Math 10-C Exponents & Radicals Assignment List Name: KEY

C1: Prime Factorization

- Eratosthenes' Sieve
- Prime Factorization Practice

C2: Perfect Squares & Square Roots

- Text pg. 64: 3, 12, 13
- Quizlet – Perfect Squares & Square Roots (http://quizlet.com/_bkzdc)

C3: Perfect Cubes & Cube Roots

- Text pg. 64: 4, 16, 17
- Quizlet – Perfect Cubes & Cube Roots (http://quizlet.com/_bkywk)

C4: Entire & Mixed Radicals

- Entire & Mixed Radicals Investigation
- Radicals Worksheet
- Text pg. 76: 4abc, 5abcd
- Text. pg. 64: 20, 18, 24
- Exponents & Radicals Quiz C1-C4

C5: Exponents with Rational Bases

- Basic Exponents Review
- Investigate Negative Exponents
- Powers with Rational Bases Assignment
- Exponents & Radicals Quiz (Rational Bases)

C6: Exponents with Variables Bases

- Powers with Variables Bases Assignment
- Text pg. 68: 11, 15, 16

C7: Number Systems & Ordering

- In class questions.

Exponents & Radicals Chapter Review Assignment

M10C - Prime Factorization Practice C1

1. a) $2 \mid 84$, $2 \mid 42$, $3 \mid 21$, $7 \mid 7$, 1

$84 = \boxed{2^2 \cdot 3 \cdot 7}$

b) $120 \to 10, 12 \to (2,5), (2,6) \to (2,3)$

$120 = \boxed{2^3 \cdot 3 \cdot 5}$

c) $2 \mid 172$, $2 \mid 86$, 43

$172 = \boxed{2^2 \cdot 43}$

d) $100 \to 10, 10 \to (2,5), (2,5)$

$100 = \boxed{2^2 \cdot 5^2}$

e) $2 \mid 96$, $2 \mid 48$, $2 \mid 24$, $2 \mid 12$, $2 \mid 6$, $3 \mid 3$, 1

$96 = \boxed{2^5 \cdot 3}$

f) $3 \mid 351$, $3 \mid 117$, $3 \mid 39$, $13 \mid 13$, 1

$351 = \boxed{3^3 \cdot 13}$

$3 \overline{)351}$: -3, 5, -3, 21 → 117

$3 \overline{)117}$: -9, 27 → 39

2. Factor pairs of 36 →

1, 36	1 group of 36	or 36 groups of 1
2, 18	2 groups of 18	or 18 groups of 2
3, 12	3 groups of 12	or 12 groups of 3
4, 9	4 groups of 9	or 9 groups of 4
6, 6	6 groups of 6	

3. $5 \mid 1925$, $5 \mid 385$, $7 \mid 77$, $11 \mid 11$, 1

$5 \overline{)1925}$: -15, 42, -40, 25 → 385

$5 \overline{)385}$: -35, 35 → 77

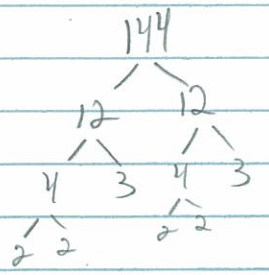
$1925 = 5 \cdot 5 \cdot 7 \cdot 11$

$(5 \cdot 5) \cdot 7 \cdot 11$ | $\ell = 25$ $w = 7$ $h = 11$

$5 \cdot (5 \cdot 7) \cdot 11$ | $\ell = 5$ $w = 35$ $h = 11$

$5 \cdot 5 \cdot (7 \cdot 11)$ | $\ell = 5$ $w = 5$ $h = 77$

$(5 \cdot 11)\, 5 \cdot 7$ | $\ell = 55$ $w = 5$ $h = 7$

4. 

$144 = 2 \cdot 2 \cdot 2 \cdot 2 \cdot 3 \cdot 3$

$(2 \cdot 2 \cdot 2 \cdot 2) \cdot 3 \cdot 3 = 16 \cdot 3 \cdot 3$ sum = 22

$(2 \cdot 2 \cdot 2 \cdot 3) \cdot 2 \cdot 3 = 24 \cdot 2 \cdot 3$ sum = 29

$(2 \cdot 2 \cdot 3 \cdot 3) \cdot 2 \cdot 2 = \boxed{36 \cdot 2 \cdot 2}$ sum = 40

5. $43\_\underline{0}$ Last digit must be 0 or 5 ∵ divisible by 5.

← Last digit must be 0 ∵ divisible by 4.

Divisible by 3 means sum of digits must be divisible by 3

∴ possibilities are $\boxed{4320}$ ✓

4350 × last two digits not divisible by 4

$\boxed{4380}$ ✓

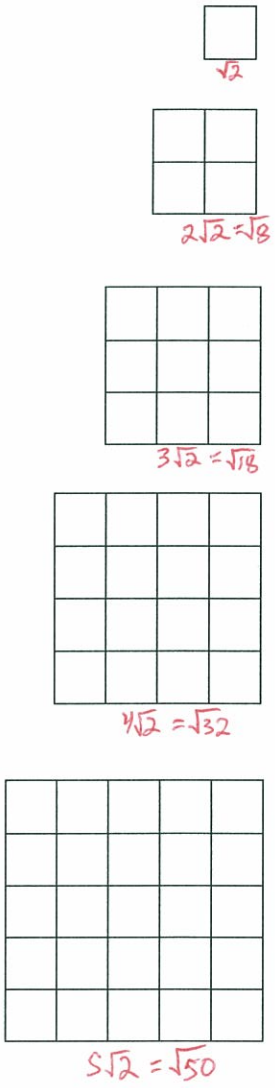
The last two digits could be 20 or 80.

6. Use divisibility rules to check answers.

Math 10-C Entire & Mixed Radicals Investigation **Name:** KEY

1. Complete the table below given the information provided.

   Each of the small squares below has an area of 2. The first one is completed for you.



Total Area	Side Length (written as an entire radical)	Side Length (written as a multiple of $\sqrt{2}$)
2 units^2	$\sqrt{2}$	$1\sqrt{2}$
8 units^2	$\sqrt{8}$	$2\sqrt{2}$
18 units^2	$\sqrt{18}$	$3\sqrt{2}$
32 units^2	$\sqrt{32}$	$4\sqrt{2}$
50 units^2	$\sqrt{50}$	$5\sqrt{2}$

Looking at the completed table we can see that there are two different ways to represent the 'Side Length'. Try to describe the relationship between the two side length columns (hint: think factors). If you need more help seeing the relationship continue to the next page…

If the following are true ... ***(verify with a calculator if you'd like)***

$\sqrt{8} = \sqrt{4} \cdot \sqrt{2} = 2\sqrt{2}$

$\sqrt{12} = \sqrt{4} \cdot \sqrt{3} = 2\sqrt{3}$

$\sqrt{24} = \sqrt{4} \cdot \sqrt{6} = 2\sqrt{6}$

$\sqrt{18} = \sqrt{9} \cdot \sqrt{2} = 3\sqrt{2}$

$\sqrt{27} = \sqrt{9} \cdot \sqrt{3} = 3\sqrt{3}$

$\sqrt{63} = \sqrt{9} \cdot \sqrt{7} = 3\sqrt{7}$

$\sqrt{32} = \sqrt{16} \cdot \sqrt{2} = 4\sqrt{2}$

then answer these...

