

Chapter 0 Multiple-Choice Practice Test

Directions: This practice test features multiple-choice questions based on the content in Chapter 0: Preliminaries.

- 0.1:** Fundamental Skills in Algebra
- 0.2:** Numbers, Sets, and Absolute Values
- 0.3:** Coordinates and Geometry
- 0.4:** Defining a Function
- 0.5:** Linear Functions and Equations
- 0.6:** Modifying Functions; Inverse Functions
- 0.7:** Quadratics
- 0.8:** Trigonometry
- 0.9:** Exponents and Logarithms
- 0.10:** Sigma Notation

For each question, select the best answer provided and do your figuring in the margins. If you encounter difficulties with a question, then move on and return to it later. Follow these guidelines:

- Do not use a calculator of any kind. All of these problems are designed to contain simple numbers.
- Adhere to the time limit of 90 minutes.
- After you complete all the questions, compare your responses to the answer key on the last page. Note any topics that require revision.

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Preliminaries

Number of Questions—50

Suggested Time—1 hour 30 minutes

NO CALCULATOR

1. Which numbers are rational?

I. -5 II. $\frac{8}{3}$ III. $\pi - 2$

(A) I only

(B) II only

(C) I and II only

(D) II and III only

(E) I, II, and III

2. Which line is vertical?

(A) $y = 4$

(B) $x = 3$

(C) $y = x$

(D) $x + y = 0$

(E) None of the above

3. $\cos\left(\frac{3\pi}{4}\right)$ is

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

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

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

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

(E) $\frac{\sqrt{2}}{2}$

4. What is an equation of the line that passes through the point $(-2, 1)$ and has a slope of $-\frac{1}{2}$?

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

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

(C) $y - 1 = -\frac{1}{2}(x + 2)$

(D) $y + 1 = \frac{1}{2}(x - 2)$

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

5. A circular sector of radius 3 is intercepted by a central angle of 100° . The sector's area is

(A) $\frac{5\pi}{4}$

(B) $\frac{5\pi}{3}$

(C) $\frac{5\pi}{2}$

(D) 5π

(E) $\frac{10\pi}{3}$

6. $\sqrt{a} + \sqrt{b} =$

(A) $\sqrt{a+b}$

(B) $\sqrt{a-b}$

(C) $\sqrt{ab}$

(D) $a\sqrt{b}$

(E) None of the above

7. $\sec\left(\frac{\pi}{2}\right)$ is

(A) -1

(B) 0

(C) 1

(D) π

(E) undefined

8. A man stands 50 feet from a building that is 200 feet tall. The angle between the man's shadow and the top of the building is

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

9. Which function does *not* have all real numbers as its domain?

(A) $y = \frac{x^2}{x}$

(B) $y = 2^x$

(C) $y = -3 \sin(x - 4) + 9$

(D) $y = |x - 4| - 2$

(E) $y = -7$

10. Which equation represents a circle centered at $(-4, 8)$ with a radius of 2 ?

(A) $(x - 4)^2 + (y - 8)^2 = 2$

(B) $(x - 4)^2 + (y + 8)^2 = 2$

(C) $(x + 4)^2 + (y - 8)^2 = 2$

(D) $(x - 4)^2 + (y + 8)^2 = 4$

(E) $(x + 4)^2 + (y - 8)^2 = 4$

11. Which statement gives *one* transformation that must be applied to $f(x)$ to obtain the new function $g(x) = 3f(2x - 4) + 7$?

(A) The graph of $f(x)$ must be shifted 2 units to the left.

(B) The graph of $f(x)$ must be shifted 2 units to the right.

(C) The graph of $f(x)$ must be shifted 4 units to the left.

(D) The graph of $f(x)$ must be shifted 4 units to the right.

(E) The graph of $f(x)$ must be shifted down 7 units.

12. What are the solutions to $|x - 4| + 2 = 5$?

(A) $x = -1$

(B) $x = 3$

(C) $x = 7$

(D) $x = -1, x = 7$

(E) $x = 1, x = 7$

13. Which expression is equivalent to $\frac{1}{a} + \frac{1}{b}$?

(A) $\frac{a+b}{ab}$

(B) $\frac{1}{a+b}$

(C) $\frac{1}{ab}$

(D) $\frac{ab}{a+b}$

(E) $\frac{2}{a+b}$

14. The equation $\frac{(x-4)^2}{64} + \frac{(y+7)^2}{81} = 1$ represents

- (A) an ellipse centered at $(-4, 7)$ with width 8 and height 9
- (B) an ellipse centered at $(-4, 7)$ with width 16 and height 18
- (C) an ellipse centered at $(4, -7)$ with width 8 and height 9
- (D) an ellipse centered at $(4, -7)$ with width 16 and height 18
- (E) a hyperbola centered at $(4, -7)$

15. A line segment is drawn between the points $(2, 4)$ and $(6, -4)$. Which statements are true?

- I. The line segment has a slope of -2 .
- II. The line segment has a midpoint of $(4, 0)$.
- III. The line segment has a length of 80 .

