Part A: Product and Power Rules for Exponents

Practice 1

1.

$x^5 = x \cdot x \cdot x \cdot x \cdot x$

$x \cdot x \cdot x \cdot x \cdot x$

2.

6^2x^4

$6 \cdot 6 \cdot x \cdot x \cdot x \cdot x$

3.

$x^{8+2} = x^{10}$

4.

2^{8+11}

2^{19}

5.

3^{5+8+-3}

3^{10}

6.

x^{2+2+1}

x^5

7.

$x^{2+1} \cdot y^{2+5}$

x^3y^7

8.

$x^{3+2} \cdot y^{9+1}$

x^5y^{10}

9.

$x^{8+1} \cdot y^{-2+4} \cdot z^{-3+8}$

$x^9y^2z^5$

10.

$2^{2+3} \cdot y^{3+8}$

2^5y^{11}

11.

$5^{8+1} \cdot x^{1+2} \cdot y^{1+4}$

$5^9 x^3 y^5$

12.

$2^{9+6} \cdot 5^{3+11}$

$2^{15} 5^{14}$

13.

$a^{1+1} \cdot b^{1+1}$

$a^2 b^2$

14.

$3^7 \cdot 5^5 \cdot x^{5+12}$

$3^7 \cdot 5^5 \cdot x^{17}$

15.

$a^{2+1} \cdot b^{2+1} \cdot c^{2+1}$

$a^3 b^3 c^3$

16.

$5 + 3 + n = 15$

$n = 7$

17.

$-3 + n + 5 = 8$

$n = 6$

18.

$n \cdot 7 = 35$

$n = 5$

19.

$17^{8 \cdot \frac{1}{2}}$

17^4

20.

$x^{\frac{2}{3} \cdot 18} = x^{\frac{36}{3}}$

x^{12}

21.
$y^{\frac{11}{3} \cdot \frac{3}{2}} = y^{\frac{33}{6}}$
$y^{\frac{11}{2}}$

22.
$a^{3 \cdot 3}$
a^{9}

23.
$x^{9 \cdot 5}$
x^{45}

24.
$y^{3 \cdot 2}$
y^{6}

25.
$x^{2 \cdot 5} \cdot y^{3 \cdot 5}$
$x^{10}y^{15}$

26.
$x^{1 \cdot 3} \cdot y^{2 \cdot 3}$
$x^{3}y^{6}$

27.
$p^{8 \cdot \frac{1}{2}} \cdot q^{14 \cdot \frac{1}{2}}$
$p^{4}q^{7}$

28.
$x^{2 \cdot 4} \cdot y^{1 \cdot 4}$
$x^{8}y^{4}$

29.
$a^{1 \cdot 7} \cdot b^{3 \cdot 7} \cdot c^{1 \cdot 7}$
$a^{7}b^{21}c^{7}$

30.
$p^{27 \cdot \frac{1}{3}} \cdot q^{39 \cdot \frac{1}{3}}$
$p^{9}q^{13}$

31.
$2^{2}x^{2}$
$4x^{2}$

32.

5^3y^3

$125y^3$

33.

$3^3x^{8 \cdot 3}$

$27x^{24}$

Practice 2

1.

$x^{15 + -12 + 1}$

x^4

2.

$a^{\frac{2}{3} + \frac{2}{3} + \frac{5}{3}} = a^{\frac{9}{3}}$

a^3

3.

$2^3 \cdot 3^2 = 8 \cdot 9$

72

4.

$5^2 \cdot 2^4 = 25 \cdot 16$

400

5.

$a^{5 + 7} \cdot b^{2 + 8}$

$a^{12}b^{10}$

6.

$9^{9 + 3} \cdot x^{2 + 2} \cdot y^{3 + 1}$

$9^{12}x^4y^4$

7.

$m^{3 + 14} \cdot n^{7 + -5}$

$m^{17}n^2$

8.