$\sqrt{50} = \sqrt{25} \cdot \sqrt{2} = 5\sqrt{2}$

$\sqrt{20} = \sqrt{4} \cdot \sqrt{5} = 2\sqrt{5}$

$\sqrt{200} = \sqrt{100} \cdot \sqrt{2} = 10\sqrt{2}$

$\sqrt{72} = \sqrt{36} \cdot \sqrt{2} = 6\sqrt{2}$

$\sqrt{45} = \sqrt{9} \cdot \sqrt{5} = 3\sqrt{5}$

$\sqrt{300} = \sqrt{100} \cdot \sqrt{3} = 10\sqrt{3}$

$\sqrt{98} = \sqrt{49} \cdot \sqrt{2} = 7\sqrt{2}$

$\sqrt{500} = \sqrt{100} \cdot \sqrt{5} = 10\sqrt{5}$

Radicals Worksheet Name: KEY

Evaluate the Perfect Squares

1^2	2^2	3^2	4^2	5^2	6^2	7^2	8^2	9^2	10^2	11^2	12^2	13^2	14^2	15^2
1	4	9	16	25	36	49	64	81	100	121	144	169	196	225

1. Simplify the following.

$\sqrt{1}$ $=1$ | $\sqrt{4}$ $=2$ | $\sqrt{9}$ $=3$ | $\sqrt{16}$ $=4$ | $\sqrt{25}$ $=5$ | $\sqrt{36}$ $=6$

$\sqrt{144}$ $=12$ | $\sqrt{\frac{4}{9}}$ $=\frac{2}{3}$ | $\sqrt{\frac{9}{100}}$ $=\frac{3}{10}$ | $\sqrt{\frac{9}{36}}$ $=\frac{3}{6}=\frac{1}{2}$ | $\sqrt{\frac{25}{100}}$ $=\frac{5}{10}=\frac{1}{2}$ | $\sqrt{\frac{900}{100}}$ $=\sqrt{9}$ $=3$

2. Find the value of the following.

$\sqrt{49}$ $=7$ | $2\sqrt{16}$ $=2\cdot 4$ $=8$ | $25\sqrt{4}$ $=25\cdot 2$ $=50$ | $\sqrt{9}+\sqrt{36}$ $=3+6$ $=9$ | $5\sqrt{4}+10\sqrt{9}$ $=5\cdot 2+10\cdot 3$ $=10+30$ $=40$

3. Convert the following entire radicals to mixed radicals in simplest form.

$\sqrt{12}$ $=\sqrt{4}\cdot\sqrt{3}$ $=2\sqrt{3}$ | $\sqrt{27}$ $=\sqrt{9}\cdot\sqrt{3}$ $=3\sqrt{3}$ | $\sqrt{32}$ $=\sqrt{16}\cdot\sqrt{2}$ $=4\sqrt{2}$ | $\sqrt{60}$ $=\sqrt{4}\cdot\sqrt{15}$ $=2\sqrt{15}$ | $\sqrt{72}$ $=\sqrt{36}\cdot\sqrt{2}$ $=6\sqrt{2}$ | $\sqrt{242}$ $=\sqrt{121}\cdot\sqrt{2}$ $=11\sqrt{2}$

4. Simplify the following.

$\sqrt{200}$ $=\sqrt{100}\cdot\sqrt{2}$ $=10\sqrt{2}$ | $\sqrt{36}$ $=6$ | $\sqrt{45}$ $=\sqrt{9}\cdot\sqrt{5}$ $=3\sqrt{5}$ | $\sqrt{49}$ $=7$ | $\sqrt{64}$ $=8$ | $\sqrt{108}$ $=\sqrt{36}\cdot\sqrt{3}$ $=6\sqrt{3}$

5. Simplify the following.

$\sqrt{18} = \sqrt{9}\cdot\sqrt{2}$
$= 3\sqrt{2}$

$5\sqrt{24} = 5\sqrt{4}\cdot\sqrt{6}$
$= 5\cdot 2\sqrt{6}$
$= 10\sqrt{6}$

$\sqrt{15} = \sqrt{15}$

$4\sqrt{20} = 4\cdot\sqrt{4}\cdot\sqrt{5}$
$= 4\cdot 2\sqrt{5}$
$= 8\sqrt{5}$

$6\sqrt{16} = 6\cdot 4$
$= 24$

$7\sqrt{17} = 7\sqrt{17}$

$8\sqrt{18} = 8\sqrt{9}\cdot\sqrt{2}$
$= 8\cdot 3\sqrt{2}$
$= 24\sqrt{2}$

$10\sqrt{98} = 10\sqrt{49}\cdot\sqrt{2}$
$= 10\cdot 7\cdot\sqrt{2}$
$= 70\sqrt{2}$

$\sqrt{18} = \sqrt{9}\cdot\sqrt{2}$
$= 3\sqrt{2}$

$5\sqrt{24} = 5\sqrt{4}\cdot\sqrt{6}$
$= 5\cdot 2\sqrt{6}$
$= 10\sqrt{6}$

$\sqrt{32} = \sqrt{16}\cdot\sqrt{2}$
$= 4\sqrt{2}$

$\sqrt{200} = \sqrt{100}\cdot\sqrt{2}$
$= 10\sqrt{2}$

6. Convert the following radicals to mixed radicals in simplest form.

$3\sqrt{12} = 3\sqrt{4}\cdot\sqrt{3} = 6\sqrt{3}$

$2\sqrt{32} = 2\sqrt{16}\cdot\sqrt{2} = 8\sqrt{2}$

$5\sqrt{24} = 5\sqrt{4}\cdot\sqrt{6} = 10\sqrt{6}$

$6\sqrt{98} = 6\sqrt{49}\cdot\sqrt{2} = 42\sqrt{2}$

$4\sqrt{200} = 4\sqrt{100}\cdot\sqrt{2} = 40\sqrt{2}$

$8\sqrt{18} = 8\sqrt{9}\sqrt{2} = 24\sqrt{2}$

7. Simplify the following.

$4\sqrt{8} = 4\sqrt{4}\cdot\sqrt{2} = 8\sqrt{2}$

$2\sqrt{16} = 2\cdot 4 = 8$

$16\sqrt{18} = 16\sqrt{9}\sqrt{2} = 48\sqrt{2}$

$32\sqrt{9} = 32\cdot 3 = 96$

$25\sqrt{25} = 25\cdot 5 = 125$

$4\sqrt{1} = 4$

8. Simplify the following.

$4\sqrt{4} = 4\cdot 2 = 8$

$2\sqrt{81} = 2\cdot 9 = 18$

$9\sqrt{25} = 9\cdot 5 = 45$

$3\sqrt{9} = 3\cdot 3 = 9$

$100\sqrt{2\bullet 18} = 100\sqrt{36} = 100\cdot 6 = 600$

$\sqrt{16\sqrt{16}} = \sqrt{16\cdot 4} = 4\cdot 2 = 8$

9. Convert the following mixed radicals to entire radicals.

$3\sqrt{2} = \sqrt{9}\cdot\sqrt{2} = \sqrt{18}$

$2\sqrt{3} = \sqrt{4}\cdot\sqrt{3} = \sqrt{12}$

$5\sqrt{6} = \sqrt{25}\sqrt{6} = \sqrt{150}$

$6\sqrt{7} = \sqrt{36}\cdot\sqrt{7} = \sqrt{252}$

$4\sqrt{10} = \sqrt{16}\cdot\sqrt{10} = \sqrt{160}$

$2\sqrt{11} = \sqrt{4}\cdot\sqrt{11} = \sqrt{44}$

Evaluate the Perfect Cubes

1^3	2^3	3^3	4^3	5^3	6^3	7^3	8^3	9^3	10^3
1	8	27	64	125	216	343	512	729	1000

1. Evaluate the following.

$\sqrt[3]{1} = 1$ $\quad \sqrt[3]{-8} = -2$ $\quad \sqrt[3]{27} = 3$ $\quad \sqrt[3]{\frac{27}{8}} = \frac{3}{2}$ $\quad \sqrt[3]{\frac{1000}{125}} = \frac{10}{5} = 2$ $\quad \sqrt[3]{\frac{10}{270}} = \sqrt[3]{\frac{1}{27}} = \frac{1}{3}$