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

16. If $f(x) = x^3 - 4$, then $f^{-1}(x) =$

(A) $f^{-1}(x) = \sqrt[3]{x+4}$

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

(C) $f^{-1}(x) = \sqrt[3]{x-4}$

(D) $f^{-1}(x) = \sqrt[3]{x^3 - 8}$

(E) $f^{-1}(x) = \frac{1}{\sqrt[3]{x+4}}$

17. Which statement is true about $f(x) = x^2 - 4x + 5$?

(A) $f(x)$ has a minimum at $(-2, 1)$.

(B) $f(x)$ has a maximum at $(-2, 1)$.

(C) $f(x)$ has a minimum at $(2, 1)$.

(D) $f(x)$ has a maximum at $(2, 1)$.

(E) $f(x)$ has a minimum at $(4, 5)$.

18. If $f(x) = x^2 - 4$ and $g(x) = \sin^2(x - 3)$, then $g(f(x)) =$

(A) $\sin^4(x - 3) - 4$

(B) $\sin^2(x^2 - 7)$

(C) $\sin^4(x - 3) - 4 \sin^2(x - 3)$

(D) $\sin^2(x^2 - x - 7)$

(E) $\sin^2(x^2 - 4)$

19. What is the solution set of x in the following system of equations?

$$y = 5x - 3$$

$$y = x^2 + 1$$

(A) $\{-17, -2\}$

(B) $\{-4, -1\}$

(C) $\{1, 4\}$

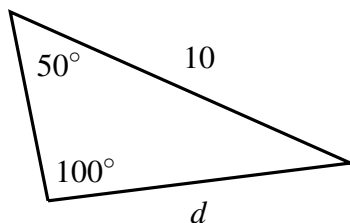
(D) $\{2, 17\}$

(E) $\{4\}$

20. Which expression is equivalent to $(4w^2x^8y^{-2}\sqrt{z})^{-1/2}$, assuming all quantities are positive?

(A) $\frac{2wx^4\sqrt[4]{z}}{y}$ (B) $\frac{y}{2wx^4\sqrt[4]{z}}$ (C) $\frac{2y}{wx^4\sqrt[4]{z}}$ (D) $\frac{wx^4\sqrt[4]{z}}{2y}$ (E) $\frac{2wx^4}{y^2\sqrt{z}}$

21. In the following triangle, which expression equals d ?



- (A) $\frac{\sin 50^\circ}{\sin 100^\circ}$
- (B) $\frac{\sin 100^\circ}{10 \sin 50^\circ}$
- (C) $\frac{\sin 50^\circ}{10 \sin 100^\circ}$
- (D) $\frac{10 \sin 50^\circ}{\sin 100^\circ}$
- (E) $\frac{10 \sin 100^\circ}{\sin 50^\circ}$

22. For $x \neq 1$, $\frac{2x^2 - 5x + 9}{x - 1} =$

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

(B) $2x - 3 + \frac{6}{x - 1}$

(C) $2x^2 - 3x + \frac{6}{x - 1}$

(D) $2x - 3$

(E) $2x - 7 + \frac{2}{x - 1}$

23. The range of $-3 \cos\left(4x - \frac{\pi}{3}\right) + 7$ is

(A) $[-4, 10]$

(B) $[-3, 3]$

(C) $[4, 10]$

(D) $[5, 11]$

(E) $[11, 15]$

24. The domain of $g(x) = \frac{\log_2 x}{x-5}$ is

(A) $(-\infty, 0) \cup (0, \infty)$

(B) $(-\infty, 5) \cup (5, \infty)$

(C) $(0, 5) \cup (5, \infty)$

(D) $(0, \infty)$

(E) $(-\infty, \infty)$

25. Assuming that the domains are restricted to avoid division by zero, $\frac{x^2 - 10x + 24}{x - 3} \cdot \frac{2(x - 6)^{-1}}{x - 4} =$