$x^{1 + 2} \cdot y^{1 + 1} \cdot z^{1 + 3}$

$x^3y^2z^4$

9.
$3 \cdot 2 \cdot x^{2+3}$
$6x^5$

10.
$8 \cdot 3 \cdot x^{1+1} \cdot y^{2+2}$
$24x^2y^4$

11.
$12^{5 \cdot 3}$
12^{15}

12.
$26^{2 \cdot 4}$
26^8

13.
$5^{7 \cdot 8}$
5^{56}

14.
$n + -6 + 3 = 1$
$n = 4$

15.
$3 \cdot n = 33$
$n = 11$

16.
$2^{8 \cdot \frac{2}{3}}$
$2^{\frac{16}{3}}$

17.
$x^{\frac{1}{2} \cdot 12}$
x^6

18.
$8^{\frac{1}{2} \cdot 2} = 8^1$
8

19.
$12^{5 \cdot 2} y^{1 \cdot 2}$
$12^{10} y^2$

20.

$x^{5 \cdot 4} y^{8 \cdot 4}$

$x^{20} y^{32}$

21.

$7^{4 \cdot 5} x^{1 \cdot 5}$

$7^{20} x^5$

22.

$a^{2 \cdot 2} b^{3 \cdot 2} c^{4 \cdot 2}$

$a^4 b^6 c^8$

23.

$m^{2 \cdot 9} n^{8 \cdot 9}$

$m^{18} n^{72}$

24.

$4^4 x^4 y^{2 \cdot 4}$

$4^4 x^4 y^8$

25.

$a^{11 \cdot 8} b^{5 \cdot 8}$

$a^{88} b^{40}$

26.

$m^{20 \cdot \frac{1}{2}} n^{6 \cdot \frac{1}{2}}$

$m^{10} n^3$

27.

$x^{9 \cdot 2} b^{16 \cdot 2}$

$x^{18} b^{32}$

28.

$2^{2 \cdot 2} \cdot 3^2 = 2^4 \cdot 9 = 16 \cdot 9$

144

29.

$5^3 x^{2 \cdot 3} y^3 z^3 = 5^3 x^6 y^3 z^3$

$125 x^6 y^3 z^3$

30.

$64^{\frac{1}{2}}x^{8\cdot\frac{1}{2}}y^{20\cdot\frac{1}{2}}$

$8x^4y^{10}$

Part B: Applications of Exponent Rules 1–3

Practice 1

1.

$x^{2\cdot 2}y^{3\cdot 2}\cdot x^8 = x^{4+8}y^6$

$x^{12}y^6$

2.

$x^1y^1\cdot x^{1\cdot 3}y^{2\cdot 3} = x^{1+3}y^{1+6}$

x^4y^7

3.

$a^{12\cdot\frac{1}{3}}b^{6\cdot\frac{1}{3}}\cdot a^2b^5 = a^{4+2}b^{2+5}$

a^6b^7

4.

$x^4y^4\cdot x^{2\cdot 2}y^2 = x^{4+4}y^{4+2}$

x^8y^6

5.

$a^{\frac{1}{3}}b^{\frac{4}{3}}\cdot a^{\frac{1}{3}}b^{2\cdot\frac{1}{3}} = a^{\frac{1}{3}+\frac{1}{3}}b^{\frac{4}{3}+\frac{2}{3}} = a^{\frac{2}{3}}b^{\frac{6}{3}}$

$a^{\frac{2}{3}}b^2$

6.

$a^{7\cdot 2}b^{3\cdot 2}\cdot a^{-1}b^{-2} = a^{14+-1}b^{6+-2}$

$a^{13}b^4$

7.

$2x\cdot 3^2x^{5\cdot 2} = 2\cdot 3^2\cdot x^{1+10} = 2\cdot 9x^{11}$

$18x^{11}$

8.

$3^2x^{5\cdot 2}y^{7\cdot 2}\cdot 5x = 9\cdot 5x^{10+1}y^{14}$

$45x^{11}y^{14}$

9.

$5^2x^2y^2\cdot 2^3x^{2\cdot 3}y^3 = 25\cdot 8x^{2+6}y^{2+3}$

$200x^8y^5$

10.

