Math 9 Lesson 4: Exponents (solutions)

- Exponents and Exponent laws with whole-number exponents
- Includes variable bases
- $2^7 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 128; n^4 = n \times n \times n \times n$
- Exponent laws ex. $6^0 = 1; m^1 = m; n^5 \times n^3 = n^8; \frac{y^7}{y^3} = y^4;$

  $(5n)^3 = 5^3 \times n^3; \left(\frac{m}{n}\right)^5 = \frac{m^5}{n^5};$ and $\left(3^2\right)^4 = 3^8$
- Limited to whole-number exponents and whole-number exponent outcomes when simplified
- $(-3)^2$ does not equal -3^2

1. 2^6
   64

2. Simplify $a \times a \times a \times a \times a$
   a^5

3. $(-3)^4$
   81

4. $n \times n^7 \times n^4$
   n^{12}

5. $\left(x^5\right)(x) \cdot x^3$
   x^9

6. $\left(3x^3\right)^3$
   $27x^9$

7. $\left(\frac{2}{-3}\right)^3$
   $-\frac{8}{27}$

8. Simplify $\frac{x^5}{x^3}$
   x^2

9. $x^a \cdot x^b$
   x^{a+b}

10. $\left(\frac{2}{3}\right)^3$
    $\frac{8}{27}$

11. $\left(\dfrac{a}{b}\right)^c$

$\dfrac{a^c}{b^c}$

12. Evaluate $(-5)^2$

25

13. Evaluate -5^2

-25

14. $\dfrac{x^5}{x^3} \div \dfrac{x}{x^2}$

$x^2 \times \dfrac{x^2}{x}$

x^3

15. $\dfrac{5ab^3c}{15a^3b^5}$

$\dfrac{c}{3a^2b^2}$

16. $a^b \cdot a^d \cdot a$

a^{b+d+1}

17. $\left(\dfrac{2x^2y^3}{z^5}\right)^3$

$\dfrac{8x^6y^9}{z^{15}}$

18. $\dfrac{(-3)^4}{(-3)^2} \times -3^2$

$(-3)^2 \times -9$

-81

19. $-2(-2)^2 - (-3)^2$

$-2 \times 4 - 9$

$-8 - 9 = -17$

20. $\left(\left(2x^2\right)^3\right)^2$

$\left(8x^6\right)^2$

$64x^{12}$

21. $\left(2\left(3a^2\right)^3\right)^2$

$4\left(3a^2\right)^6$

$2916a^{12}$

22. $(-1)^{2024}$

1

23. $\frac{(-2)^{100}}{-2^{98}}$

$\frac{2^{100}}{-2^{98}} = -2^2 = -4$

24. $1^0 + 0^1$

$1 + 0 = 1$

25. 0^0

Undefined

26. $\left(\frac{4p^4p^6q^4}{2p^8q^3}\right)^3$

$\left(\frac{2p^{10}q^4}{p^8q^3}\right)^3$

$\left(2p^2q\right)^3$

$8p^6q^3$

27. $\left(\frac{(-3)^2}{(-2)^4}\right)^2$

$\left(\frac{9}{16}\right)^2$

$\frac{81}{256}$

28. $-2\left(-\frac{3}{4}\right)^2 + (-1)^3 - \left(\frac{-2^4}{(-2)^3}\right)^2$

$-2\left(\frac{9}{16}\right) - 1 - \left(\frac{-16}{-8}\right)^2$

$-\frac{9}{8} - 1 - 4$

$-\frac{49}{8}$

29. $\frac{2}{x}\left(\frac{3x}{2x^2}\right)^3 \div \frac{1}{x^3}$

$\frac{2}{x} \times \frac{27x^3}{8x^6} \times x^3$

$\frac{27x^3 \cdot x^3}{4x^7}$

$\frac{27}{4x}$

30. Solve $27 = 9^{3x}$

$3^3 = \left(3^2\right)^{3x}$

$3 = 6x$

$\frac{1}{2} = x$

31. Solve $\dfrac{3^{10}}{3^x} = 3^{x+1}$

$3^{10-x} = 3^{x+1}$

$10 - x = x + 1$

$9 = 2x$

$x = \dfrac{9}{2}$

32. Solve $8^{1-2x} = \dfrac{2^9}{2^x}$

$\left(2^3\right)^{(1-2x)} = 2^{9-x}$

$3 - 6x = 9 - x$

$-6 = 5x$

$x = -\dfrac{6}{5}$

33. Challenge:

a. $\left[\dfrac{(-3)^3}{3^2}\right]^2 - \left[\dfrac{(-3)^4}{3^3}\right]^1 + \left[\dfrac{(-3)^1}{3}\right]^0$

$\left[\dfrac{-27}{9}\right]^2 - \dfrac{81}{27} + 1$

$9 - 3 + 1 = 7$

b. Solve $\left(\dfrac{8^{1-2x}}{2^{x+3}}\right)^4 = 2$

$\left(\dfrac{\left(2^3\right)^{(1-2x)}}{2^{x+3}}\right)^4 = 2$

$\left(\dfrac{2^{3-6x}}{2^{x+3}}\right)^4 = 2$

$\left(2^{-7x}\right)^4 = 2$

$2^{-28x} = 2^1$

$-28x = 1$

$-1 = 28x$

$x = -\dfrac{1}{28}$

c. Solve $32 \times 2 + 2^{x+1} = 3 \times 2^x$

$2^{x+1} - 3 \cdot 2^x = -2 \times 2^5$

$2^x \cdot 2 - 3 \cdot 2^x = -2^6$

$2^x(2 - 3) = -2^6$

$-2^x = -2^6$

$x = 6$