$$\text{base} \rightarrow 3^4 \leftarrow \text{exponent}$$

1. Product of like bases: $a^m a^n = a^{m+n}$

2. Quotient of like bases: $\dfrac{a^m}{a^n} = a^{m-n}$

3. Power to a power: $(a^m)^n = a^{mn}$

4. Product to a power: $(ab)^m = a^m b^m$

5. Quotient to a power: $\left(\dfrac{a}{b}\right)^n = \dfrac{a^n}{b^n}$

6. Zero exponent: $a^0 = 1$

7. Negative exponent: $a^{-n} = \dfrac{1}{a^n}$ or $\dfrac{1}{a^{-n}} = a^n$

Properties of Exponents

$$\text{base} \rightarrow 3^4 \leftarrow \text{exponent}$$

Practice Problems – Simplify the expressions.

1. $7^2 \bullet 7^3 \;=\; 7^5$

2. $(2^3)^4 \quad 2^{12}$

3. $(m^3)^2 \quad m^6$

4. $(4r)^2 \bullet r$

   $16r^2 \cdot r^1 \;=\; 16r^3$

5. $(3x)^3(-5y)^2 \quad 27 \cdot 25 x^3 y^2$

   $(3^3 x^3)(25y^2)$

6. $x^{-4} \quad \dfrac{1}{x^4}$

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7. $2x^{-2}$ $\dfrac{2}{x^2}$

8. $x^{-3}y^{-2}$ $\dfrac{1}{x^3 y^2}$

9. $\dfrac{4x}{y^{-5}}$ $4xy^5$

10. $\dfrac{2}{(5x)^{-2}}$ $\dfrac{2(5x)^2}{1} = 50x^2$

11. $\dfrac{2x^4 y^2}{xy} \cdot \dfrac{3x^2 y}{4x}$

$\dfrac{6x^6 y^3}{4x^2 y} = \boxed{\dfrac{3x^4 y^2}{2}}$

12. $\dfrac{16r^5 s^9}{-2rs^2} \cdot \dfrac{r^2 s}{-8} = \dfrac{16r^7 s^{10}}{16rs^2} = \boxed{r^6 s^8}$

13. $\dfrac{(3y)^{-3}}{4x^{-2}} = \dfrac{x^2}{4 \cdot 27 y^3} =$

14. $\dfrac{x^{-2}}{(x^5 y^{-4})^{-2}}$ $\dfrac{(x^5 y^{-4})^{+2}}{x^2} = \dfrac{x^{10} y^{-8}}{x^2} = \boxed{\dfrac{x^8}{y^8}}$

15. $u^3 v^2 \cdot (uv^2)^3$

$u^3 v^2 \cdot u^3 v^6$

$u^6 v^8$

16. $\dfrac{r^{-2}}{4r^5 \cdot 4r^{-5}}$ $16r^0 r^2 = \boxed{\dfrac{1}{16r^2}}$

Name _____

Date _____ Period _____

Product of Powers: Simplify using the property $a^m \cdot a^n = $ _____

a. $2^{1/2} \cdot 2^{3/2}$

b. $3^{3/4} \cdot 3^{5/4}$

c. $5^{1/2} \cdot 5^{3/4}$

Power of a Power: Simplify using the property $(a^m)^n = $ _____ .

d. $\left(4^{3/4}\right)^{2/3}$

e. $\left(6^{1/2}\right)^4$

f. $(3^5)^{1/4}$

Power of a Product: Simplify using the property $(ab)^m = $ _____

g. $(2 \cdot 3^{1/2})^4$

h. $3^{3/4} \cdot 6^{3/4}$

i. $(4 \cdot 2)^{2/3}$

Quotient of Powers: Simplify using the property $\dfrac{a^m}{a^n} = $ _____

j. $\dfrac{2^{5/3}}{2^{1/3}}$

k. $\dfrac{5^{3/4}}{5^{1/2}}$

l. $\dfrac{7^5}{7^{2/3}}$

Power of a Quotient: Simplify using the property $\left(\dfrac{a}{b}\right)^m = $ _____

m. $\left(\dfrac{3}{4}\right)^{1/3}$

n. $\left(\dfrac{5}{2}\right)^{5/2}$

o. $\dfrac{6^{1/4}}{2^{1/4}}$

Mixed Practice

1. $9^{1/2} \cdot 9^{3/4}$

2. $\left(7^{2/3} \cdot 5^{1/6}\right)^3$

3. $\dfrac{3^{5/6}}{3^{1/3}}$

4. $\left(\dfrac{16^{2/3}}{4^{2/3}}\right)^4$

5. $\left(2^{1/2} \cdot 3^{3/4}\right)^{1/2}$
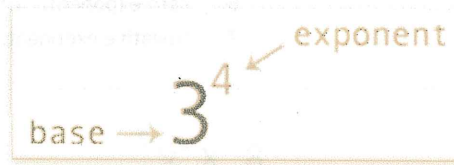
6. $\left(\dfrac{3^{5/4}}{7^{1/2}}\right)^2$