$x^{-1}y^{-5} \cdot x^{2 \cdot 5}\ y^{3 \cdot 5}\ z^{4 \cdot 5} = x^{-1+10}\ y^{-5+15}z^{20}$

$x^9y^{10}z^{20}$

11.

$5^2a^2 \cdot 3a^nb^9 = 25 \cdot 3 \cdot a^{2+n} \cdot b^9$

$2 + n = 7$

$n = 5$

12.

$V = s^3;\ s = 2x^3y$

$V = (2x^3y)^3$

$V = 2^3x^{3 \cdot 3}\ y^3$

$V = 8x^9y^3$ cubic feet

13.

$A = \frac{1}{2}bh;\ b = 6x,\ h = 2x^2$

$A = \frac{1}{2} \cdot 6x \cdot 2x^2$

$A = \frac{1}{2} \cdot 6 \cdot 2 \cdot x^{1+2}$

$A = 6x^3$ square units

14.

$A = lw;\ l = 8a^3b^2,\ w = 7a^5b^4$

$A = (8a^3b^2)(7a^5b^4)$

$A = 8 \cdot 7 \cdot a^{3+5}\ b^{2+4}$

$A = 56a^8b^6$ square cm

15.

$V = \pi r^2h;\ r = x^5,\ h = 11x^3$

$V = \pi(x^5)^2(11x^3) = 11\pi \cdot x^{10+3}$

$V = 11\pi \cdot x^{13}$ cubic inches

16.

$A = lw;\ l = a^2c,\ w = ab^5$

$A = (a^2c)(ab^5) = a^{2+1}\ b^5c$

$A = a^3b^5c$ square yards

17.

$A = s^2;\ s = 4x$

$A = (4x)^2 = 4^2x^2$

$A = 16x^2$ square units

Practice 2

1.

$x^{\frac{1}{3}\cdot 4}y^{6\cdot 4}\cdot x^{\frac{1}{3}}y = x^{\frac{4}{3}+\frac{1}{3}}y^{24+1}$

$x^{\frac{5}{3}}y^{25}$

2.

$a^{3\cdot\frac{1}{2}}b^{\frac{1}{2}}\cdot a^{\frac{1}{2}}b = a^{\frac{3}{2}+\frac{1}{2}}\cdot b^{\frac{1}{2}+\frac{2}{2}} = a^{\frac{4}{2}}b^{\frac{3}{2}}$

$a^2b^{\frac{3}{2}}$

3.

$2^3ab\cdot 2^2a^{3\cdot 2}b^2 = 2^{3+2}a^{1+6}b^{1+2}$

$2^5a^7b^3$

4.

$3^2a^{4\cdot 2}b^{7\cdot 2}\cdot 3^{14}a^6b^{-2} = 3^{2+14}a^{8+6}b^{14+-2}$

$3^{16}a^{14}b^{12}$

5.

$x^3y^3\cdot x^6y^6 = x^{3+6}y^{3+6}$

x^9y^9

6.

$x^3y\cdot x^{5\cdot 3}y^{3\cdot 3} = x^{3+15}y^{1+9}$

$x^{18}y^{10}$

7.

$3^3x^{2\cdot 3}y^{5\cdot 3}\cdot 3xy = 3^{3+1}x^{6+1}y^{15+1}$

$3^4x^7y^{16}$

8.

$\frac{1}{2}x^{-8}y^{-1}\cdot 4^2x^{11\cdot 2}y^2 = \frac{1}{2}\cdot 16\cdot x^{-8+22}y^{-1+2}$

$8x^{14}y$

9.

$3^2a^2b^2\cdot 3a^2b = 3^{2+1}a^{2+2}b^{2+1} = 3^3a^4b^3$

$27a^4b^3$

10.

$x^{8\cdot 2}y^{5\cdot 2}\cdot 2^3x^{5\cdot 3}y^3 = x^{16}y^{10}\cdot 8x^{15}y^3 = 8x^{16+15}y^{10+3}$

$8x^{31}y^{13}$

11.