(A) $\frac{2(x - 4)}{x - 3}$

(B) $\frac{2}{x - 3}$

(C) $\frac{2}{(x - 3)(x - 6)}$

(D) $\frac{2(x - 6)(x - 4)}{x - 3}$

(E) $\frac{2}{x - 4}$

26. For $\pi < \theta < \frac{3\pi}{2}$, $\cos \theta = -\frac{1}{5}$. Then $\sin \theta =$

(A) $-\frac{\sqrt{24}}{5}$

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

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

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

(E) $\frac{\sqrt{24}}{5}$

27. The solution set of x in $\frac{3}{x-1} = \frac{x-2}{2}$ is

- (A) $\{-4, 1\}$ (B) $\left\{-\frac{3}{2}, 1\right\}$ (C) $\{-1, 4\}$ (D) $\{-1\}$ (E) $\{4\}$

28. A downward-opening parabola intersects the y -axis at $(0, 30)$ and has zeros of $x = -2$ and $x = 5$. The parabola's equation is

- (A) $y = (x - 2)(x + 5)$
(B) $y = (x + 2)(x - 5)$
(C) $y = 3(x - 2)(x - 5)$
(D) $y = -3(x - 2)(x + 5)$
(E) $y = -3(x + 2)(x - 5)$

29. What are the solutions to the equation $\frac{x^2 - 5x - 24}{x - 8} = 2x - 5$?

(A) $x = -3$

(B) $x = \frac{5}{2}$

(C) $x = 8$

(D) $x = -3, x = 8$

(E) The equation has no solutions.

30. What value of x satisfies $2^{3x-1} = 8^{4x-2}$?

(A) $\log_2\left(\frac{1}{5}\right)$ (B) $\log_2\left(\frac{5}{9}\right)$ (C) $\frac{1}{5}$ (D) $\frac{5}{9}$ (E) 1

31. $\sum_{i=1}^5 (2i - 1) =$

(A) 8

(B) 20

(C) 25

(D) 30

(E) 125

32. Which expression is equivalent to $\left(4a^4 b^3 c^{-7} d^{-5}\right)^2$, where all quantities are positive?

(A) $16a^8 b^6 c^{-14} d^{-10}$

(B) $\frac{a^4 b^3}{16c^7 d^5}$

(C) $\frac{c^{14}}{16a^8 b^6}$

(D) $\frac{a^2 b}{16c^9 d^7}$

(E) $\frac{16c^9 d^7}{a^2 b}$

33. A sphere with radius r has a volume of $\frac{4}{3}\pi r^3$ and a surface area of $4\pi r^2$. A spherical ball has a surface area of 400π square meters. Its volume, in cubic meters, is

(A) 10 (B) $\frac{40\pi}{3}$ (C) 1000 (D) $\frac{400\pi}{3}$ (E) $\frac{4000\pi}{3}$

34. If $f(x) = x^2 + 4$, then $\frac{f(x+h) - f(x)}{h} =$

(A) $2x + h$ (B) $2x + 2h$ (C) $x^2 + h$ (D) $2x + h + 4$ (E) $x^2 + h + 4$

35. For $0 < x < 1$, which inequality is true?

(A) $\sqrt{x} < x^2 < x$

(B) $x^2 < x < \sqrt{x}$

(C) $\sqrt{x} < x < x^2$

(D) $x^2 < \sqrt{x} < x$

(E) $x < \sqrt{x} < x^2$

36. If $a = be^{cd}$, then $d =$

(A) $\frac{\ln(b) - \ln(a)}{c}$

(B) $\frac{\ln a}{c \ln b}$

(C) $\sqrt[c]{\frac{a}{b}}$

(D) $\frac{1}{c}e^{a/b}$

(E) $\frac{\ln(a) - \ln(b)}{c}$

37. $\sin^{-1}\left(\sin \frac{2\pi}{3}\right) =$

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

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

(C) $\frac{2\pi}{3}$

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

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

38. Which expression is equivalent to $e^{f(x)}$? (Note: $\log x = \log_{10} x$.)

(A) $10^{f(x)\log e}$

(B) $10^{f(x)+\log e}$

(C) $10^{f(x)\ln 10}$

(D) $10^{f(x)-\log e}$

(E) $10^{f(x)+\ln 10}$

39. Let f be an invertible function. The graph of $y = g(x)$ is obtained by performing the following transformations to the graph of $y = f(x)$:

- The graph is reflected across the line $y = x$.
- The graph is then shifted 4 units to the left.
- The graph is then translated 3 units down.

Which function is $g(x)$?