2. Simplify the following. (mixed radical in simplest form where possible)

$\sqrt[3]{16} = \sqrt[3]{8}\cdot\sqrt[3]{2} = 2\sqrt[3]{2}$ $\quad \sqrt[3]{54} = \sqrt[3]{27}\cdot\sqrt[3]{2} = 3\sqrt[3]{2}$ $\quad \sqrt[3]{48} = \sqrt[3]{8}\cdot\sqrt[3]{6} = 2\sqrt[3]{6}$ $\quad 5\sqrt[3]{2000} = 5\sqrt[3]{1000}\cdot\sqrt[3]{2} = 5\cdot 10\sqrt[3]{2} = 50\sqrt[3]{2}$

3. Convert the following mixed radicals to entire radicals.

$2\sqrt[3]{3} = \sqrt[3]{8}\cdot\sqrt[3]{3} = \sqrt[3]{24}$ $\quad 3\sqrt[3]{2} = \sqrt[3]{27}\cdot\sqrt[3]{2} = \sqrt[3]{54}$ $\quad 2\sqrt[3]{4} = \sqrt[3]{8}\cdot\sqrt[3]{4} = \sqrt[3]{32}$ $\quad 5\sqrt[3]{10} = \sqrt[3]{125}\cdot\sqrt[3]{10} = \sqrt[3]{1250}$

4. Simplify the following. (mixed radical in simplest form where possible)

$2\sqrt[3]{16} = 2\cdot\sqrt[3]{8}\cdot\sqrt[3]{2} = 2\cdot 2\sqrt[3]{2} = 4\sqrt[3]{2}$ $\quad \sqrt[3]{216} = 6$ $\quad 4\sqrt[3]{8} = 4\cdot 2 = 8$ $\quad 3\sqrt[3]{8000} = 3\sqrt[3]{8}\cdot\sqrt[3]{1000} = 3\cdot 2\cdot 10 = 60$

Radicals & Variables

1. Simplify the following.

$\sqrt{x^2}$ $= x$ $\quad$ $\sqrt{x^4}$ $= x^2$ $\quad$ $\sqrt{x^6}$ $= x^3$ $\quad$ $\sqrt{x^{10}y^8}$ $= x^5y^4$ $\quad$ $\sqrt{16x^{16}}$ $= 4x^8$ $\quad$ $\sqrt{36x^8}$ $= 6x^4$

2. Simplify the following. (mixed radical in simplest form where possible)

$\sqrt{x^3} = \sqrt{x^2}\cdot\sqrt{x} = x\sqrt{x}$ $\quad$ $\sqrt{x^5} = \sqrt{x^4}\cdot\sqrt{x} = x^2\sqrt{x}$ $\quad$ $\sqrt{x^7} = \sqrt{x^6}\cdot\sqrt{x} = x^3\sqrt{x}$ $\quad$ $\sqrt{x^{15}} = \sqrt{x^{14}}\cdot\sqrt{x} = x^7\sqrt{x}$ $\quad$ $\sqrt{9x^9} = 3\sqrt{x^8}\sqrt{x} = 3x^4\sqrt{x}$ $\quad$ $\sqrt{18x^7} = \sqrt{9}\cdot\sqrt{x^6}\cdot\sqrt{2x} = 3x^3\sqrt{2x}$

$\sqrt{12x^3y^6} = \sqrt{4}\sqrt{x^2}y^3\sqrt{3x} = 2xy^3\sqrt{3x}$ $\quad$ $\sqrt{50x^{11}y^5} = \sqrt{25}\sqrt{x^{10}}\sqrt{y^4}\sqrt{2xy} = 5x^5y^2\sqrt{2xy}$ $\quad$ $\sqrt{36x^{16}y^9} = 6x^8\sqrt{y^8}\cdot\sqrt{y} = 6x^8y^4\sqrt{y}$

3. Simplify the following. (mixed radical in simplest form where possible)

$\sqrt[3]{8x^3} = 2x$ $\quad$ $\sqrt[3]{16x^{12}} = \sqrt[3]{8}\,x^4\sqrt[3]{2} = 2x^4\sqrt[3]{2}$ $\quad$ $3\sqrt[3]{16x^{10}} = 3\sqrt[3]{8}\sqrt[3]{x^9}\sqrt[3]{2x} = 6x^3\sqrt[3]{2x}$ $\quad$ $\sqrt[3]{27x^8y^4} = 3\sqrt[3]{x^6}\sqrt[3]{y^3}\sqrt[3]{x^2y} = 3x^2y\sqrt[3]{x^2y}$

4. The square root of large numbers

$\sqrt{720} = \sqrt{144}\cdot\sqrt{5} = \boxed{12\sqrt{5}}$

2 | 720
2 | 360
2 | 180
2 | 90
5 | 45
3 | 9
3 | 3
1

$2\cdot2\cdot2\cdot2\cdot3\cdot3\cdot5 = 720$
$(2\cdot2\cdot3)(2\cdot2\cdot3)\cdot5 = 720$
$12^2\cdot5 = 720$

$\sqrt{1944} = \sqrt{18^2}\cdot\sqrt{6} = \boxed{18\sqrt{6}}$

2 | 1944
2 | 972
2 | 486
3 | 243
3 | 81
3 | 27
3 | 9
3 | 3
1

$2\cdot2\cdot2\cdot3\cdot3\cdot3\cdot3 = 1944$
$(2\cdot3\cdot3)(2\cdot3\cdot3)(2\cdot3) = 1944$
$18^2\cdot6 = 1944$

$\sqrt{3375} = \sqrt{15^2}\cdot\sqrt{15} = \boxed{15\sqrt{15}}$

5 | 3375
5 | 675
5 | 135
3 | 27
3 | 9
3 | 3
1

$3\cdot3\cdot3\cdot5\cdot5\cdot5 = 3375$
$(3\cdot5)(3\cdot5)(3\cdot5) = 3375$
$15^2\cdot15 = 3375$

M10C Quiz – Exponents & Radicals C1-C4 **Name:** KEY

Evaluate each of the following and record on the Numerical Response Answer Sheet provided:

1. $\sqrt{81} = \boxed{9}$

2. $\sqrt[3]{64} = \boxed{4}$

3. $\dfrac{\sqrt{144}}{36^{\frac{1}{2}}} = \dfrac{12}{6} = \boxed{2}$

4. $\dfrac{\sqrt{100}}{\sqrt[3]{8}} = \dfrac{10}{2} = \boxed{5}$

Express each entire radical as a mixed radical in simplest form. Your final answer should be in the form $a\sqrt{b}$ or $a\sqrt[3]{b}$. For each question please record the value of a followed by the value of b on the Numerical Response Answer Sheet provided.

5. $\sqrt{50} = \sqrt{25}\cdot\sqrt{2}$
$= \boxed{5\sqrt{2}}$

6. $\sqrt{20} = \sqrt{4}\cdot\sqrt{5}$
$= \boxed{2\sqrt{5}}$

7. $3\sqrt{27} = 3\cdot\sqrt{9}\cdot\sqrt{3}$
$= \boxed{9\sqrt{3}}$

8. $\sqrt{48} = \sqrt{16}\cdot\sqrt{3}$
$= \boxed{4\sqrt{3}}$

9. $\sqrt[3]{32} = \sqrt[3]{8}\cdot\sqrt[3]{4}$
$= \boxed{2\sqrt[3]{4}}$

10. $2\sqrt[3]{54} = 2\sqrt[3]{27}\cdot\sqrt[3]{2}$
$= \boxed{6\sqrt[3]{2}}$

Express each mixed radical as an entire radical. Your final answer should be in the form $\sqrt{b}$ or $\sqrt[3]{b}$. For each question please record the value of b on the Numerical Response Answer Sheet provided.

