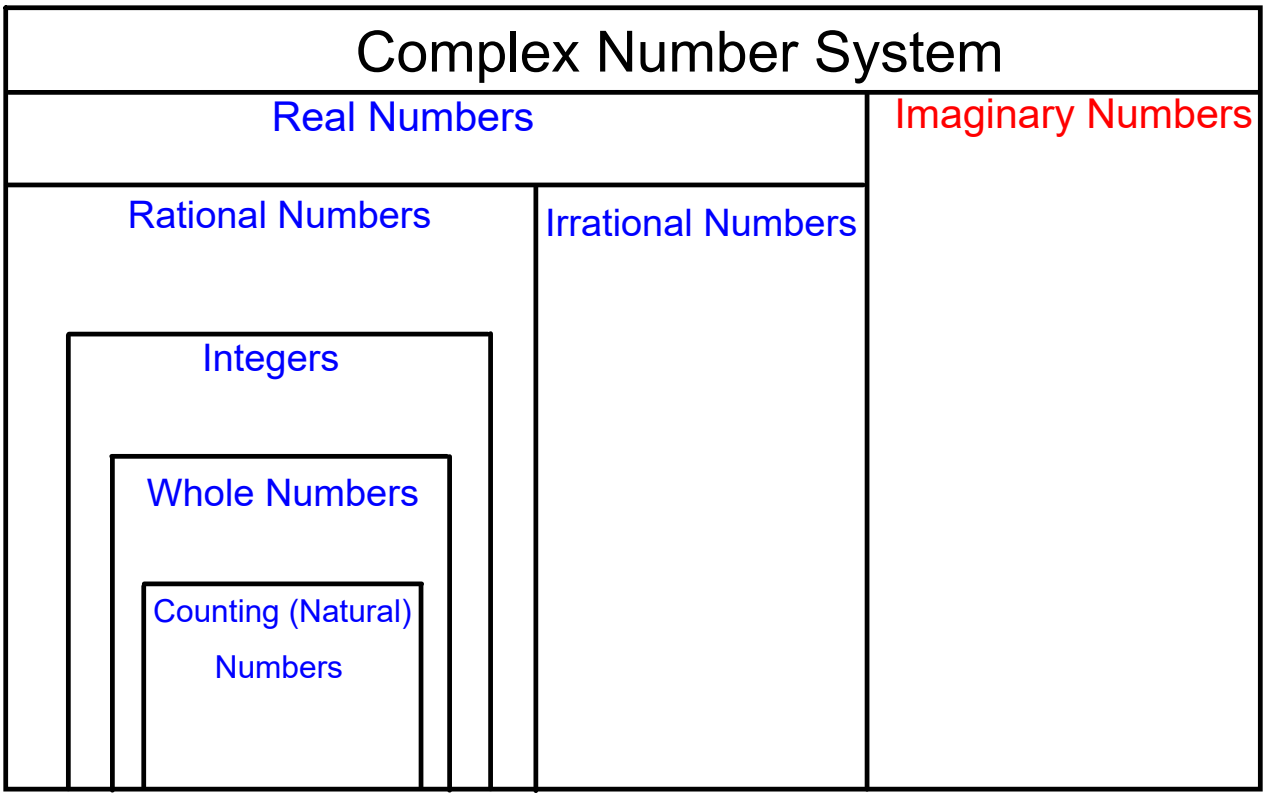

Given the following expressions, fill in the chart.

	Expression as repeated multiplication	Simplified
$7^4 \cdot 7^5$	$7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7 \cdot 7$	7^9 40,353,607
$(-4)^2 \cdot (-4)^3$	$(-4)(-4) \cdot (-4)(-4)(-4)$	$(-4)^5 = -1024$
$x^1 \cdot x^5$	$x \cdot x \cdot x \cdot x \cdot x \cdot x$	x^6

Simplify:

1) $5^2 \cdot 5^3 = 5^5$

3125

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

$(-6)^5 = -7776$

3) $m^6 \cdot m^4$

m^{10}

4) $n^2 \cdot m^5$

n^2m^5

Draw a conclusion:

If a is a real number and m and n are integers, then $a^m \cdot a^n = a^{m+n}$

Given the following expressions, fill in the chart.

