

Algebraic Equations & Inequalities

PSU Math Relays 2017

- For each problem below choose the best answer from the given choices and shade the appropriate letter on the answer sheet.
- You must shade your choice on the answer sheet. Only the answer sheet will be graded.
- Calculator is **not** allowed.

1. Solve the equation $\sqrt{x+17} = x-3$.
(A) -1 (B) 1 (C) 3 (D) 8 (E) -8
2. Solve the literal equation $3(5x+2a) = 2bx+3c$ for x .
(A) $\frac{3c-2a}{5-2b}$ (B) $\frac{3c-6a}{15+2b}$ (C) $\frac{3c+6a}{15-2b}$ (D) $\frac{3c+6a}{15+2b}$ (E) $\frac{3c-6a}{15-2b}$
3. Solve the equation $x^2+4x+6=0$.
(A) $2 \pm \sqrt{2}i$ (B) $-2 \pm \sqrt{2}i$ (C) $2 \pm \sqrt{2}$ (D) $2 \pm \sqrt{10}$ (E) $-2 \pm \sqrt{10}$
4. Solve the equation $\frac{x+2}{x} + \frac{x}{x-2} = 4$.
(A) $-2 \pm \sqrt{2}$ (B) $2 \pm \sqrt{2}$ (C) $-2 \pm \sqrt{2}i$ (D) $2 \pm \sqrt{2}i$ (E) $2 \pm \sqrt{6}$
5. Solve the equation $\frac{3}{x-1} - \frac{2}{x+2} = \frac{5}{2}$.
(A) $\frac{5}{2}, -13$ (B) $-2, \frac{13}{5}$ (C) $2, -\frac{13}{5}$ (D) $2, \frac{13}{5}$ (E) $-2, -\frac{13}{5}$
6. Solve the equation $4x^4 - 17x^2 + 4 = 0$.
(A) $4, \frac{1}{4}$ (B) $2, -2, \frac{1}{4}, 0$ (C) $4, \frac{1}{2}, -\frac{1}{2}$ (D) $2, \frac{1}{2}$ (E) $2, -2, \frac{1}{2}, -\frac{1}{2}$
7. Solve the equation $\sqrt{2x-1} - \sqrt{2x+10} = -1$.
(A) -13 (B) 13 (C) -23 (D) 23 (E) -2
8. Solve the equation $|2x-5| = 7$.
(A) $-1, 6$ (B) $1, -6$ (C) 1 (D) -6 (E) $7/2$
9. Solve the equation $(2t+1)^{\frac{2}{3}} = 25$.
(A) $\frac{1 \pm 5\sqrt[3]{5}}{2}$ (B) $\frac{-1 \pm 5\sqrt[3]{5}}{2}$ (C) $62, 63$ (D) $62, -63$ (E) $-62, 63$