11. $5\sqrt{10} = \sqrt{25}\cdot\sqrt{10}$
$= \boxed{\sqrt{250}}$

12. $2\sqrt[3]{5} = \sqrt[3]{8}\cdot\sqrt[3]{5}$
$= \boxed{\sqrt[3]{40}}$

Math 10-C Basic Exponents Review **Name:** KEY

The Meaning of an Exponent

2^3 = $2 \bullet 2 \bullet 2$ = 8

as a power (exponential form) | as a product (3 factors of the base 2) | standard form

3^2
$= 3 \bullet 3$
$= 9$

4^3
$= 4 \cdot 4 \cdot 4$
$= 64$

5^2
$= 5 \cdot 5$
$= 25$

7^2
$= 7 \cdot 7$
$= 49$

12^2
$= 12 \cdot 12$
$= 144$

Just as -7 means $-1 \bullet 7$ so does -2^3 mean $-1 \bullet 2^3$ and so $-1 \bullet 2 \bullet 2 \bullet 2 = -8$

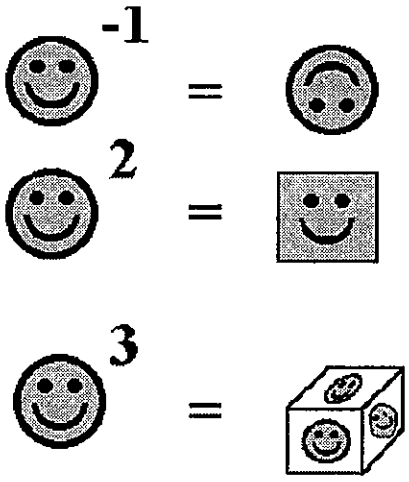
-3^2
$= -1 \bullet 3 \bullet 3$
$= -9$

-4^3
$= -1 \cdot 4 \cdot 4 \cdot 4$
$= -64$

-5^2
$= -1 \cdot 5 \cdot 5$
$= -25$

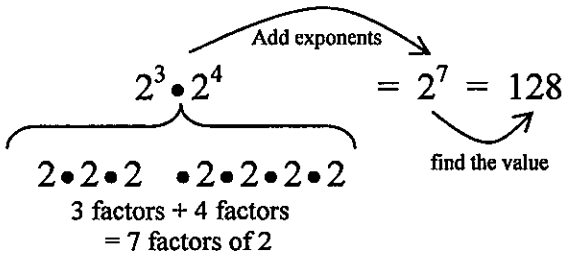
-7^2
$= -1 \cdot 7 \cdot 7$
$= -49$

-12^2
$= -1 \cdot 12 \cdot 12$
$= -144$

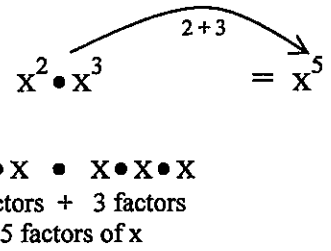


The Product Rule

Numbers as powers



Variables



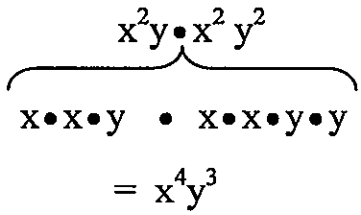
In general: Add exponents $x^m \bullet x^n = x^{m+n}$

Simplify the following

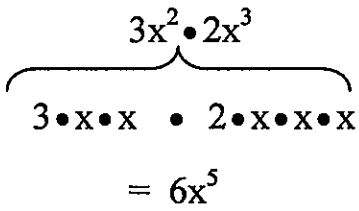
$2^2 \bullet 2^4 = 2^6$ $\quad 3^5 \bullet 3^4 = 3^9$ $\quad 4^{12} \bullet 4^4 = 4^{16}$ $\quad 5^3 \bullet 5^2 \bullet 5^1 = 5^6$

$x^2 \bullet x^4 = x^6$ $\quad y^2 \bullet y^4 = y^6$ $\quad x^2 \bullet x^4 \bullet x^5 = x^{11}$ $\quad x \bullet x \bullet x^3 = x^5$

Multiple variables



Numbers and Variables



Simplify the following

$xy^2 \bullet xy^4$ $= x^2y^6$ $\quad xy^2 \bullet x^4y$ $= x^5y^3$ $\quad 2x^2 \bullet 3x^4$ $= 6x^6$ $\quad 2x^2 \bullet 2x^4$ $= 4x^6$

$2x^2y \bullet 3xy^4$ $= 6x^3y^5$ $\quad 2x^2y \bullet 3xy^4 \bullet 4x^3y^5$ $= 24x^6y^{10}$ $\quad -y^2 \bullet -y$ $= y^3$ $\quad -2x^2 \bullet 2x^4 \bullet -2x^4$ $= 8x^{10}$

$(x^2y^2)(x^5y^4)$ $= x^7y^6$ $\quad (x^7y^2)(x^3y^8)$ $= x^{10}y^{10}$ $\quad (2xy^2)(4xy)$ $= 8x^2y^3$ $\quad (3x^5y)(5x^3y)$ $= 15x^8y^2$

The Quotient Rule

$$x^5 \div x^2 = \frac{x^5}{x^2} = \frac{x \bullet x \bullet x \bullet x \bullet x}{x \bullet x} = x^3$$

subtract exponents: $5-2$

$$x^5y^3 \div x^2y = \frac{x^5y^3}{x^2y} = \frac{x \bullet x \bullet x \bullet x \bullet x \bullet y \bullet y \bullet y}{x \bullet x \bullet y} = x^3y^2$$

subtract exponents: $5-2 \quad 3-1$

In general: $x^m \div x^n = x^{m-n}$	$x^a y^b \div x^c y^d = x^{a-c} y^{b-d}$

Simplify the following

$x^5 \div x^2 = x^3$ $\quad$ $y^7 \div y^4 = y^3$ $\quad$ $x^5y^8 \div xy^2 = x^4y^6$ $\quad$ $x^6y^2 \div xy = x^5y$

$\frac{x^7}{x^3} = x^4$ $\quad$ $\frac{x^{25}}{x^5} = x^{20}$ $\quad$ $\frac{x^6y^4}{x^3y^2} = x^3y^2$ $\quad$ $\frac{x^6y^4}{xy} = x^5y^3$

$\frac{10x^4}{2x^3} = 5x$ $\quad$ $\frac{12x^{12}}{2x^2} = 6x^{10}$ $\quad$ $\frac{30x^2y^4}{15xy^3} = 2xy$ $\quad$ $\frac{45x^{10}y^6}{9x^8y} = 5x^2y^5$

$\frac{4x^4}{12x^3} = \frac{1}{3} \cdot x = \frac{x}{3}$ $\quad$ $\frac{4x^{12}}{14x^2} = \frac{2}{7} \cdot x^{10} = \frac{2x^{10}}{7}$ $\quad$ $\frac{18x^2y^4}{12xy^3} = \frac{3xy}{2}$ $\quad$ $\frac{1200x^{100}y^{60}}{500x^{99}y^{59}} = \frac{12xy}{5}$

$12x^4 \div 2x^2 = 6x^2$ $\quad$ $2x^7 \div 10x^2 = \frac{x^5}{5}$ $\quad$ $-12x^2y^6 \div 3xy^4 = -4xy^2$ $\quad$ $12x^2y^3 \div -24xy^2 = -\frac{xy}{2}$

THE WORLD OF BRACKETS

Recall: the exponent relates to the variable or number it is directly beside

$2xy^3 = 2 \bullet x \bullet y \bullet y \bullet y$

And $-2xy^3 = -1 \bullet 2 \bullet x \bullet y \bullet y \bullet y$

The ONLY way the exponent relates to MORE than the variable or number it is directly beside is with . . . BRACKETS!

