

## eSpyMath: AP Precalculus Practice Questions (2024)

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1. If  $\alpha$  and  $\beta$  are the roots of the quadratic equation of  $x^2 - 4x + 2 = 0$ , determine  $(\alpha + \beta) \times (\alpha \times \beta)$

2. If  $\alpha$  and  $\beta$  are the roots of the quadratic equation of  $x^2 - 4x + 2 = 0$ , determine  $|\alpha - \beta|$

3. Find  $f \circ g(4)$  where  $f\left(\frac{1}{x}\right) = \sqrt{x} - 2$  and  $g(x) = 2x$

4. For what value of  $a$ , the value of the term of  $ax^2 - 2x + 3a$  is always positive?

5. What is the numerical coefficient of the term containing  $u^4v^3$  in the expansion of  $(3u + v)^7$ ?

6. What is the inverse of the matrix  $\begin{bmatrix} 5 & -1 \\ 7 & 2 \end{bmatrix}$ ?

7. If  $g(x) = x^4 + Cx^3 + Dx^2 + 6$ , and  $g(2) = 8$  and  $g(-2) = -32$ , what is the value of  $3C + D$ ?

8. If  $h(x) = x^5 - 3x^3 + 2x - 4$ , find  $h(-1)$ .

9. What is the domain of  $h(x) = \frac{x^2 - 9}{x^3 - 27}$ ?

10. What is the domain of  $p(x) = \frac{\sqrt{2x - 6}}{x^2 - 4x + 4}$ ?

11. Which of the following represents the equation of  $k^{-1}(x)$  for the inverse of the function  $k(x) = 2^{x+2} - 4$ ?

12. Which of the following is equivalent to the expression  $\log_5\left(\frac{p^4q^3}{r^2}\right)$ ?

(A)  $\frac{4}{5}\log_5 p + \frac{3}{5}\log_5 q - \frac{2}{5}\log_5 r$

(B)  $\frac{1}{5}(4\log_5 p + 3\log_5 q) - \frac{2}{5}\log_5 r$

(C)  $4\log_5 p + 3\log_5 q - 2\log_5 r$

(D)  $\frac{4}{2}\log_5 p + \frac{3}{2}\log_5 q - \log_5 r$

13. Identify the vertical asymptote(s) for the function  $g(x) = \frac{x^3 - 1}{x^2 - x - 6}$ .

14. Given  $h(x) = \begin{cases} -2x^2 + 8, & x \leq 1 \\ \sqrt{x+4}, & x > 1 \end{cases}$ , find  $h(0.5)$ .

15. Find the slant asymptote of  $m(x) = \frac{2x^2 - 5x}{x - 2}$ .

16. In polar coordinates, which of the following choices is not equivalent to  $(3, -\frac{\pi}{4})$ ?

(A)  $(3, \frac{7\pi}{4})$

(B)  $(-3, \frac{3\pi}{4})$

(C)  $(3, \frac{15\pi}{4})$

(D)  $(-3, -\frac{5\pi}{4})$

17. Which of the following represents zeros of  $S(\theta) = 3 - 3\cos 2\theta$ ?

(A)  $\frac{\pi}{6}, \frac{5\pi}{6}$

(B)  $0, \pi, 2\pi$

(C)  $\frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$

(D)  $\frac{\pi}{3}, \frac{2\pi}{3}, \frac{4\pi}{3}, \frac{5\pi}{3}$

18. Which of the following choices represents the corresponding rectangular equation of the curve with the parametric equations  $x(t) = 4t$ ,  $y(t) = t^2 - 2t + 3$ ?

(A)  $y = \frac{1}{16}x^2 - \frac{1}{2}x + 3$

(B)  $y = \frac{1}{4}x^2 - 2x + 3$

(C)  $y = x^2 - 8x + 12$

(D)  $y = 4x - x^2 + 3$

19. Evaluate:  $\sin\left(\arctan\left(\frac{4}{3}\right)\right)$ , given that  $0 \leq \theta \leq \frac{\pi}{2}$ .

20. Given that  $\cos \alpha = \frac{3}{5}$  and  $\sin \alpha < 0$ , find  $\sin \alpha$ .

(A)  $\sqrt{\frac{16}{25}}$

(B)  $-\sqrt{\frac{16}{25}}$

(C)  $\frac{4}{5}$

(D)  $-\frac{4}{5}$

21. Which of the following is a possible equation for the sinusoidal graph shown with a maximum at  $y = 4$ , a minimum at  $y = -2$ , and a period of 8?

