Section 2.2b – Combined Operations

This booklet belongs to:_____Block: _____

- ✓ Take everything we have learned so far and put it all together
- ✓ 1st thing: Do I have a **COMMON BASE**
- ✓ 2nd thing: Work those **NEGATIVES** to get to a **COMMON BASE**
- ✓ 3rd thing: Which **RULE(S)** do I apply

Example 1:

$$\frac{2^6 2^4}{2^2} \rightarrow \frac{2^{6+4}}{2^2} \rightarrow \frac{2^{10}}{2^2} \rightarrow 2^{10-2} \rightarrow 2^8$$

Example 2:

$$\frac{(x^4)^6}{x^9} \rightarrow \frac{x^{4*6}}{x^9} \rightarrow \frac{x^{24}}{x^9} \rightarrow x^{24-9} \rightarrow x^{15}$$

Example 3:

$$\boxed{FN}\ \frac{(-3)^5 \cdot (-3)^4}{-3^2}\ \boxed{FP}\ \boxed{FN} \rightarrow \frac{-3^5 \cdot 3^4}{(-1)3^2} \rightarrow \frac{(-1)3^5 \cdot 3^4}{(-1)3^2} \rightarrow \frac{3^{5+4}}{3^2} \rightarrow \frac{3^9}{3^2} \rightarrow 3^{9-2} \rightarrow 3^7$$

Example 4: Common Base here so no need for FP or FN

$$\frac{(-2)^3 \cdot (-2)^2}{(-2)^4} \rightarrow \frac{(-2)^{3+2}}{(-2)^4} \rightarrow \frac{(-2)^5}{(-2)^4} \rightarrow (-2)^{5-4} \rightarrow (-2)^1 \rightarrow -2$$

Example 5:

$$\frac{4r \cdot r}{r} \rightarrow \frac{4r^2}{r} \rightarrow 4r^{2-1} \rightarrow 4r$$

Example 6:

$$\frac{15t^4 \cdot t^5}{3t^2} \rightarrow \frac{15t^{4+5}}{3t^2} \rightarrow \frac{15t^9}{3t^2} \rightarrow \frac{15}{3} \cdot \frac{t^9}{t^2} \rightarrow 5t^{9-2} \rightarrow 5t^7$$

Example 7:

$$\left(\frac{2^2}{3^3}\right)^2 \left(\frac{2^4}{3^5}\right)^3 \rightarrow \left(\frac{2^{2*2}}{3^{3*2}}\right)\left(\frac{2^{4*3}}{3^{5*3}}\right) \rightarrow \left(\frac{2^4}{3^6}\right)\left(\frac{2^{12}}{3^{15}}\right) \rightarrow \frac{2^4 * 2^{12}}{3^6 * 3^{15}} \rightarrow \frac{2^{4+12}}{3^{6+15}} \rightarrow \frac{2^{16}}{3^{21}}$$

Last Thing

- If bases are separated by **addition or subtraction** you can only **solve them**
- The **rules do not apply** to **addition and subtraction!**
- Be Careful!!!

Example 8:

$$2^4 \cdot 2^2 + 2^3$$

$$2^{4+2} + 2^3$$

$$2^6 + 2^3$$

$$64 + 8$$

$$72$$

Can't use exponent rules when adding or subtracting bases! All you can do is solve!

Example 9:

$$3^7 \div 3^5 - 3^2 \cdot 3^2$$

$$3^{7-5} - 3^{2+2}$$

$$3^2 - 3^4$$

$$9 - 81$$

$$-72$$

The Most Complex

- Tackling these questions involves combining all the rules we have learned
- Remembering that a number next to a variable means multiply ($3x\ means\ 3 \cdot x$)
- Multiple variables next to one another is all multiplication too ($xyz\ means\ x \cdot y \cdot z$)
- Using all of those tidbits we can rearrange questions and simplify complex statements

Example 10: Simplify

$$(4ab^{-1})^3(2a^2b^3)^2$$

Solution 10:

Remember that if a number or variable do not have an exponent, they have an exponent of 1

- Waterbomb in the outer exponent – Power to a Power – Multiply the Exponents

$$4^3a^3b^{-3} \cdot 2^2a^4b^6$$

- Multiply the common bases – Add the Exponents
- Compute the numerical situations (rearrange the factors)

$$64 \cdot 4a^7b^3 \quad \rightarrow \quad \boldsymbol{256a^7b^3}$$

Example 11: Simplify

$$\frac{(x^2y^2)^{-2}(x^2y^2)^3}{x^{-1}y^{-2}}$$

Solution 11:

Power to a Power
Waterbomb
(**Multiply) Exponents**

$$\frac{(x^2y^2)^{-2}(x^2y^2)^3}{x^{-1}y^{-2}} \quad \rightarrow \quad \frac{x^{-4}y^{-4} \cdot x^6y^6}{x^{-1}y^{-2}}$$

Multiply Common Base
Add Exponents

Divide Common Base
Subtract Exponents

$$\frac{x^2y^2}{x^{-1}y^{-2}} \quad \rightarrow \quad \boldsymbol{x^3y^4}$$

These are the most challenging and give you something to work to for

Foundations and Pre-Calculus 10!

Section 2.2b – Practice Questions

PROFICIENT LEVEL QUESTIONS

Simplify the following, leave answer in **exponential form**

1.
$$\frac{2^7 \cdot 2^5}{2^8}$$

2.
$$\frac{(-3)^4 \cdot (-3)^8}{(-3)^{10}}$$

3.
$$\frac{(-7)^5 \cdot (-7)^4}{(-7)^7 \cdot (-7)^1}$$

4.
$$\frac{5^4 \cdot (-5)^5 \cdot 5^5}{-5 \cdot 5^3}$$

5.
$$\frac{(-3)^{10} \cdot (-3)^0}{3^3 \cdot (-3)^3 \cdot 3^1}$$

6.
$$\frac{(-2)^5 \cdot 2^3 \cdot (-2)^4}{2^4 \cdot -2^2 \cdot (-2)^3}$$

7.
$$\frac{-q^{-4} \cdot q^7}{(-q)^2}$$

8.
$$\frac{r^3 \cdot r^6}{-r^{-4}}$$

9.

$$\frac{(-w)^7 \cdot -w^4 \cdot w}{-w^5}$$

10.

$$\frac{j^0 \cdot -j^0}{(-j)^0}$$

Simplify and then solve the following.

11. $(-2)^2 \cdot 2^4 + (-2)^3 \div 2^1$

12. $(-8)^{-2} \cdot 8^4 + (-8)^{13} \div 8^{11}$

13.

$$\frac{(-2)^5 + (-2)^2}{(-2)^4}$$

14.

$$\frac{(-3)^4 - (3)^2}{(-3)^3}$$

EXTENDING LEVEL QUESTIONS

15. $$\frac{\left(5mn^2\right)^2\left(2m^2n\right)^3}{(2m^2n)^2}$$

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16. $$\frac{\left(3a^{-2}b^3\right)^2\left(3a^{-1}b^{-4}\right)^{-1}}{(3a^2b^{-2})^{-3}}$$

Answer Key – Section 2.2b

1. 2^4	2. $(-3)^2$ or 3^2	3. -7	4. 5^{10}	5. -3^3	6. -2^3	7. $-q$
8. $-r^{13}$	9. $-w^7$	10. -1	11. 60	12. 0	13. $-\frac{7}{4}$	14. $-\frac{8}{3}$
15. $50m^4n^5$	16. $81a^3b^4$					

Extra Work Space