Section 2.2a – Power to a Power and Zero Power

This booklet belongs to:_____Block: _____

Power to a Power

- $(2^3)^4$ means what?
  - Well if 2^3 means: 2 multiplied by itself 3 times
  - Then $(2^3)^4$ must mean: 2^3 multiplied by itself 4 times

$$(2^3)^4 = 2^3 \cdot 2^3 \cdot 2^3 \cdot 2^3$$

✓ And we know that when you **MULTIPLY** a **COMMON BASE** you **ADD** the exponents

$$(2^3)^4 = 2^3 \cdot 2^3 \cdot 2^3 \cdot 2^3 = 2^{3+3+3+3} = 2^{12}$$

❖ Well remember that **repeated addition** is just **multiplication**!

❖ Then a **Power to a Power** means that we can just **MULTIPLY the exponents**

$$(2^3)^4 = 2^{3 \cdot 4} = 2^{12}$$

Power to a Power Rule

Must have a **COMMON BASE**

$$(a^m)^n = a^{m*n}$$

- The same process follows if the **base is a fraction**! $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

Example 1: Write the following as Power to a Power Combinations

a) $\left(\frac{2}{3}\right)^2$

b) $\left(\frac{4^2}{5^3}\right)^5$

Solution:

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

$$\left(\frac{4^2}{5^3}\right)^5 = \frac{4^{10}}{5^{15}}$$

Zero Power

Follow this logic:

$$1 = \frac{2^4}{2^4}$$

$$1 = 2^{4-4}$$

$$1 = 2^0$$

or

$$2^4 = 2 \cdot 2 \cdot 2 \cdot 2$$
$$2^3 = 2 \cdot 2 \cdot 2$$
$$2^2 = 2 \cdot 2$$
$$2^1 = 2$$
$$2^0 = ? \qquad \rightarrow 2^0 = 1$$

- At each step I have divided by 2
- So, when I get to the last one, what is $2 \div 2$?

Example 2:

$$3^0 = 1 \qquad 4^0 = 1 \qquad 17^0 = 1$$

Watch the negatives!

$$-4^0 = (-1)4^0 = (-1)1 = -\mathbf{1} \qquad and \qquad -(2)^0 = -(1) = -\mathbf{1}$$

FN $\qquad$ FN

Variables as Bases

- When it comes to the **logic of exponents** it **doesn't change** when we move from numbers to variables (unknowns)

Multiplication Rule

$x^4 \cdot x^2$ Do I have a **COMMON BASE**? YUP!

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

Division Rule

$\frac{r^{12}}{r^4}$ Do I have a **COMMON BASE**? YUP!

$$\frac{r^{12}}{r^4} = r^{12-4} = r^8$$

Power to a Power Rule

$(k^2)^3$ Remember, we **MULTIPLY** the **EXPONENTS**

$$(k^2)^3 = k^{2 \cdot 3} = k^6$$

Look out for those negatives, be careful!

$$-q^4 \cdot q^2 = (-1)q^4 \cdot q^2 = (-1)q^6 = -q^6$$

FN FP

LOGIC IS THE SAME!!

Section 2.2a – Practice Questions

EMERGING LEVEL QUESTIONS

1. Explain $(5^3)^4$ using repeated multiplication.

Simplify the following, write in exponential form:

2. $(2^3)^4$	3. $(4^3)^3$
4. $(7^0)^5$	5. $-(2^2)^3$
6. $[(-2)^2]^3$	7. $[(2^3)^4]^5$

PROFICIENT LEVEL QUESTIONS

Will the following answers be positive or negative (think about signs from inside out), **why?**

8. $(-2^2)^3$	9. $(-2^2)^4$
10. $((-2)^3)^3$	11. $((-2)^2)^3$
12. $\{[(-2)^3]^2\}^2$	13. $\{[(-2^2)^3]^2\}^2$

Evaluate the following, use BEDMAS, leave answer in exponential form

14. $(-2 \cdot 3)^2$

15. $-(2 \cdot 3)^2$

16. $(-2+3)^4$

17. $(-2+3)^5$

18. $\left(-\frac{6}{2}\right)^4$

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

Simplify the following.

20. $(-7)^0$

21. -7^0

22. $\frac{3^0}{-3^0}$

23. $\frac{2^4}{2^0}$

EXTENDING LEVEL QUESTIONS

24. $\left(\frac{2^{12}}{3^2} \cdot \frac{2^4}{3^{13}}\right)^0$

25. $(2^{-5} \cdot 2^4 \cdot 2^{12} \cdot -2^4)^0$

26. $\left(\frac{2^2}{3^2} \cdot \frac{2^4}{3^3}\right)^4$

27. $\left(\frac{2^4}{3^2} \cdot \frac{2^1}{3^4}\right)^2$

EMERGING LEVEL QUESTIONS

Leave your answers in exponential form

28. $x^2 \cdot x^3$

29. $-r^7 \cdot r^4$

30. $t^1 \cdot t^6$

31. $(-t)^4 \cdot (-t)^7$

32. $\frac{z^5}{z^3}$

33. $\frac{m^4}{m^4}$

34. $\frac{-k^{17}}{k^{-3}}$

35. $\frac{(-r)^{17}}{-r^{-2}}$

36. $(-a^2)^3$

37. $-(c^4)^2$

38. $-(-c^3)^7$

39. $((-r)^4)^2$

PROFICIENT LEVEL QUESTIONS

40. $(c^{-4})^{-2}$

41. $((-c)^{-5})^{-2}$

42. $-x^2 \cdot (-x)^3 \cdot x^4$	43. $-f^0 \cdot f^2 \cdot (-f)^0$
44. $n^{-2} \cdot n^4$	45. $(-g)^2 \cdot -g^3 \cdot (-g)$
46. $\frac{-m^7}{m^{-4}}$	47. $\frac{t^{-3}}{t^{-4}}$
48. $\frac{(-w)^{14}}{-w^{-4}}$	49. $\frac{q^0}{q^{-6}}$
50. $\left(\frac{(-a)^5}{(-a)^7}\right)^{-2}$	51. $\left(\frac{j^6}{j^2}\right)^4$

Answer Key – Section 2.2a

1. $5^3 \cdot 5^3 \cdot 5^3 \cdot 5^3$	2. 2^{12}	3. 4^9
4. 7^0 or 1	5. -2^6	6. $(-2)^6$ or 2^6
7. 2^{60}	8. Negative	9. Positive
10. Negative	11. Positive	12. Positive
13. Positive	14. $(-6)^2$ or 6^2	15. -6^2
16. 1^4 or 1	17. 1^5 or 1	18. $(-3)^4$ or 3^4
19. $(-2)^3$ or -2^3	20. 1	21. -1
22. -1	23. 2^4	24. 1
25. 1	26. $\frac{2^{24}}{3^{20}}$	27. $\frac{2^{10}}{3^{12}}$
28. x^5	29. $-r^{11}$	30. t^7
31. $(-t)^{11}$ or $-t^{11}$	32. z^2	33. 1
34. $-k^{20}$	35. r^{19}	36. $-a^6$
37. $-c^8$	38. c^{21}	39. $(-r)^8$ or r^8
40. c^8	41. $(-c)^{10}$ or c^{10}	42. x^9
43. $-f^2$	44. n^2	45. g^6
46. $-m^{11}$	47. t	48. $-w^{18}$
49. q^6	50. $(-a)^4$ or a^4	51. j^{16}

Extra Work Space