x+3y^2}{2x+y}$ | D) $\frac{-2x}{x+3y^2}$ | |

69. If $x + 2xy - y^2 = 2$, then at the point $(1, 1)$, $\frac{dy}{dx} =$

- | | | | | |
|------------------|------------------|------|-------------------|----------------|
| A) $\frac{3}{2}$ | B) $\frac{1}{2}$ | C) 0 | D) $-\frac{3}{2}$ | E) nonexistent |
|------------------|------------------|------|-------------------|----------------|

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70. If $x^3 + 3xy + 2y^3 = 17$, then, in terms of x and y , $\frac{dy}{dx} =$

A) $-\frac{x^2 + y}{x + 2y^2}$

C) $-\frac{x^2 + y}{x + 2y}$

E) $\frac{-x^2}{1 + 2y^2}$

B) $-\frac{x^2 + y}{x + y^2}$

D) $-\frac{x^2 + y}{2y^2}$

71. If $x^2 + xy = 10$, then when $x = 2$, $\frac{dy}{dx} =$

A) $-\frac{7}{2}$

B) -2

C) $\frac{2}{7}$

D) $\frac{3}{2}$

E) $\frac{7}{2}$

72. If $xy^2 + 2xy = 8$, then at the point $(1, 2)$, $y' =$

A) $-\frac{5}{2}$

B) $-\frac{4}{3}$

C) -1

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

E) 0

73. If $y^2 - 2xy = 16$, then $\frac{dy}{dx} =$

A) $\frac{x}{y-x}$

B) $\frac{y}{x-y}$

C) $\frac{y}{y-x}$

D) $\frac{y}{2y-x}$

E) $\frac{2y}{x-y}$

74. If $\frac{dy}{dx} = \sqrt{1-y^2}$, then $\frac{d^2y}{dx^2} =$

A) $-2y$

B) $-y$

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

D) y

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

Tangents and Normals

75. The slope of the line tangent to the curve $y^2 + (xy + 1)^3 = 0$ at $(2, -1)$ is

A) $-\frac{3}{2}$

B) $-\frac{3}{4}$

C) 0

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

E) $\frac{3}{2}$

76. The slope of the line tangent to the graph of $\ln(xy) = x$ at the point where $x = 1$ is

A) 0

B) 1

C) e

D) e^2

E) $1-e$

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77. The slope of the line tangent to the graph of $y = \ln\left(\frac{x}{2}\right)$ at $x = 4$ is

- A) $\frac{1}{8}$ B) $\frac{1}{4}$ C) $\frac{1}{2}$ D) 1 E) 4

78. The slope of the line normal to the graph of $y = 2\ln(\sec x)$ at $x = \frac{\pi}{4}$ is

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

79. An equation of the line tangent to the graph of $f(x) = x(1-2x)^3$ at the point $(1, -1)$ is

- A) $y = -7x + 6$ C) $y = -2x + 1$ E) $y = 7x - 8$
B) $y = -6x + 5$ D) $y = 2x - 3$

80. An equation of the line tangent to the graph of $y = \frac{2x+3}{3x-2}$ at the point $(1, 5)$ is

- A) $13x - y = 8$ C) $x - 13y = 64$ E) $-2x + 3y = 13$
B) $13x + y = 18$ D) $x + 13y = 66$

81. An equation of the line tangent to the graph of $y = x + \cos x$ at the point $(0, 1)$ is

- A) $y = 2x + 1$ C) $y = x$ E) $y = 0$
B) $y = x + 1$ D) $y = x - 1$

82. Let f be the function given by $f(x) = 3e^{2x}$ and let g be the function given by $g(x) = 6x^3$. At what value of x do the graphs of f and g have parallel tangent lines? (Calculator)

- A) -0.701 B) -0.567 C) -0.391 D) -0.302 E) -0.258

83. Which of the following is an equation of the line tangent to the graph of $f(x) = x^4 + 2x^2$ at the point where $f'(x) = 1$? (Calculator)

- A) $y = 8x - 5$ C) $y = x - 0.763$ E) $y = x - 2.146$
B) $y = x + 7$ D) $y = x - 0.122$

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84. An equation of the line normal to the graph of $y = x^3 + 3x^2 + 7x - 1$ at the point where $x = -1$ is

- A) $4x + y = -10$ C) $4x - y = 2$ E) $x + 4y = -25$
B) $x - 4y = 23$ D) $x + 4y = 25$

Position/Velocity/Acceleration

85. A particle moves along the x -axis so that at any time $t \geq 0$ its position is given by
 $x(t) = t^3 - 3t^2 - 9t + 1$. For what values of t is the particle at rest?

- A) None B) 1 only C) 3 only D) 5 only E) 1 and 3

86. The position of a particle moving along a straight line at any time t is given by $s(t) = t^2 + 4t + 4$.
What is the acceleration of the particle when $t = 4$?

- A) 0 B) 2 C) 4 D) 8 E) 12

87. A particle moves along a line so that at time t , where $0 \leq t \leq \pi$, its position is given by

$s(t) = -4 \cos t - \frac{t^2}{2} + 10$. What is the velocity of the particle when its acceleration is zero?
(Calculator)

- A) -5.19 B) 0.74 C) 1.32 D) 2.55 E) 8.13

88. A particle moves along the x -axis so that its position at time t is given by $x(t) = t^2 - 6t + 5$. For
what value of t is the velocity of the particle zero?