$a^{2 \cdot 5} b^{3 \cdot 5} \cdot a^{8n} c^n = a^{26} b^{15} c^2$

$a^{10 + 8n} \cdot b^{15} \cdot c^n = a^{26} b^{15} c^2$

$n = 2$

12.

$V = lwh;\ l = w = 4a,\ h = 6b$

$V = 4a \cdot 4a \cdot 6b = 4 \cdot 4 \cdot 6 \cdot a^2 b$

$V = 96a^2 b$ cubic feet

13.

$V = \frac{4}{3}\pi r^3;\ r = 10x^5 y^3$

$V = \frac{4}{3}\pi (10x^5 y^3)^3 = \frac{4}{3}\pi \cdot 10^3\ x^{5 \cdot 3}\ y^{3 \cdot 3}$

$V = \frac{4{,}000}{3}\pi\, x^{15} y^9$ cubic units

14.

$A = s^2;\ s = 3ab$

$A = (3ab)^2 = 3^2 a^2 b^2$

$A = 9a^2 b^2$ square inches

15.

$V = s^3; s = 5p^7 q^9$

$V = (5p^7 q^9)^3 = 5^3\ p^{7 \cdot 3}\ q^{9 \cdot 3}$

$V = 125p^{21} q^{27}$ cubic units

16.

$A = lw;\ l = 3x^{11} y,\ w = 13x^5 y^2$

$A = (3x^{11} y)(13x^5 y^2) = 3 \cdot 13 \cdot x^{11 + 5}\ y^{1 + 2}$

$A = 39x^{16} y^3$ square feet

17.

$A = \frac{1}{2}bh;\ b = a^4 b,\ h = 5ab^8$

$A = \frac{1}{2}(a^4 b)(5ab^8) = \frac{1}{2} \cdot 5 \cdot a^{4 + 1}\ b^{1 + 8}$

$A = \frac{5}{2}a^5 b^9$ square cm

Targeted Review

Problem	1	2–4	5	6	7	8	9–12	13	14	15–16	17	18
Lesson Origin	FS	1, 5	1	17, 18	V	2	1	17	2	PA	PA	7

1.
$P = 4s$; $s = x + 8$
$P = 4(x + 8)$
$P = 4x + 32$ feet

2.
The Distributive Property

3.
$4(4) + 32 = 48$ feet

4.
(48 feet)($\frac{1\ yd}{3\ feet}$) = 16 yds

5.
w: width, L: length
$2L + 2w \leq 200$
$L \geq w + 5$

6.
t: tens, u: units
$u - t = 5$
$10t + u = 3(t + u)$

7.
Sample: An equation has an equal symbol and has an expression on either side. Equations can be solved. Expressions do not have an equal symbol and can be simplified by combining like terms, or evaluated.

8.
$x^2 + 2x - 6 = 0$

9. Irrational

10. Irrational

11. Irrational

12. Rational

13.
Substitution
$y = x + 1$
$y = 2x - 2$
$x + 1 = 2x - 2$
$3 = x$
$y = (3) + 1$
$y = 4$
$(3, 4)$

14.
$5x + 3 = 4x + 7$
$x + 3 = 7$
$x = 4$

15.
1 and 100, 2 and 50, 4 and 25, 5 and 20,
10 and 10

16.
1 and 48, 2 and 24, 3 and 16, 4 and 12,
6 and 8

17. B
A. −400
B. −30
C. 30
D. 66
Distractor Rationale:
A. This would be the solution if place value is ignored.
C. This would be the solution if the numbers are not squared.
D. This would be the solution if the −4 is ignored.

18. C
A. Sammi purchased 6 pencils and 2 books.
B. Sammi purchased 1 pencil and 4 books.
C. Sammi purchased 6 books and 2 pencils.
D. Sammi purchased 4 books and 26 pencils.
Distractor Rationale:
A. This does not make the equation true when substituted.
B. These are the coefficients of the variables, not the solution.
D. These are the numbers in the given equation.