(A)  $y = 3\sin\left(\frac{\pi}{4}x\right) + 1$

(B)  $y = 3\cos\left(\frac{\pi}{4}x\right) - 1$

(C)  $y = 6\sin\left(\frac{\pi}{4}x\right) + 1$

(D)  $y = 6\cos\left(\frac{\pi}{4}x\right) + 1$

22. Which of the following is equivalent to  $2\sin(7x)\cos(2x) + 2\cos(7x)\sin(2x)$ ?

(A)  $2\sin 5x$

(B)  $2\sin 9x$

(C)  $2\cos 5x$

(D)  $2\cos 9x$

23. Given  $\cos x = -1/3$  and  $\tan x > 0$ , find  $\cos 2x$ .

24. Determine the period of the function  $y = -3\cos\left(2\left(x + \frac{\pi}{4}\right)\right)$ .

25. Solve the equation  $\log_d(5 - \log_d(m)) = n$  for  $m$ .

26. Determine whether the function  $h(x) = x^6 - x^2 \cos(x)$  is odd, even, or neither.

27. Find the linear equation for the function  $p$  that passes through the points  $(2, -5)$  and  $(-4, 3)$ .

28. Find Inverse function of  $f(x)$ , which is  $f^{-1}(x)$  where  $f(x-1) = x^2 + 2x$

29. If  $m(x) = x^3 + 1$  and  $n(x) = \sqrt[3]{x-5}$ , find the composition  $(n \circ m)(x)$ .

30. Evaluate the limit  $\lim_{x \rightarrow \infty} k(x)$ , where  $k(x) = (3x - 5)^2 - (2x + 7)^4$ .

31. Solve the inequality:  $\frac{3(x+2)}{(x-2)(x+4)} \geq 0$ .

32. Determine the equation of the ellipse shown in the graph below, with its center at  $(2, -3)$ , horizontal major axis of length 10, and minor axis of length 6.

33. Evaluate the limit:  $\lim_{x \rightarrow -\infty} 4^{-x} - 1$ .

**34. What is the function whose graph is a reflection over the y-axis of the graph of  $h(x) = 2 - 4^x$  ? (Reflection over the y-axis)**

**35. Which of the following functions does not have an inverse function on the specified domain?**

(A)  $y = \cos(x)$ , where  $0 \leq x \leq \pi$

(B)  $y = x^2 - 3$

(C)  $y = \frac{1}{x} - 3$

(D)  $y = 3^x$

**36. Give an algebraic expression for  $\sin(\cos^{-1}(x))$ . (Algebraic Expression)**

**37. A circle is graphed using the parametric equations shown below:  $x = 7\sin(t) - 2$  and  $y = 7\cos(t) + 4$  Where is the center of the circle located? (Parametric Equations)**



**38. The table shows the predicted growth of a particular bacteria population after various numbers of hours. Write an explicit formula for the sequence of the number of bacteria. (Arithmetic Sequence)**

Hours ( $n$ )	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Bacteria ( $b_n$ )	23	46	69	92	115

**39. What are the points where the graph of the polynomial  $g(x) = 3(x + 6)(x - 6)^2$  crosses the x-axis? (Polynomial Zeros)**

**40. Evaluate:  $\lim_{x \rightarrow \infty} \frac{2x^2 - 5x - 7}{4x^2 + 5x - 9}$  (Limits)**

**41. Given the function  $g(x) = (x^2 - 4) - (x - 2)(x + 1)$ , at what value of  $x$  is the absolute maximum of  $g(x)$  over the interval  $[-1.5, 3]$ ? (Maximum Value of a Function)**

**42. Approximate  $\log_5 36$ , given that  $\log_2 5 \approx 2.33$  and  $\log_2 3 \approx 1.58$ .**

**43. (Exponential Equation): Solve for  $y$  :  $5^{2y} = 25^{y+1}$ .**

**44. Convert the complex number  $(1 - 4i)$  to Polar form  $r(\cos(\theta) + i\sin(\theta))$  ? (Complex Number Representation)**

**45. Find the angle between two vectors  $\vec{r}$  and  $\vec{s}$  with magnitudes 3 and 4, respectively, that has a dot product equal to 6. (Vector Dot Product)**