$(2xy)^3 = (2xy)(2xy)(2xy) = 8x^3y^3$

$2(xy)^3 = 2(xy)(xy)(xy) = 2x^3y^3$

$(-2xy)^3 = (-2xy)(-2xy)(-2xy) = -8x^3y^3$

SO:

$\left(\frac{2}{3}\right)^2$ $(x^3)^2$ $(x^7)^2$ $(x^3y)^2$ $(3x^3y)^2$

$= \left(\frac{2}{3}\right)\left(\frac{2}{3}\right)$ $= (x^3)(x^3)$ $= (x^7)(x^7)$ $= (x^3y)(x^3y)$ $= (3x^3y)(3x^3y)$

$= \left(\frac{4}{9}\right)$ $= x^6$ $= x^{14}$ $= x^6y^2$ $= 9x^6y^2$

<u>The Power Rule</u>

When a power is raised to an exponent, we multiply exponents.

$(x^m)^n = x^{mn}$ $(x^a y^b)^c = x^{ac}y^{bc}$ $\left(\frac{x^a}{y^b}\right)^c = \frac{x^{ac}}{y^{bc}}$

Simplify the following

$(x^2)^3 = x^6$ $(x^4)^5 = x^{20}$ $(x^2y^3)^3 = x^6y^9$ $(x^5y)^6 = x^{30}y^6$

$(2^2)^3 = 2^6$ $(2x^4)^3 = 8x^{12}$ $\left(\frac{x^2}{y^3}\right)^3 = \frac{x^6}{y^9}$ $\left(\frac{x^5}{y^2}\right)^7 = \frac{x^{35}}{y^{14}}$

$= 64$

$4(xy^4)^2 = 4x^2y^8$ $\left(\frac{2^3}{5}\right)^2 = \frac{2^6}{5}$ $\left(\frac{3x^2}{2y^3}\right)^3 = \frac{27x^6}{8y^9}$ $\left(\frac{12xy^3}{6z^2}\right)^3 = \left(\frac{2xy^3}{z^2}\right)^3$

$= \frac{64}{5}$ $= \frac{8x^3y^9}{z^6}$

Math 10-C Investigate Negative Exponents Name: KEY

Complete the chart by dividing each row by 2.

Exponential Form	Expanded Form	Value
2^3	$2 \cdot 2 \cdot 2$	8
$\frac{2^3}{2} = 2^{3-1} = 2^2$	$\frac{2 \cdot 2 \cdot 2}{2} = 2 \cdot 2$	4
$\frac{2^2}{2} = 2^{2-1} = 2^1$	$\frac{2 \cdot 2}{2} = 2$	2
$\frac{2}{2} = 2^{1-1} = 2^0$	$\frac{2}{2} = 1$	1
$\frac{2^0}{2} = 2^{0-1} = 2^{-1}$	$\frac{1}{2}$	$\frac{1}{2}$ $\frac{1}{2^1}$
$\frac{2^{-1}}{2} = 2^{-1-1} = 2^{-2}$	$\frac{1}{2} \div 2 = \frac{1}{2 \cdot 2}$	$\frac{1}{4}$ $\frac{1}{2^2}$
$\frac{2^{-2}}{2} = 2^{-2-1} = 2^{-3}$	$\frac{1}{2 \cdot 2} \div 2 = \frac{1}{2 \cdot 2 \cdot 2}$	$\frac{1}{8}$ $\frac{1}{2^3}$

Complete the chart by dividing each row by 3.

Exponential Form	Expanded Form	Value
3^2	$3 \cdot 3$	9
$\frac{3^2}{3} = 3^{2-1} = 3^1$	3	3
$\frac{3^1}{3} = 3^{1-1} = 3^0$	$\frac{3}{3} = 1$	1
$\frac{3^0}{3} = 3^{0-1} = 3^{-1}$	$\frac{1}{3}$	$\frac{1}{3}$ $\frac{1}{3^1}$
$\frac{3^{-1}}{3} = 3^{-1-1} = 3^{-2}$	$\frac{1}{3} \div 3 = \frac{1}{3 \cdot 3}$	$\frac{1}{9}$ $\frac{1}{3^2}$
$\frac{3^{-2}}{3} = 3^{-2-1} = 3^{-3}$	$\frac{1}{3 \cdot 3} \div 3 = \frac{1}{3 \cdot 3 \cdot 3}$	$\frac{1}{27}$ $\frac{1}{3^3}$

Based on the patterns in the previous charts, please determine the value of the following:

$4^{-1} = \frac{1}{4}$ $4^{-2} = \frac{1}{16}$ $4^{-3} = \frac{1}{64}$

$5^{-1} = \frac{1}{5}$ $5^{-2} = \frac{1}{25}$ $5^{-3} = \frac{1}{125}$

$6^{-1} = \frac{1}{6}$ $6^{-2} = \frac{1}{36}$ $6^{-3} = \frac{1}{216}$

$8^{-2} = \frac{1}{8^2} = \frac{1}{64}$ $7^{-2} = \frac{1}{7^2} = \frac{1}{49}$ $10^{-3} = \frac{1}{10^3} = \frac{1}{1000}$

$12^{-1} = \frac{1}{12}$ $2^{-4} = \frac{1}{2^4} = \frac{1}{16}$ $9^{-2} = \frac{1}{9^2} = \frac{1}{81}$

$7^{-3} = \frac{1}{7^3} = \frac{1}{343}$ $144^{-1} = \frac{1}{144}$ $10^{-4} = \frac{1}{10^4} = \frac{1}{10\,000}$

M10C - Exp + Rad. Powers w/ Rational Bases

1. a) $16^{\frac{1}{2}} = \sqrt{16} = \boxed{4}$

b) $100^{\frac{1}{2}} = \sqrt{100} = \boxed{10}$

c) $8^{\frac{1}{3}} = \sqrt[3]{8} = \boxed{2}$

d) $64^{\frac{1}{3}} = \sqrt[3]{64} = \boxed{4}$

e) $(-8)^{\frac{1}{3}} = \sqrt[3]{-8} = \boxed{-2}$

f) $\left(\frac{1}{4}\right)^{\frac{1}{2}} = \sqrt{\frac{1}{4}} = \boxed{\frac{1}{2}}$

g) $\left(\frac{49}{144}\right)^{\frac{1}{2}} = \sqrt{\frac{49}{144}} = \boxed{\frac{7}{12}}$

h) $\left(\frac{8}{27}\right)^{\frac{1}{3}} = \sqrt[3]{\frac{8}{27}} = \boxed{\frac{2}{3}}$

2. a) $50^{\frac{1}{2}} = \sqrt{50} = \sqrt{25}\cdot\sqrt{2} = \boxed{5\sqrt{2}}$

b) $48^{\frac{1}{2}} = \sqrt{48} = \sqrt{16}\cdot\sqrt{3} = \boxed{4\sqrt{3}}$

c) $500^{\frac{1}{2}} = \sqrt{500} = \sqrt{100}\cdot\sqrt{5} = \boxed{10\sqrt{5}}$

d) $16^{\frac{1}{3}} = \sqrt[3]{16} = \sqrt[3]{8}\cdot\sqrt[3]{2} = \boxed{2\sqrt[3]{2}}$

e) $81^{\frac{1}{3}} = \sqrt[3]{81} = \sqrt[3]{27}\cdot\sqrt[3]{3} = \boxed{3\sqrt[3]{3}}$

f) $(-40)^{\frac{1}{3}} = \sqrt[3]{-40} = \sqrt[3]{-8}\cdot\sqrt[3]{5} = \boxed{-2\sqrt[3]{5}}$