	Expression as repeated multiplication	Simplified
$(5^3)^2$	$(5^3)(5^3)$ $5 \cdot 5 \cdot 5 \cdot 5 \cdot 5 \cdot 5$	$5^6 = 15{,}625$
$[(-6)^2]^4$	$(-6)^2(-6)^2(-6)^2(-6)^2$ $(-6)(-6)(-6)(-6)(-6)(-6)(-6)(-6)$	$(-6)^8$ $1{,}679{,}616$ $\cancel{-6^8}$
$(a^2)^3$	$a^2 \cdot a^2 \cdot a^2$ $a \cdot a \cdot a \cdot a \cdot a \cdot a$	a^6

Simplify:

5) $(10^3)^3 = 10^9$

6) $[(-2)^3]^4$

$(-2)^{12} = 4096$

7) $(c^2)^6 = c^{12}$

8) $(-3^2)^2$

$(-9)^2 = 81$

Draw a conclusion:

If a is a real number and m and n are integers, then $(a^m)^n = a^{m \cdot n}$

Simplify:

9) $(2m)^3$

$(2m)(2m)(2m)$

$8m^3$

$2^3m^3 = 8m^3$

10) $(-3n)^2$

$(-3)^2n^2$

$9n^2$

11) $(mn)^2$

m^2n^2

Draw a conclusion:

If a and b are real numbers and m is an integer, then $(ab)^m = a^m b^m$

Simplify:

12) $\frac{2^7}{2^2} = 2^5 = 32$

$\frac{\cancel{2}\cdot\cancel{2}\cdot 2\cdot 2\cdot 2\cdot 2\cdot 2}{\cancel{2}\cdot\cancel{2}}$

13) $\frac{8^5}{8^2} = 8^3$

$\frac{8^2}{8^5} = \frac{1}{8^3}$

14) $\frac{x^3}{x^1} = x^2$

$\frac{x}{x^3} = \frac{1}{x^2}$

Draw a conclusion:

If a is a real number and m and n are integers, $a \neq 0$, then $\frac{a^m}{a^n} = a^{m-n}$

Simplify:

15) $\left(\frac{x}{4}\right)^5 = \frac{x^5}{(4)^5} = \frac{x^5}{1024}$

16) $\left(\frac{-4}{5}\right)^3$

$\frac{(-4)^3}{5^3} = \frac{-64}{125}$

17) $\left(\frac{-3}{4}\right)^2$ $\frac{(-3)^2}{4^2} = \frac{9}{16}$

Draw a conclusion:

If a and b are real numbers and m is an integer and $b \neq 0$, then $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

Properties of Exponents

Product of Powers: $a^m \bullet a^n = a^{m+n}$

Power of a Power: $(a^m)^n = a^{mn}$

Power of a Product: $(ab)^m = a^m b^m$

Quotient of Powers: $\dfrac{a^m}{a^n} = a^{m-n} \quad a \neq 0$

Power of a Quotient: $\left(\dfrac{a}{b}\right)^m = \dfrac{a^m}{b^m} \quad b \neq 0$

Quick Check

18) $(5pq)^3$

$5^3p^3q^3$

$125p^3q^3$

19) $[(d + 9)^7]^3$

$(d+9)^{21}$

$d^{21} + 9^{21}$

$(d+9)^{21}$

20) $(-20x^3)^2(-x^7)$

21) $\left(\frac{3x^5}{7y^2}\right)^3 = \frac{3^3x^{15}}{7^3y^6} = \frac{27x^{15}}{343y^6}$

22) $\left(\frac{\cancel{2}^{1}\cancel{m^5}^{m^3}n}{\cancel{4}_{2}\cancel{m^2}}\right)^2 \left(\frac{mn^{\cancel{4}\,3}}{5\cancel{n}}\right)^2$

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

$\frac{m^6n^2}{4} \cdot \frac{m^2n^6}{25} = \frac{m^8n^8}{100}$