

ALGEBRAIC SIMPLIFICATION

Pitt State Math Relays 2019

For each question below, completely shade in the rectangle with the letter of the **simplest** correct answer in the appropriate space on the answer sheet. Only the answer sheet will be graded. NO CALCULATORS.

- Find the coefficient for x^3y^4 in the expansion of $(4x - 2y)^7$.
(A) 35,840 (B) 35 (C) 1024 (D) -71680 (E) none of these
- Factor completely $6x^2 + 15x - 9$.
(A) $(3x - 3)(2x + 3)$ (B) $3(2x - 1)(x + 3)$ (C) $(x - 3)(6x + 3)$
(D) $(6x - 3)(x + 3)$ (E) none of these
- Simplify $\frac{12!}{8!4!}$.
(A) 2970 (B) 495 (C) 1 (D) $\frac{3}{8}$ (E) none of these
- Simplify $8x^3 - \{7x^2 - 6[x^2 - 5x(x^2 - x)] + 4x^3\}$
(A) $-26x^3 + 29x^2$ (B) $4x^3 + 9x^2$ (C) $4x^3 - 13x^2$ (D) $x^3 + 5x^2$ (E) none of these
- Combine and simplify $\frac{x}{2x+4} - \frac{2}{x^2+3x+2}$.
(A) $\frac{x^2+2x+24}{2(x+2)(x+1)}$ (B) $\frac{1}{x+1}$ (C) $\frac{x-2}{-2x}$ (D) $\frac{x^2+x-4}{2(x+1)(x+2)}$ (E) none of these
- $-3|x| + |-x| =$
(A) -3 (B) $2|x|$ (C) $-2|x|$ (D) $3|x|$ (E) none of these
- $\frac{2x-6}{2x^2+3x-9} \div \frac{x^2-9x+18}{x^2-9}$
(A) $\frac{-2(x+18)}{x-9}$ (B) $\frac{2(x-3)}{(x-6)(2x-3)}$ (C) $\frac{2}{18x(x-2)}$ (D) $\frac{2(x+3)(x-6)}{(x+3)(x-3)^2}$ (E) none of these
- If $x < 2$, simplify $|x - 2| - 4| - 6|$
(A) $x - 22$ (B) $-x - 22$ (C) $x - 26$ (D) $x - 12$ (E) none of these
- The equality $5^3 = 125$ can be written as
(A) $\log_3 125 = 5$ (B) $\log_5 125 = 3$ (C) $\log_3 5 = 125$ (D) $\log_5 3 = 125$ (E) none of these

10. Simplify $\sqrt{6}(\sqrt{2} + \sqrt{3})$

- (A) $6\sqrt{5}$ (B) $4\sqrt{3} - 2\sqrt{2}$ (C) $2\sqrt{18}$ (D) $2\sqrt{3} + 3\sqrt{2}$ (E) none of these

11. Simplify $\frac{12r^3s^3t^4}{56r^7s^5t^2}$

- (A) $\frac{3t^8}{14r^{14}s^{15}}$ (B) $\frac{2r^3s^2}{3t^2}$ (C) $\frac{2t^2}{7s^3t^3}$ (D) $\frac{3t^2}{14r^4s^2}$ (E) none of these

12. Simplify $(-1)^{-2019} + (-1)^{2019}$

- (A) -1^0 (B) 0 (C) -2 (D) 2^{4038} (E) none of these

13. Simplify $81^{3/4}$

- (A) 27 (B) $60\frac{3}{4}$ (C) 9 (D) $3\sqrt[4]{9}$ (E) none of these

14. For $x > 0$, $\frac{5}{\sqrt{x} - 2} =$

- (A) $5\sqrt{x} + 6$ (B) $\frac{25}{x-4}$ (C) $\frac{5\sqrt{x} + 10}{x-4}$ (D) $\frac{25}{x+4}$ (E) none of these

15. Simplify $\frac{(2^{n-1}2^{2n+1})^3}{2^{5n}}$

- (A) $\frac{2^6}{2^{5n}}$ (B) 2^{-2n+3} (C) 2^{6n^2-8n-3} (D) 2^{4n} (E) none of these

16. $x^{-1} + x^{-2} =$

- (A) $\frac{1}{x^3}$ (B) $\frac{2}{x^3}$ (C) $\frac{2}{x}$ (D) $\frac{x+1}{x^2}$ (E) none of these

17. $\log_8 64 =$

- (A) 2 (B) 8 (C) $\frac{1}{2}$ (D) $\frac{1}{8}$ (E) none of these

18. Simplify $[(s+5)(s+5) + (s-5)(s-5)][(s+5)(s+5) - (s-5)(s-5)]$.

- (A) 0 (B) 1 (C) $40s^3 + 1000s$ (D) $s^4 - 25s^2 - 625$ (E) none of these

19. Written in simplest form, the expression $\frac{\frac{x}{4} - \frac{1}{x}}{\frac{1}{2x} + \frac{1}{4}}$ is equivalent to

- (A) $x - 1$ (B) $x - 2$ (C) $\frac{x-2}{2}$ (D) $\frac{x^2-4}{x+2}$ (E) none of these

20. Simplify $\frac{a^2b^{-3}}{a^{-4}b^2}$

- (A) $\frac{a^6}{b^5}$ (B) $\frac{a^2}{b}$ (C) $\frac{b^5}{a^6}$ (D) $a^{-2}b^{-1}$ (E) none of these