3. a) $9^{\frac{3}{2}} = \left(\sqrt{9}\right)^3 = 3^3 = \boxed{27}$

b) $64^{\frac{2}{3}} = \left(\sqrt[3]{64}\right)^2 = 4^2 = \boxed{16}$

c) $(-27)^{\frac{4}{3}} = \left(\sqrt[3]{-27}\right)^4 = (-3)^4 = \boxed{81}$

d) $\left(\frac{27}{8}\right)^{\frac{2}{3}} = \left(\sqrt[3]{\frac{27}{8}}\right)^2 = \left(\frac{3}{2}\right)^2 = \boxed{\frac{9}{4}}$

e) $\left(\frac{-27}{64}\right)^{\frac{2}{3}} = \left(\sqrt[3]{\frac{-27}{64}}\right)^2 = \left(\frac{-3}{4}\right)^2 = \boxed{\frac{9}{16}}$

f) $\left(\frac{4}{25}\right)^{\frac{3}{2}} = \left(\sqrt{\frac{4}{25}}\right)^3 = \left(\frac{2}{5}\right)^3 = \boxed{\frac{8}{125}}$

4. a) $3^{\frac{1}{2}} \cdot 3^{\frac{3}{2}} = 3^{\frac{1}{2}+\frac{3}{2}}$
$= 3^{\frac{4}{2}}$
$= 3^2$
$= \boxed{9}$

b) $\sqrt[3]{7} \cdot 7^{\frac{2}{3}} = 7^{\frac{1}{3}} \cdot 7^{\frac{2}{3}}$
$= 7^{\frac{3}{3}}$
$= 7^1$
$= \boxed{7}$

c) $\frac{8^{\frac{5}{2}}}{8^{\frac{1}{2}}} = 8^{\frac{5}{2}-\frac{1}{2}}$
$= 8^{\frac{4}{2}}$
$= 8^2$
$= \boxed{64}$

d) $\frac{4^{\frac{5}{6}}}{4^{\frac{1}{3}}} = 4^{\frac{5}{6}-\frac{1}{3}}$
$= 4^{\frac{5}{6}-\frac{2}{6}}$
$= 4^{\frac{3}{6}}$
$= 4^{\frac{1}{2}}$
$= \sqrt{4}$
$= \boxed{2}$

e) $\left(5^{\frac{2}{3}}\right)^3 = 5^2$
$= \boxed{25}$

f) $\left(3^{\frac{3}{4}}\right)^{\frac{4}{3}} = 3^1$
$= \boxed{3}$

g) $(2^6 \cdot 3^2)^{\frac{1}{2}} = 2^3 \cdot 3^1$
$= 8 \cdot 3$
$= \boxed{24}$

h) $(\sqrt{3} \cdot \sqrt[3]{2})^6 = (3^{\frac{1}{2}} \cdot 2^{\frac{1}{3}})^6$
$= 3^3 \cdot 2^2$
$= 27 \cdot 4$
$= \boxed{108}$

i) $\left(\frac{6^4}{2^2}\right)^{\frac{1}{2}} = \frac{6^2}{2}$
$= \frac{36}{2}$
$= \boxed{18}$

j) $\left(\frac{3^{\frac{1}{2}}}{\sqrt[4]{5}}\right)^8 = \left(\frac{3^{\frac{1}{2}}}{5^{\frac{1}{4}}}\right)^8$
$= \frac{3^4}{5^2}$
$= \boxed{\frac{81}{25}}$

k) $\left(5^{\frac{1}{6}} \cdot 5^{\frac{5}{6}}\right)^6 = 5 \cdot 5^2$
$= 5^3$
$= \boxed{125}$

l) $\frac{2^5 \cdot 3^3}{2^3 \cdot 3} = (2^2 \cdot 3^2)^{\frac{1}{2}}$
$= 2 \cdot 3$
$= \boxed{6}$

5. a) $3^{-2} = \frac{1}{3^2}$
$= \boxed{\frac{1}{9}}$

b) $2^{-4} = \frac{1}{2^4}$
$= \boxed{\frac{1}{16}}$

c) $6 \cdot 3^{-2} = 6 \cdot \frac{1}{3^2}$
$= 6 \cdot \frac{1}{9}$
$= \frac{6}{9}$
$= \boxed{\frac{2}{3}}$

d) $(-7)^{-2} = \frac{1}{(-7)^2}$
$= \boxed{\frac{1}{49}}$

e) $\frac{1}{2^{-3}} = 2^3$
$= \boxed{8}$

f) $\frac{1}{4^{-2}} = 4^2$
$= \boxed{16}$

g) $\frac{3}{4^{-2}} = 3 \cdot 4^2$
$= 3 \cdot 16$
$= \boxed{48}$

h) $\frac{3^{-2}}{2^{-3}} = \frac{2^3}{3^2}$
$= \boxed{\frac{8}{9}}$

i) $\left(\frac{1}{2}\right)^{-2} = 2^2$
$= \boxed{4}$

j) $\left(-\frac{2}{3}\right)^{-3} = \left(-\frac{3}{2}\right)^3$
$= \boxed{\frac{-27}{8}}$

6. a) $8^5 \cdot 8^{-3} = 8^2$
$= \boxed{64}$

b) $5^{-2} \cdot 5^{-1} = 5^{-3}$
$= \frac{1}{5^3}$
$= \boxed{\frac{1}{125}}$

c) $2^{-3} \cdot 3^2 = \frac{1}{2^3} \cdot 9$
$= \boxed{\frac{9}{8}}$

d) $\frac{7^2}{7^{-1}} = 7^2 \cdot 7^1$
$= 7^3$
$= \boxed{343}$

e) $\frac{3^{-5}}{3^{-2}} = 3^{-3}$
$= \frac{1}{3^3}$
$= \boxed{\frac{1}{27}}$

f) $(2^{-2})^2 = 2^{-4}$
$= \frac{1}{2^4}$
$= \boxed{\frac{1}{16}}$

g) $(3^2)^{-1} = 3^{-2}$
$= \frac{1}{3^2}$
$= \boxed{\frac{1}{9}}$

h) $(2^{-3} \cdot 5)^{-2} = 2^6 \cdot 5^{-2}$
$= 2^6 \cdot \frac{1}{5^2}$
$= \boxed{\frac{64}{25}}$

i) $\left(\frac{1}{5^{-2}}\right)^{-1} = (5^2)^{-1}$
$= 5^{-2}$
$= \frac{1}{5^2}$
$= \boxed{\frac{1}{25}}$

j) $\left(\frac{4^{-1}}{3^{-2}}\right)^{-2} = \frac{4^2}{3^4}$
$= \boxed{\frac{16}{81}}$

k) $\left(\frac{6^2 \cdot 6^{-5}}{6^{-4}}\right)^{-2} = \left(\frac{6^{-3}}{6^{-4}}\right)^{-2}$
$= (6)^{-2}$
$= \frac{1}{6^2}$
$= \boxed{\frac{1}{36}}$

l) $\left(\frac{3^{-2} \cdot 4^{-3}}{3 \cdot 4^{-4}}\right)^{-1} = (3^{-3} \cdot 4)^{-1}$
$= 3^3 \cdot 4^{-1}$
$= \boxed{\frac{27}{4}}$