(A) $g(x) = f(x+4) - 3$

(B) $g(x) = f(x-4) - 3$

(C) $g(x) = f^{-1}(x+4) - 3$

(D) $g(x) = f^{-1}(x-4) - 3$

(E) $g(x) = f^{-1}(x-4) + 3$

40. If a , b , and c are real numbers, then $4^a \frac{2^{3b-1}}{8^{1-c}} =$

(A) $2^{a+3b+c-2}$

(B) 2^{a+3b-c}

(C) $2^{2a+3b-3c+2}$

(D) $2^{2a+3b+3c-4}$

(E) $2^{a(3b-1)/(1-c)}$

41. Which values of x satisfy $2 \sin^2 x = 1 + \sin x$ on $[0, 2\pi]$?

I. $x = 0$

II. $x = \frac{\pi}{2}$

III. $x = \frac{7\pi}{6}$

IV. $x = \frac{11\pi}{6}$

(A) I only

(B) II only

(C) III and IV only

(D) II, III, and IV only

(E) I, II, III, and IV

42. If $f(x) = \cos(2x + 4)$ and $g(x) = \sqrt{x - 2}$, then the domain of $f(g(-2x))$ is

(A) $(-\infty, -2]$

(B) $(-\infty, -1]$

(C) $[1, \infty)$

(D) $[2, \infty)$

(E) $(-\infty, \infty)$

43. Which interval of x satisfies the inequality $x^2 - 4x + 3 > 0$?

(A) $(1, 3)$

(B) $[1, 3]$

(C) $(-\infty, 1) \cup (3, \infty)$

(D) $(-\infty, 1] \cup [3, \infty)$

(E) $(-\infty, \infty)$

44. $\frac{\sin^8 x - \cos^8 x}{\sin^4 x + \cos^4 x} =$

(A) $\frac{1}{2}$

(B) 1

(C) $\sin^2 x - \cos^2 x$

(D) $\sin^4 x + \cos^4 x$

(E) $\cos^2 x - \sin^2 x$

45. What values of x satisfy $\log_5(x - 3) + \log_5(x + 1) = 1$?

(A) $x = -4, x = 2$

(B) $x = -2, x = 4$

(C) $x = -2$

(D) $x = 2, x = 4$

(E) $x = 4$

46. The function $ax^2 + 2x + c$ is rewritten in the form $a(x - h)^2 + k$, where h and k are constants. What is the value of k ?

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

47. Which set of x satisfies $e^{2x} - 5e^x + 6 = 0$?

- (A) $\{-\ln 3, -\ln 2\}$
(B) $\{-\ln 2, \ln 3\}$
(C) $\left\{-\ln\left(\frac{3}{2}\right), -\ln\left(\frac{2}{3}\right)\right\}$
(D) $\{\ln 2, \ln 3\}$
(E) $\{2, 3\}$

48. The interval of x that satisfies $\frac{x-2}{x+4} > 0$ is

(A) $(-4, 2)$

(B) $(-\infty, -4)$

(C) $(-4, \infty)$

(D) $(2, \infty)$

(E) $(-\infty, -4) \cup (2, \infty)$

49. $\cos(\tan^{-1} x) =$

(A) $\frac{x}{\sqrt{1+x^2}}$

(B) x

(C) $\frac{1}{\sqrt{1+x^2}}$

(D) $\frac{1}{\sqrt{1-x^2}}$

(E) $\frac{\sqrt{1+x^2}}{x}$

50. Which expression is equivalent to $\log 2w + 3 \log x - \frac{1}{2} \log 4y + 3 \log z$, where w , x , y , and z are all positive?

(A) $\log \left(\frac{\sqrt{y}}{wx^3z^3} \right)$

(B) $\log \left(\frac{wx^3z^3}{2\sqrt{y}} \right)$

(C) $\log \left(\frac{w\sqrt{y}}{4x^3z^3} \right)$

(D) $\log \left(\frac{wz^3}{2x^3\sqrt{y}} \right)$

(E) $\log \left(\frac{wx^3z^3}{\sqrt{y}} \right)$

This marks the end of the test. The following page contains the answers to all the questions.

- | | |
|-------|-------|
| 1. C | 33. E |
| 2. B | 34. A |
| 3. B | 35. B |
| 4. C | 36. E |
| 5. C | 37. B |
| 6. E | 38. A |
| 7. E | 39. C |
| 8. A | 40. D |
| 9. A | 41. D |
| 10. E | 42. B |
| 11. B | 43. C |
| 12. E | 44. C |
| 13. A | 45. E |
| 14. D | 46. C |
| 15. D | 47. D |
| 16. A | 48. E |
| 17. C | 49. C |
| 18. B | 50. E |
| 19. C | |
| 20. B | |
| 21. D | |
| 22. B | |
| 23. C | |
| 24. C | |
| 25. B | |
| 26. A | |
| 27. C | |
| 28. E | |
| 29. E | |
| 30. D | |
| 31. C | |
| 32. A | |