- A) 1 B) 2 C) 3 D) 4 E) 5

89. The position of a particle moving along the x -axis is $x(t) = \sin(2t) - \cos(3t)$ for time $t \geq 0$.
When $t = \pi$, the acceleration of the particle is

- A) 9 B) $\frac{1}{9}$ C) 0 D) $-\frac{1}{9}$ E) -9

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Free Response Questions

1. Let f be the function given by $f(x) = \frac{2x-5}{x^2-4}$.
 - (a) Find the domain of f .
 - (b) Write an equation for each vertical and horizontal asymptote for the graph of f .
 - (c) Find $f'(x)$.
 - (d) Write an equation for the line tangent to the graph of f at the point $(0, f(0))$.
2. Let f be the function given by $f(x) = \sqrt{x^4 - 16x^2}$.
 - (a) Find the domain of f .
 - (b) Describe the symmetry, if any, of the graph of f .
 - (c) Find $f'(x)$.
 - (d) Find the slope of the line normal to the graph of f at $x = 5$.
3. A particle moves on the x -axis so that its position at time $t \geq 0$ is given by $x(t) = 2te^{-t}$.
 - (a) Find the acceleration of the particle at $t = 0$.
 - (b) Find the velocity of the particle when its acceleration is 0.
 - (c) Find the total distance traveled by the particle from $t = 0$ to $t = 5$.

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Chapter 1 – 3 AP Exam Problems - Answers

1.	B	AB	1985	#36	26%	53.	A	BC	1998	#5	60%
2.	C	AB	1985	#12	82%	54.	C	AB	1993	#25	60%
3.	D	AB	1988	#2	60%	55.	A	BC	1985	#11	41%
4.	C	AB	1988	#22	64%	56.	B	BC	1985	#17	90%
5.	C	AB	1988	#31	50%	57.	B	BC	1988	#3	79%
6.	A	AB	1988	#32	46%	58.	A	BC	1988	#8	95%
7.	C	AB	1988	#42	56%	59.	E	BC	1988	#28	79%
8.	D	AB	1985	#29	56%	60.	B	BC	1993	#8	88%
9.	A	AB	1993	#5	67%	61.	D	BC	1993	#15	92%
10.	E	AB	1993	#9	88%	62.	D	AB	1985	#10	56%
11.	A	AB	1993	#13	65%	63.	D	AB	1988	#6	83%
12.	E	AB	1993	#35	48%	64.	C	AB	1988	#24	21%
13.	A	AB	1998	#26	41%	65.	E	AB	1993	#31	30%
14.	C	BC	1988	#5	72%	66.	E	BC	1985	#26	59%
15.	E	BC	1993	#10	70%	67.	B	BC	1993	#18	91%
16.	A	BC	1998	#79	45%	68.	A	AB	1985	#13	81%
17.	C	BC	1993	#2	87%	69.	E	AB	1988	#9	81%
18.	E	BC	1998	#12	72%	70.	A	AB	1993	#4	66%
19.	D	AB	1985	#5	81%	71.	A	AB	1998	#6	68%
20.	E	AB	1985	#41	32%	72.	B	BC	1985	#9	74%
21.	D	AB	1993	#3	85%	73.	C	BC	1988	#6	84%
22.	C	AB	1993	#29	40%	74.	B	BC	1998	#81	25%
23.	B	AB	1998	#83	45%	75.	D	BC	1998	#3	58%
24.	E	AB	1985	#25	43%	76.	A	BC	1993	#17	73%
25.	B	AB	1988	#29	45%	77.	B	AB	1985	#8	60%
26.	C	AB	1993	#37	24%	78.	B	AB	1993	#16	42%
27.	D	BC	1988	#10	64%	79.	A	AB	1988	#11	61%
28.	A	AB	1988	#41	30%	80.	B	AB	1993	#7	65%
29.	C	BC	1985	#16	57%	81.	B	AB	1998	#18	71%
30.	E	AB	1988	#27	53%	82.	C	AB	1998	#77	63%
31.	C	AB	1985	#6	80%	83.	D	AB	1998	#87	40%
32.	B	AB	1985	#23	59%	84.	E	BC	1985	#32	63%
33.	B	AB	1988	#15	65%	85.	C	AB	1988	#16	74%
34.	C	AB	1993	#1	92%	86.	B	AB	1985	#11	84%
35.	C	AB	1985	#18	58%	87.	D	AB	1993	#26	46%
36.	B	AB	1988	#12	76%	88.	C	AB	1998	#14	94%
37.	E	AB	1993	#8	70%	89.	E	BC	1993	#12	82%
38.	B	BC	1993	#26	80%						
39.	A	AB	1985	#20	57%						
40.	A	AB	1985	#3	81%						
41.	A	BC	1993	#21	56%	1.					
42.	D	AB	1998	#10	74%	2.					
43.	E	BC	1985	#6	81%	3.					
44.	C	AB	1988	#1	88%						
45.	D	AB	1993	#10	76%						
46.	D	BC	1985	#19	68%						
47.	E	BC	1988	#4	80%						
48.	E	AB	1985	#2	74%						
49.	E	AB	1988	#18	73%						
50.	A	AB	1993	#24	65%						
51.	E	AB	1998	#16	69%						
52.	E	AB	1998	#28	56%						

Free Response

- | | | | | |
|----|--|------|----|----|
| 1. | | 1985 | AB | #1 |
| 2. | | 1988 | AB | #1 |
| 3. | | 1993 | AB | #2 |