7. a) $16^{-\frac{1}{2}} = \frac{1}{16^{\frac{1}{2}}} = \frac{1}{\sqrt{16}} = \boxed{\frac{1}{4}}$

b) $49^{-\frac{1}{2}} = \frac{1}{49^{\frac{1}{2}}} = \frac{1}{\sqrt{49}} = \boxed{\frac{1}{7}}$

c) $(-8)^{-\frac{1}{3}} = \frac{1}{(-8)^{\frac{1}{3}}} = \frac{1}{\sqrt[3]{-8}} = \boxed{-\frac{1}{2}}$

d) $125^{-\frac{1}{3}} = \frac{1}{125^{\frac{1}{3}}} = \frac{1}{\sqrt[3]{125}} = \boxed{\frac{1}{5}}$

e) $\frac{1}{9^{-\frac{1}{2}}} = 9^{\frac{1}{2}} = \sqrt{9} = \boxed{3}$

f) $\frac{5}{64^{-\frac{1}{3}}} = 5 \cdot 64^{\frac{1}{3}} = 5\sqrt[3]{64} = 5 \cdot 4 = \boxed{20}$

g) $\left(\frac{1}{81}\right)^{-\frac{1}{2}} = 81^{\frac{1}{2}} = \sqrt{81} = \boxed{9}$

h) $\left(\frac{25}{144}\right)^{-\frac{1}{2}} = \left(\frac{144}{25}\right)^{\frac{1}{2}} = \sqrt{\frac{144}{25}} = \boxed{\frac{12}{5}}$

i) $\left(\frac{343}{216}\right)^{-\frac{1}{3}} = \left(\frac{216}{343}\right)^{\frac{1}{3}} = \sqrt[3]{\frac{216}{343}} = \boxed{\frac{6}{7}}$

j) $\frac{36^{-\frac{1}{2}}}{27^{-\frac{1}{3}}} = \frac{27^{\frac{1}{3}}}{36^{\frac{1}{2}}} = \frac{\sqrt[3]{27}}{\sqrt{36}} = \frac{3}{6} = \boxed{\frac{1}{2}}$

8 a) $9^{-\frac{3}{2}} = \frac{1}{9^{\frac{3}{2}}} = \frac{1}{\left(\sqrt{9}\right)^3} = \frac{1}{3^3} = \boxed{\frac{1}{27}}$

b) $27^{-\frac{4}{3}} = \frac{1}{27^{\frac{4}{3}}} = \frac{1}{\left(\sqrt[3]{27}\right)^4} = \frac{1}{3^4} = \boxed{\frac{1}{81}}$

c) $\frac{1}{4^{-\frac{5}{2}}} = 4^{\frac{5}{2}} = \left(\sqrt{4}\right)^5 = 2^5 = \boxed{32}$

d) $\frac{-2}{216^{-\frac{2}{3}}} = -2 \cdot 216^{\frac{2}{3}}$
$= -2\left(\sqrt[3]{216}\right)^2$
$= -2(6)^2$
$= -2(36)$
$= \boxed{-72}$

e) $\left(\frac{-8}{27}\right)^{-\frac{2}{3}} = \left(-\frac{27}{8}\right)^{\frac{2}{3}}$
$= \left(\sqrt[3]{\frac{-27}{8}}\right)^2$
$= \left(-\frac{3}{2}\right)^2$
$= \boxed{\frac{9}{4}}$

f) $\left(\frac{81}{16}\right)^{-\frac{3}{4}} = \left(\frac{16}{81}\right)^{\frac{3}{4}}$
$= \left(\sqrt[4]{\frac{16}{81}}\right)^3$
$= \left(\frac{2}{3}\right)^3$
$= \boxed{\frac{8}{27}}$

9. a) $4^2 \cdot 4^{-\frac{3}{2}} = 4^{2-\frac{3}{2}}$
$= 4^{\frac{4}{2}-\frac{3}{2}}$
$= 4^{\frac{1}{2}}$
$= \sqrt{4}$
$= \boxed{2}$

b) $9^{-\frac{1}{4}} \cdot 9^{-\frac{1}{4}} = 9^{-\frac{1}{4}-\frac{1}{4}}$
$= 9^{-\frac{2}{4}}$
$= 9^{-\frac{1}{2}}$
$= \frac{1}{\sqrt{9}}$
$= \boxed{\frac{1}{3}}$

c) $\frac{5^{-\frac{1}{2}}}{5^{\frac{1}{2}}} = 5^{-\frac{1}{2}-\frac{1}{2}}$
$= 5^{-1}$
$= \boxed{\frac{1}{5}}$

d) $\frac{16^{-1}}{16^{-\frac{5}{4}}} = 16^{-1+\frac{5}{4}}$
$= 16^{-\frac{4}{4}+\frac{5}{4}}$
$= 16^{\frac{1}{4}}$
$= \sqrt[4]{16}$
$= \boxed{2}$

e) $\left(6^{-\frac{3}{7}}\right)^7 = 6^{-2}$
$= \frac{1}{6^2}$
$= \boxed{\frac{1}{36}}$

f) $\left(2^{\frac{1}{2}} \cdot 3^{\frac{1}{4}}\right)^{-8} = 2^{-4} \cdot 3^{-2}$
$= \frac{1}{2^4} \cdot \frac{1}{3^2}$
$= \frac{1}{16} \cdot \frac{1}{9}$
$= \boxed{\frac{1}{144}}$

g) $\left(\frac{1}{144^{-\frac{1}{4}}}\right)^2 = \left(144^{\frac{1}{4}}\right)^2$
$= 144^{\frac{1}{2}}$
$= \sqrt{144}$
$= \boxed{12}$

h) $\left(\frac{4^{-6}}{3^{-9}}\right)^{\frac{1}{3}} = \frac{4^{-2}}{3^{-3}}$
$= \frac{3^3}{4^2}$
$= \boxed{\frac{27}{16}}$

i) $\left(\frac{5^6 \cdot 5^{-9}}{5^3}\right)^{\frac{1}{3}} = \left(\frac{5^{-3}}{5^3}\right)^{\frac{1}{3}}$
$= \left(5^{-6}\right)^{\frac{1}{3}}$
$= 5^{-2}$
$= \frac{1}{5^2}$
$= \boxed{\frac{1}{25}}$

j) $\left(\frac{6^{-1}\cdot 2^{\frac{1}{3}}}{6^{-\frac{1}{2}}\cdot 2^{-\frac{1}{2}}}\right)^{-6} = \frac{6^{6}\cdot 2^{-2}}{6^{3}\cdot 2^{3}}$

$= 6^{3}\cdot 2^{-5}$

$= 6^{3}\cdot\frac{1}{2^{5}}$

$= \frac{216}{32}$

$= \boxed{\frac{27}{4}}$

2	216 32
2	108 16
2	54 8
	27 4

k) $\frac{5^{-2}}{125^{\frac{1}{3}}} = \frac{5^{-2}}{\sqrt[3]{125}}$

$= \frac{5^{-2}}{5}$

$= 5^{-3}$

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

$= \boxed{\frac{1}{125}}$

l) $\left(8^{\frac{2}{3}}\right)\left(16^{\frac{3}{2}}\right) = \left(\sqrt[3]{8}\right)^{2}\cdot\left(\sqrt{16}\right)^{3}$

$= 2^{2}\cdot 4^{3}$

$= 4\cdot 64$

$= \boxed{256}$

10. a) $4^{0} = \boxed{1}$ b) $\frac{1}{6^{0}} = \frac{1}{1}$ c) $2\cdot 5^{0} = 2\cdot 1$

$= \boxed{1}$ $= \boxed{2}$

d) $\left(\frac{35}{41}\right)^{0} = \boxed{1}$ e) $\left(\frac{4^{7}\cdot 4^{-\frac{3}{2}}}{5^{\frac{2}{5}}\cdot 7^{-5}}\right)^{0} = \boxed{1}$