**46. How long will it take for 500 to triple in value in an investment when interest is compounded continuously at the rate of 4.2% per annum? Round your answer to the nearest year. (Compound Interest)**

**47. (Projectile Motion): A rock is thrown vertically upward from a cliff that is 100 feet above ground level with an initial velocity of 60 feet per second. The height  $h$ , in feet above ground level, of the rock  $t$  seconds after the throw is given by the function  $h(t) = -16t^2 + 60t + 100$ . At approximately what value of  $t$  will the rock be at the height of 80 feet and moving upward?**

**48. (Exponential Decay): A ball is dropped from a height of 25 feet. After each bounce, the ball reaches 80% of its previous height. How high will the ball rebound after the second bounce?**

**49. (Exponential Decay):** Suppose you release a balloon from a height of 20 feet. After it ascends, it stabilizes at 120% of its previous height each minute. How high, to the nearest tenth, will the balloon be after 2 minutes?

**50.** What is the third term in the expansion of  $(2a + 3b)^5$ ?

**51. Simplify:**  $\ln\left(\sqrt[3]{e^3 x}\right)$ .

**52.** If  $\sec x \neq 1$ , which of the following is equivalent to  $\frac{\tan^2 x}{1 + \sec x}$ ?

**53. 4.** If  $\cos \alpha = a$ , then what is  $\sin \alpha \cdot \cos \alpha \cdot \cot \alpha$ ?

**54.** If  $g(\theta) = m \sin \theta + n$ , what is the maximum value of  $g(\theta)$ ?

55. Which of the following equations could represent the graph shown below, assuming the graph depicts a simple transformation of a basic trigonometric function with a period of  $\pi$  and an amplitude of 1?

56. Which of the following expressions is equivalent to  $\sec\left(\frac{3\pi}{4}\right)$ ?

(A)  $y = -\frac{1}{2}\cos(2x)$

(B)  $\tan\frac{3\pi}{4}$

(C)  $\csc\left(-\frac{3\pi}{4}\right)$

(D)  $\cos\frac{3\pi}{4}$

57. In which quadrant is the terminal side of angle  $\phi$  located if the graphs of  $y = \tan\phi$  and  $y = \sec\phi$  are both increasing when angle  $\phi$  is increasing?

58. Evaluate:  $\sec\left(\tan^{-1}\left(\frac{5}{12}\right)\right)$

59. For the expression  $k - \frac{1}{\cos^2 \phi} = \cos^2 \phi$  to be an identity, what does k equal?

(A) 1

(B) 0

(C)  $\sin^2 \phi$

(D)  $\tan^2 \phi$

60. What is the expression  $\frac{\cos 2\phi}{2\sin \phi}$  equivalent to?

61. In the interval  $0 \leq x < 2\pi$ , what are the solutions of the equation  $\cos^2 x = \cos x$ ?

62. What is the expression  $\frac{\cos(x - \frac{\pi}{2})}{\sin x}$  equivalent to?

63. If  $\cos C = \frac{4}{5}$  and  $\cos D = \frac{5}{13}$ , and if C and D are acute angles, what is the value of  $\sin(C + D)$ ?

**64. Which of the following choices represents the graph of  $r = 4 \sin \theta$  in polar coordinates?**

- (A) A circle centered at the pole with a radius of 4.
- (B) A cardioid that starts at the pole and extends to the right.
- (C) A limaçon with an inner loop.
- (D) A circle centered on the horizontal axis, 2 units to the right of the pole.

**65. Which of the following points does not change the location of the point  $(3, \frac{3\pi}{4})$  in polar coordinates?**

- (A)  $(3, \frac{11\pi}{4})$
- (B)  $(-3, \frac{7\pi}{4})$
- (C)  $(-3, \frac{3\pi}{4})$
- (D)  $(3, \frac{-5\pi}{4})$

**66. Given the polar coordinates  $(5, -\frac{\pi}{6})$ , find the rectangular coordinates of this point.**

**67. Given the rectangular coordinates  $(2, -2)$ , find the polar coordinates of this point.**

68. If  $h(x) = x^2 - 4x + 3$  and  $p(x) = 3 - x$ , then what does  $p(h(x))$  equal?

(A)  $3x^2 - 12x + 6$

(B)  $x^2 - 4x$

(C)  $-x^2 + 4x$

(D)  $9 - x^2 + 4x - 3$

69. Let  $g$  be a function defined for all real numbers. Which of the following conditions is not sufficient to guarantee that  $g$  has an inverse function?