10. Solve the equation $\sqrt{3y - 5} = y - 3$.
 (A) 2 (B) 7 (C) 2, 7 (D) 4 (E) 1
11. One number is 1 more than twice a second number. The sum of the two numbers is 37. Find the smaller number.
 (A) 11 (B) 12 (C) 13 (D) 24 (E) 25
12. Solve the inequality $6x + 4 \geq 9x - 8$.
 (A) $(-\infty, 4]$ (B) $[4, +\infty)$ (C) $[-4, +\infty)$ (D) $(-\infty, -4]$ (E) $[-4, 4]$
13. Solve the inequality $6 + 3x \leq 3(2x - 5) < 15 + 3x$.
 (A) $[7, 10]$ (B) $(7, 10]$ (C) $[-3, 0)$ (D) $(-10, 7]$ (E) $[-21, 30)$
14. Solve the inequality $7 \leq 1 - 2x \leq 13$.
 (A) $[3, 6]$ (B) $[6, 12]$ (C) $[-6, -3]$ (D) $[8, 14]$ (E) $[-7, -4]$
15. Solve the inequality $\frac{x - 1}{x + 2} \geq 1$.
 (A) $(-2, 1]$ (B) $(-2, \infty)$ (C) $(-\infty, -2)$
 (D) $(-\infty, -2]$ (E) $(-\infty, -2) \cup [1, \infty)$
16. Solve the inequality $|2 - x| \leq 3$.
 (A) $[-1, 5]$ (B) $[-5, 1]$ (C) $[-1, 1]$ (D) $[-5, 5]$ (E) $(-\infty, 5]$
17. Solve the inequality $|4x + 3| > 5$.
 (A) $(-2, \frac{1}{2})$ (B) $(-\frac{1}{2}, 2)$ (C) $(-\infty, -\frac{1}{2}) \cup (2, \infty)$
 (D) $(-\infty, -2) \cup (\frac{1}{2}, \infty)$ (E) $(-\infty, \infty)$
18. Solve the inequality $10x^3 - 3x^2 < x$.
 (A) $-\frac{1}{5} < x < \frac{1}{2}$ (B) $-\frac{1}{5} < x < 0$ or $x > \frac{1}{2}$ (C) $x < -\frac{1}{5}$ or $x > \frac{1}{2}$
 (D) $x < -\frac{1}{5}$ or $0 < x < \frac{1}{2}$ (E) None of these
19. Solve the inequality $\frac{(x - 5)(2x - 3)}{(x + 2)(x + 1)} \geq 0$.
 (A) $-2 < x < -1$ or $x \geq 5$ (B) $-2 < x < -1$ or $\frac{3}{2} \leq x \leq 5$
 (C) $x < -2$ or $-1 \leq x \leq \frac{3}{2}$ (D) $x < -2$ or $-1 < x \leq \frac{3}{2}$ or $x \geq 5$
 (E) $x \leq -2$ or $-1 \leq x \leq \frac{3}{2}$ or $x \geq 5$

20. Let $f(x) = (x - 2)^3(x^2 - 2x - 3)$. Determine the multiplicity of 2 as a zero of $f(x)$.
 (A) 1 (B) 2 (C) 3 (D) 4 (E) 5
21. Find all the zeros of $f(x) = x^3 - 6x^2 + 11x - 6$.
 (A) 1 (B) 1, 2 (C) 0, 1, 2 (D) 1, 2, 3 (E) -1, 2, 3
22. If $2 - 5i$ is a complex zero of a polynomial $f(x)$ with **real** coefficients, which of the following must also be a zero of $f(x)$?
 (A) $2 + 5i$ (B) 2 (C) $-5i$ (D) $5i$ (E) $-2 - 5i$
23. Solve the equation $5^{2x-1} = 25^{3-x}$.
 (A) 1 (B) 2 (C) $\frac{5}{4}$ (D) $\frac{16}{7}$ (E) none of these
24. Solve the equation $\log_3 x + \log_3(x + 6) = 3$.
 (A) 3 (B) -9 (C) 3, -9 (D) $-3 \pm 3\sqrt{2}$ (E) none of these
25. Solve the equation $e^x + 5e^{-x} = 6$.
 (A) -1 (B) 0 (C) $0, \ln 5$ (D) $\ln 3$ (E) none of these
26. The system of linear equations $\begin{cases} 3x + 2y = 5 \\ 4x + y = 10 \end{cases}$ has the solution
 (A) (1, 1) (B) (4, -1) (C) (-3, 2) (D) (3, -2) (E) (0, 3)
27. The system of linear equations $\begin{cases} x + 2y = 3 \\ 2x + 4y = 6 \end{cases}$ has
 (A) no solution (B) exactly one solution (C) exactly two solutions
 (D) infinitely many solutions (E) none of these
28. An inconsistent system of two linear equations in two variables represents
 (A) two lines that intersect at one point (B) two lines that are the same
 (C) two parallel lines (D) two perpendicular lines (E) None of these
29. The system of linear equations $\begin{cases} x + y + z = 6 \\ 2x - y - 2z = 3 \\ -x + y + z = 0 \end{cases}$ has the solution
 (A) (1, 2, 3) (B) (3, 2, 1) (C) (1, 1, 1) (D) (2, 2, 2) (E) (3, 3, 0)
30. Find the value $x + y + z$ if x , y and z satisfy the system of equations

$$\begin{cases} x - y + 2z = 6 \\ -x + 3y - 3z = 8 \\ 2x + 3z = 26 \end{cases}$$

 (A) 0 (B) 10 (C) 20 (D) 30 (E) 40