7. $\dfrac{10^{2/7}}{10^{1/2}}$

8. $\left(9^{4/5} \cdot 2^{1/2}\right)^{10}$

9. $2^{1/4} \cdot 8^{1/4}$

10. $\dfrac{10^{1/3}}{5^{1/3}}$

exponent

$$3^4$$

base → 3

1. Product of like bases: $a^m a^n = a^{m+n}$

2. Quotient of like bases: $\dfrac{a^m}{a^n} = a^{m-n}$

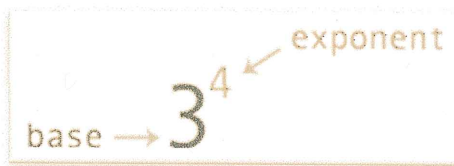3. Power to a power: $(a^m)^n = a^{mn}$

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Properties of Exponents

exponent

$$3^4$$

base → 3

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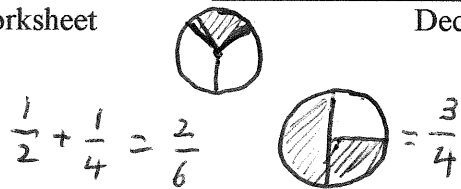
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15. $u^3 v^2 \cdot \left(uv^2\right)^3$

16. $\dfrac{r^{-2}}{4r^5 \cdot 4r^{-5}}$

Adding and Subtracting two fractions
To **add (or subtract)** two **fractions:**

$\frac{1}{2} + \frac{1}{4} = \frac{2}{6}$ $= \frac{3}{4}$

1) Find the **least common denominator**.

2) Write both original fractions as **equivalent fractions** with the least common denominator.

3) Add (or subtract) the numerators.

4) Write the result with the denominator.

Examples:

a. $4 \cdot \frac{3}{5} + \frac{1}{4} \cdot 5$ $\frac{12}{20} + \frac{5}{20} = \boxed{\frac{17}{20}}$

b. $3\frac{5}{7} - \frac{2}{3} \cdot 7 = \frac{15}{21} - \frac{14}{21} = \boxed{\frac{1}{21}}$

Multiplying two fractions–
To **multiply** two fractions:

1) Multiply the numerator by the numerator.

2) Multiply the denominator by the denominator.

For all real numbers a, b, c, d $(b \neq 0, d \neq 0)$

$$\frac{a}{b} \cdot \frac{c}{d} = \frac{ac}{bd}$$

Examples:

a. $\frac{4}{5} * \frac{3}{4} = \frac{12}{20}$ 4 $\frac{3}{5}$

b. $\frac{5}{8} * \frac{2}{7}$ $\frac{10}{56}$ 2 $\boxed{\frac{5}{28}}$

Dividing fractions –
To **divide** by a fraction, multiply by its **reciprocal.**

For all real numbers a, b, c, d $(b \neq 0, c \neq 0, d \neq 0)$

Examples:

a. $\frac{3}{5} \div \frac{2}{3}$ $\frac{3}{5} \circ \frac{3}{2}$

b. $\frac{5}{7} \div \frac{3}{4}$ $\frac{5}{7} \cdot \frac{4}{3}$

Mixed numbers can be written as an **improper fraction** and an improper fraction can be written as a mixed number.

Examples:

a. $1\frac{1}{2} * 1\frac{1}{4}$

$\frac{3}{2} \cdot \frac{5}{4}$

$1\frac{1}{2}$

b. $1\frac{1}{5} \div 2\frac{1}{4}$

$\frac{6}{5} \div \frac{9}{4}$

$\frac{6}{5} \cdot \frac{4}{9} = \frac{8}{15}$

A fraction is in **lowest terms** when the numerator and denominator have no common factor other than 1. To write a fraction in lowest terms, divide the numerator and denominator by the **greatest common factor.** **"Your calculator will do this for you." 30SX or 36XPro**

a. $\frac{45}{75} =$

b. $\frac{6}{33} =$