(A)  $g$  is one-to-one.

(B)  $g$  has a continuous, non-repeating range.

(C)  $g$  has no critical points.

(D)  $g$  passes the Horizontal Line Test in its domain.

70. Which of the following functions is not even?

(A)  $q(x) = \cos(x)$

(B)  $r(x) = \cos(3x)$

(C)  $s(x) = x^6$

(D)  $t(x) = \frac{x^3}{x^2 + 1}$

71. At what value(s) of  $x$  do the graphs of  $y = 3x + 1$  and  $y^2 = 9 - x^2$  intersect?

72. If  $g^{-1}(x)$  is the inverse of  $g(x) = 10^x$ , then what does  $g^{-1}(x)$  equal?

73. Find  $g(x+k)$  when  $g(x) = 3x^2 + 5x + 2$ .

74. Given the Markov matrix below, which of the following statements is true about the variable  $b$  ?

$$\begin{bmatrix} b & 1-b & 0 \\ 0 & b & 1-b \\ 1-b & 0 & b \end{bmatrix}$$

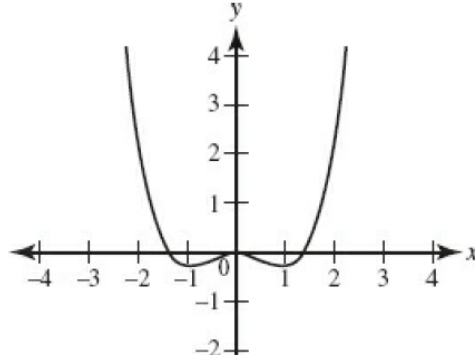
- (A)  $b$  is any real number
- (B)  $b$  is any positive real number
- (C)  $0 \leq b \leq 1$
- (D)  $b = 1$

75. For  $G(x) = g(x) + 2$  where  $g(x) = \begin{cases} 9x - 2, & \text{if } x < 3 \\ 5 - x, & \text{if } x \geq 3 \end{cases}$ , evaluate  $G(7)$ .

- (A) 62
- (B) -2
- (C) 0
- (D) 5



76. Use the graph of  $f(x)$  below to determine the intervals where  $f(x)$  is increasing and where  $f(x)$  is decreasing. Find correct one.



- (A) Increasing:  $(-2,1)$ ; decreasing:  $(-\infty,-2) \cup (1,\infty)$
- (B) Increasing:  $(-2,0) \cup (1,\infty)$ ; decreasing:  $(-\infty,-2) \cup (0,1)$
- (C) Increasing:  $(-1,\infty)$ ; decreasing:  $(-\infty,-1)$
- (D) Increasing:  $(-\infty,-2) \cup (1,\infty)$ ; decreasing:  $(-2,1)$

77. Using the tables below, evaluate  $(h \circ f)(7)$ . The tables provide values for functions  $f$  and  $h$  for various inputs.

<b>x</b>	<b>2</b>	<b>7</b>	<b>9</b>	<b>11</b>
<b>f(x)</b>	<b>5</b>	<b>3</b>	<b>8</b>	<b>6</b>

<b>x</b>	<b>3</b>	<b>5</b>	<b>8</b>	<b>6</b>
<b>h(x)</b>	<b>12</b>	<b>14</b>	<b>7</b>	<b>15</b>

- (A) 12
- (B) 14
- (C) 7
- (D) 15

78. Find the matrix product  $CD$  if it is defined, given that  $C = \begin{bmatrix} 2 & -1 \\ 4 & 6 \end{bmatrix}$  and  $D = \begin{bmatrix} -1 & 2 \\ 3 & 5 \end{bmatrix}$ .

79. Calculate the area of the triangle with the vertices  $(1,1)$ ,  $(4,3)$ , and  $(6,7)$ .

80. Find the vertical asymptote, if any, for the rational function  $h(x) = \frac{3x^2 - 2x - 1}{4x - 1}$ .

81. A garden planning app allocates a certain number of pixels on screen to represent lengths in a garden layout. If a user has a budget that allows for 600 pixels of length to design their rectangular garden, express the area  $A$  of the garden as a function of the width  $w$ , in pixels, of the rectangle.