21. $\frac{6+\sqrt{3}}{6-\sqrt{3}} =$

- (A) -1 (B) $\frac{16+2\sqrt{3}}{9}$ (C) $36-2\sqrt{3}$ (D) $\frac{13+4\sqrt{3}}{11}$ (E) none of these

22. When $c + d = 6$, what is the value of $2(c + d) + \frac{c + d}{6} + (c + d)^2 - 2$?

- (A) 47 (B) 38 (C) 37 (D) 23 (E) none of these

23. Simplify $\frac{3x}{x^2 - 49} - \frac{7}{3x - 21}$.

- (A) $\frac{1}{3(x-7)(x+7)}$ (B) $\frac{3x-7}{x^2-3x-28}$ (C) $\frac{2x-49}{3(x-7)(x+7)}$
(D) $\frac{16x+49}{3(x-7)(x+7)}$ (E) none of these

24. $4ab\sqrt{2b} - 3a\sqrt{18b^3} + 7ab\sqrt{6b} =$

- (A) $2ab\sqrt{6b}$ (B) $16ab\sqrt{2b}$ (C) $-5ab + 7ab\sqrt{6b}$ (D) $-5ab\sqrt{2b} + 7ab\sqrt{6b}$ (E) none of these

25. $\log_{49} 7 =$

- (A) 7 (B) 2 (C) $\frac{1}{2}$ (D) $\frac{1}{7}$ (E) none of these

26. Assume a and b are positive real numbers. $\left(\sqrt{a^2b^{1/2}}\right)^{-1} =$

- (A) $a^{-2}b^{\frac{1}{2}}$ (B) $-ab^4$ (C) $-ab^2$ (D) $\frac{1}{ab^{1/4}}$ (E) none of these

27. Simplify $\frac{3-2i}{5+3i}$.

- (A) $\frac{3}{5} - \frac{2}{3}i$ (B) $\frac{9}{34} - \frac{19}{34}i$ (C) $\frac{9}{16} + \frac{1}{4}i$ (D) $\frac{3}{5} + \frac{2}{3}i$ (E) none of these

28. If $f(x) = x^2 - 2$, then $f(x+h) =$

- (A) $x^2 + h^2 - 2$ (B) $x^2 - 2 + h$ (C) $x^2 + 2xh + h^2$ (D) $x^2 + 2xh + h^2 - 2$ (E) none of these

29. Simplify i^{2019} .

- (A) -1 (B) $-i$ (C) 1 (D) i (E) none of these

30. Simplify $\left(\frac{-8}{x}\right)^{\frac{2}{3}}$ when $x = -27$.

- (A) $\frac{24\sqrt{3}}{27}$ (B) $\frac{2}{3}$ (C) $\frac{4}{9}$ (D) $-\frac{4}{9}$ (E) none of these

31. Simplify $\sum_{n=1}^5 n^2$.

- (A) 55 (B) 195 (C) 100 (D) 25 (E) none of these

32. Let $h = -16t^2 + 80t + 3$. Simplify $h(2)$.

- (A) 99 (B) 80 (C) 131 (D) 227 (E) none of these

33. Simplify $h(h(1))$ for $h = -t^2 + 5t + 3$.

- (A) 37 (B) -11 (C) 7 (D) -5 (E) none of these

34. Simplify $\begin{pmatrix} 2 & -1 \\ 4 & 3 \end{pmatrix} \cdot \begin{pmatrix} -3 & 2 \\ 1 & -2 \end{pmatrix}$.

- (A) $\begin{pmatrix} 2 & 6 \\ -6 & -7 \end{pmatrix}$ (B) $\begin{pmatrix} -6 & -2 \\ 4 & -6 \end{pmatrix}$ (C) $\begin{pmatrix} -7 & 6 \\ -9 & 2 \end{pmatrix}$ (D) $\begin{pmatrix} -2 & 4 \\ -6 & -6 \end{pmatrix}$ (E) none of these

35. Simplify $\begin{vmatrix} -1 & 0 & 2 \\ 3 & 4 & -6 \\ 0 & -5 & 0 \end{vmatrix}$.

- (A) -1 (B) 0 (C) -16 (D) 60 (E) none of these

36. Simplify $\begin{vmatrix} 5 & -4 \\ 2 & 1 \end{vmatrix}$.

- (A) -18 (B) 13 (C) -3 (D) 6 (E) none of these

37. Simplify by writing as a single logarithm. $4\ln x - 2\ln 6 - \frac{1}{2}\ln y$

- (A) $\ln\left(4x - 12 - \frac{1}{2}y\right)$ (B) $\ln\left(\frac{x^4\sqrt{y}}{36}\right)$ (C) $\frac{3}{2}\ln(x - 6 - y)$ (D) $\ln\left(\frac{x^4}{36\sqrt{y}}\right)$ (E) none of these

38. Simplify $\frac{f(x+h) - f(x)}{h}$ for the function $f(x) = x^2 + 3x - 1$.

- (A) $\frac{x^2 + 2xh + h^2 + 3x + 3h - 1}{h}$ (B) $\frac{2xh + h^2 - 6x + 3h - 2}{h}$ (C) $2x + h + 3$ (D) $2x + 3$
(E) none of these