82. If  $x = 3$  is a real zero of the polynomial  $g(x) = x^3 - 9x^2 + 27x - 27$ , write  $g(x)$  as a product of linear factors.

83. Find the inverse of the matrix  $B = \begin{bmatrix} 2 & -3 \\ 0 & 6 \end{bmatrix}$  if it exists.

84. A deposit of 15,000 is made in an account that earns 4.5% interest compounded monthly.

The balance in the account after  $m$  months is given by the sequence  $b_m = 15,000 \left( 1 + \frac{0.045}{12} \right)^m$ .

Find the balance in the account after 3 years.

85. If  $\log_5(x+2) - \log_5(x-2)$ , then  $x$  lies in which of the following intervals?

(A)  $(2, \infty)$

(B)  $(0, 2)$

(C)  $(-\infty, -2)$

(D)  $(-2, 0)$

86. If  $\theta$  is an angle in standard position and its terminal side passes through the point  $P(-0.5, 0.5)$  on the unit circle, which of the following is a possible value radian value of  $\theta$  to the nearest hundredth?

(A) 2.36

(B) 3.14

(C) 4.71

(D) 5.50

87. A company finds that the revenue  $R$ , in dollars, from selling  $q$  units of a product is given by the revenue function  $R(q) = 3q^2 - 18q + 500$ . Determine the number of units sold that will maximize the revenue.

88. An object is thrown vertically upward, and its height  $t$  seconds after it is thrown is given by the equation  $H(t) = 5 + 32t - 16t^2$ . Calculate the average velocity of the object over the interval from  $t = 1$  to  $t = 3$  seconds.

89. Solve the inequality  $\frac{3x+1}{2x+3} > 4$ .

90. Given the values of a function  $g(y)$  at various points, determine between which consecutive values of  $y$  does  $g(y)$  change sign, thus indicating the presence of a root.

<b>y</b>	-2	<b>0</b>	<b>2</b>	<b>4</b>
<b>g(y)</b>	7.14	-12.32	-0.48	13.92

91. Determine the domain of the function  $g(x) = \sqrt{m-x} - \frac{1}{\sqrt{n-x}}$ , where  $0 < m < n$ ,  $0 < x < n$ .

92. Calculate the range of values for  $y$  for which the equation  $3^{y^2} + 3^y - 4 = 0$  has real solutions, rounding your answer to 2 decimal places.

93. If the pattern of growth for a certain species of bacteria doubles every hour, and there are 500 bacteria at time 0, estimate the population of the bacteria after 6 hours.

94. A box with a square base and open top is to be constructed from a square piece of cardboard with sides of 24 inches by removing equal squares of side  $y$  at each corner and folding up the flaps. What should be the side length of the squares cut from each corner to maximize the volume of the box?

95. Let  $T_3 : \mathbb{R}^2 \rightarrow \mathbb{R}^2$  be a reflection about the  $y$ -axis, and let  $T_4 : \mathbb{R}^2 \rightarrow \mathbb{R}^2$  be a dilation with factor  $k = -2$ . Find the standard matrix for the composition  $T_4 \circ T_3$  on  $\mathbb{R}^2$ .

**96. A linear function  $Q$  is used to model the quantity, in thousands, of a certain product sold as a function of its price  $x$ , in dollars. It is known that  $Q(10) = 40$  and  $Q(15) = 25$ . Based on this model, which of the following is true?**

- A) For each dollar increase in price, the quantity sold increases by approximately 3000 units.
- B) For each dollar increase in price, the quantity sold decreases by approximately 1500 units.
- C) For each dollar increase in price, the quantity sold decreases by approximately 3000 units.
- D) For each dollar increase in price, the quantity sold increases by approximately 1500 units.

**97. The function  $g$  is given by  $g(z) = z^4 - z^2$ . Which of the following statements is true and supports the claim that  $g$  is an even function and not an odd function?**

- A)  $g(0) = g(-0)$
- B)  $g(2) = g(-2)$
- C)  $-g(2) = g(-2)$
- D)  $g(2) = -g(-2)$

**98. The polynomial function  $m$  is given by  $m(x) = x^4 - 6x^3 + 8$ . Which of the following describes the behavior of  $m$  as the input values increase without bound?**

- A) The output values decrease without bound.
- B) The output values increase without bound.
- C) The output values sometimes increase without bound and sometimes decrease without bound.
- D) The output values get closer to 8.

99. The table gives values for the function  $g$  at selected values of  $x$ . Which of the following conclusions with reason is consistent with the values in the table?

$x$	1	2	3	4	6
$g(x)$	3	8	15	24	35

- A) The graph of  $g$  is concave up because the second differences of  $g(x)$  are constant and positive.
- B) The graph of  $g$  is concave down because the second differences of  $g(x)$  are constant and positive.
- C) The graph of  $g$  is linear because the first differences of  $g(x)$  are constant.
- D) The graph of  $g$  is concave up because the first differences of  $g(x)$  are increasing.

100. The polynomial function  $h$  is given by  $h(x) = cx^d$ , where  $c$  is a non-zero constant and  $d$  is a positive integer. It is known that  $\lim_{x \rightarrow \infty} h(x) = \infty$  and  $\lim_{x \rightarrow -\infty} h(x) = -\infty$ . Which of the following statements must be true?

- A) The value of  $c$  must be positive, because as  $x$  increases without bound or decreases without bound, the end behaviors of  $h$  are different.
- B) The value of  $c$  must be negative, because as  $x$  increases without bound or decreases without bound, the end behaviors of  $h$  are the same.
- C) The value of  $d$  must be even, because as  $x$  increases without bound or decreases without bound, the end behaviors of  $h$  are the same.
- D) The value of  $d$  must be odd, because as  $x$  increases without bound or decreases without bound, the end behaviors of  $h$  are different.

**101. The function  $L$  models the level of a certain medication in the bloodstream and is given by  $L(t) = \frac{300t}{1+3t}$  for  $t \geq 0$ , where  $t$  is measured in hours since the medication was taken. Which of the following describes the level of the medication in the bloodstream as time increases?**

- A) The level decreases and approaches a value of 0 mg/L.
- B) The level increases and approaches a value of 100 mg/L.
- C) The level increases and approaches a value of 300 mg/L.
- D) The medication level increases without bound.

**102. The function  $s$  is given by  $s(x) = \frac{x+2}{x-4}$ . What are all solutions to  $s(x) < 0$ ?**

- A)  $x < -2$  and  $x > 4$
- B)  $x < 4$  only
- C)  $x > -2$  only
- D)  $x > -2$  and  $x < 4$

**103. The zeros of a rational function  $h$  are 2 and -3. Which of the following expressions could define  $h(x)$ ?**

- A)  $\frac{(x-1)(x+4)}{(x-2)(x+3)}$
- B)  $\frac{(x-2)(x+3)}{(x-1)(x+4)}$
- C)  $\frac{(x-2)(x+3)}{(x+2)(x-3)}$
- D)  $\frac{(x+2)(x-3)}{(x-2)(x+3)}$



**104.** For the function  $h$ , it is known that  $h(2) = 0$  and  $h(5) = -3$ . The function  $k$  is given by  $k(x) = h(x - 3)$ . Which of the following must be a solution to  $k(x) = 0$ ?

- A)  $x = -1$
- B)  $x = 1$
- C)  $x = 5$
- D)  $x = 8$

**105.** Which of the following functions has the same end behavior as the rational function  $q$

given by  $q(x) = \frac{3x^2 + 4x - 7}{5x^2 - x + 2}$ ?

- A)  $f(x) = \frac{3}{5}$
- B)  $g(x) = 1$
- C)  $h(x) = -\frac{3}{5}$
- D)  $k(x) = x$

**106.** The rational function  $m$  is given by  $m(x) = \frac{(x-1)^2(x+3)(x-4)}{x^2(x-1)(x+2)^3}$ . For which of the following values of  $x$  does the graph of  $m$  have vertical asymptotes?

- A)  $x = 1$  and  $x = -2$  only
- B)  $x = 0$  and  $x = -2$  only
- C)  $x = 0$ ,  $x = 1$ , and  $x = -2$
- D)  $x = 0$ ,  $x = 1$ , and  $x = 4$

**107. The domain of the function  $f$  is  $-4 \leq x \leq 16$ . If the function  $k$  is given by  $k(x) = 2\left(\frac{x}{3}\right) + 1$ , what is the domain of  $k$  ?**

**108. The domain of the function  $f(x)$  is  $-4 \leq x \leq 16$ . If the function  $k(x)$  is given by  $k(x) = f\left(\frac{x}{3}\right) + 1$ , what is the domain of  $k$  ?**