M10C Exponents & Radicals Quiz (Rational Bases) /25

Name: KEY

Date: _____

1. $81^{\frac{1}{2}} =$ 9

2. $\left(\frac{16}{49}\right)^{\frac{1}{2}} =$ $\frac{4}{7}$

3. $125^{\frac{1}{3}} =$ 5

4. $\left(\frac{27}{8}\right)^{\frac{1}{3}} =$ $\frac{3}{2}$

5. $27^{\frac{2}{3}} =$ 9

6. $2^{\frac{1}{2}} \cdot 2^{\frac{5}{2}} =$ 8

7. $\frac{5^{\frac{4}{3}}}{5^{\frac{1}{3}}} =$ 5

8. $\left(\sqrt[3]{7}\right)^3 =$ 7

9. $\left(9^{\frac{1}{4}}\right)^2 =$ 3

10. $\left(3^{\frac{1}{3}} \cdot 3^{\frac{1}{6}}\right)^6 =$ 27

11. $5^{-2} =$ $\frac{1}{25}$

12. $(-5)^{-2} =$ $\frac{1}{25}$

13. $4 \cdot 2^{-3} =$ $\frac{1}{2}$

14. $\frac{1}{3^{-2}} =$ 9

15. $\left(\frac{3}{4}\right)^{-3} =$ $\frac{64}{27}$

16. $10^{-2} \cdot 10^{4} =$ 100

17. $\frac{3^{-2}}{3^{-5}} =$ 27

18. $\left(4^{-1}\right)^{3} =$ $\frac{1}{64}$

19. $\left(\frac{5^{-1}}{2^{-2}}\right)^{-2} =$ $\frac{25}{16}$

20. $\left(\frac{6^{-5} \cdot 6^{-3}}{6^{-7}}\right)^{-2} =$ 36

21. $16^{-\frac{1}{2}} =$ $\frac{1}{4}$

22. $(64)^{-\frac{1}{3}} =$ $\frac{1}{4}$

23. $\frac{1}{121^{-\frac{1}{2}}} =$ 11

24. $\left(\frac{36}{49}\right)^{-\frac{1}{2}} =$ $\frac{7}{6}$

25. $9^{-\frac{3}{2}} =$ $\frac{1}{27}$

Powers w/ Variable Bases

KEY

1. a) $c^{-4} = \boxed{\frac{1}{c^4}}$ b) $(-x)^{-2} = \frac{1}{(-x)^2} = \boxed{\frac{1}{x^2}}$ c) $3x^{-3} = \boxed{\frac{3}{x^3}}$

d) $4m^3n^{-2} = \boxed{\frac{4m^3}{n^2}}$ e) $-5x^{-3}y^{-2} = \boxed{\frac{-5}{x^3y^2}}$ f) $\frac{1}{a^{-3}} = \boxed{a^3}$

g) $\frac{3}{x^{-4}} = \boxed{3x^4}$ h) $\frac{a^{-2}}{b^{-5}} = \boxed{\frac{b^5}{a^2}}$ i) $\left(\frac{x}{y^2}\right)^{-5} = \left(\frac{y^2}{x}\right)^5 = \boxed{\frac{y^{10}}{x^5}}$

j) $\left(\frac{-2a}{b}\right)^{-3} = \left(-\frac{b}{2a}\right)^3 = \boxed{-\frac{b^3}{8a^3}}$

2. a) $c^{-4} \cdot c^{-3} = c^{-7} = \boxed{\frac{1}{c^7}}$ b) $\frac{m^3}{m^{-6}} = \boxed{m^9}$ c) $(a^{-3})^2 = a^{-6} = \boxed{\frac{1}{a^6}}$

d) $(4xy^{-3})^{-2} = 4^{-2}x^{-2}y^6 = \boxed{\frac{y^6}{16x^2}}$ e) $-4x(5x)^3 = -4x(125x^3) = \boxed{-500x^4}$ f) $\left(\frac{m^{-2}}{n^{-4}}\right)^{-3} = \boxed{\frac{m^6}{n^{12}}}$

g) $(2xy^2)(3x^{-1}y^0) = 6x^0y^2 = \boxed{6y^2}$ h) $(-3m^2n)(-4m^4n^{-2}) = 12m^6n^{-1} = \boxed{\frac{12m^6}{n}}$

i) $\left(\frac{mn^3}{m^2n}\right)^2 = (m^{-1}n^2)^2 = m^{-2}n^4 = \boxed{\frac{n^4}{m^2}}$ j) $\left(\frac{6a^{-3}b^5}{4a^2b^3}\right)^{-3} = \left(\frac{3}{2}a^{-5}b^2\right)^{-3} = \left(\frac{3}{2}\right)^{-3}a^{15}b^{-6} = \left(\frac{2}{3}\right)^3a^{15}b^{-6} = \boxed{\frac{8a^{15}}{27b^6}}$

k) $\frac{x^3y^{-2}}{(xy^4)(x^4y^3)} = \frac{x^3y^{-2}}{x^6y^6} = x^{-3}y^{-8} = \boxed{\frac{1}{x^3y^8}}$

3. a) $a^{\frac{3}{2}} \cdot a^{\frac{5}{2}} = a^{\frac{8}{2}} = \boxed{a^4}$

b) $x^{\frac{1}{2}} \cdot \left(x^{\frac{1}{2}}\right)^7 = x^{\frac{1}{2}} \cdot x^{\frac{7}{2}} = x^{\frac{8}{2}} = \boxed{x^4}$

c) $3m^{\frac{2}{4}} m^{\frac{1}{4}} = 3m^{\frac{8}{4} \cdot \frac{1}{4}} = \boxed{3m^{\frac{9}{4}}}$

d) $x^{\frac{1}{4}} \div x^{-\frac{3}{4}} = x^{\frac{1}{4} - (-\frac{3}{4})} = \boxed{x}$

e) $y^{\frac{7}{3}} \div y^{\frac{1}{3}} = y^{\frac{6}{3}} = \boxed{y^2}$

f) $\left(c^{\frac{3}{5}}\right)^5 = \boxed{c^3}$

g) $\left(x^{\frac{2}{3}} \cdot y^{\frac{4}{3}}\right)^3 = \boxed{x^2 y^4}$

h) $\left(\frac{25c^6}{16b^4}\right)^{\frac{1}{2}} = \boxed{\frac{5c^3}{4b^2}}$

i) $\left(\frac{5x^3}{20x}\right)^{\frac{1}{2}} = \left(\frac{x^2}{4}\right)^{\frac{1}{2}} = \boxed{\frac{x}{2}}$

j) $\frac{a^9 b^4}{a^7 b^0} = \left(a^2 b^4\right)^{\frac{1}{2}} = \boxed{ab^2}$

4. a) $c^{-\frac{1}{5}} \cdot c^{-\frac{6}{5}} = c^{\frac{5}{5}} = \boxed{c}$

b) $\frac{m^{\frac{1}{3}}}{m^{-\frac{5}{6}}} = m^{\frac{2}{6} - (-\frac{5}{6})} = \boxed{m^{\frac{7}{6}}}$

c) $\left(a^{\frac{1}{9}}\right)^{-3} = a^{-\frac{1}{3}} = \boxed{\frac{1}{a^{\frac{1}{3}}}} \text{ or } \boxed{\frac{1}{\sqrt[3]{a}}}$

d) $\left(x^{\frac{1}{4}} \cdot y^{-\frac{1}{3}}\right)^{-12} = x^{-3} y^4 = \boxed{\frac{y^4}{x^3}}$

e) $\frac{\left(x^3\right)^{-\frac{1}{2}}}{\left(x^{\frac{5}{2}}\right)^{\frac{1}{5}}} = \frac{x^{-\frac{3}{2}}}{x^{\frac{1}{2}}} = x^{-2} = \boxed{\frac{1}{x^2}}$

5. a) $x^0 = \boxed{1}$

b) $\frac{3}{b^0} = \frac{3}{1} = \boxed{3}$

c) $\left(\frac{2x^3y^2}{15xy^{-3}}\right)^0 = \boxed{1}$

d) $x^0 \cdot \left(-8x^{-6}\right)^{\frac{1}{3}} = 1\left(\sqrt[3]{-8}\, x^{-2}\right) = \boxed{\frac{-2}{x^2}}$

M10C Exp & Rad Chapter Review Answer Key

1. **(a) Both** **(b) Perfect Square**

2. **(a) Entire;** $4\sqrt{3}$ **(b) Mixed;** $\sqrt[3]{128}$ **(c) Entire;** $4\sqrt{5}$ **(d) Entire;** $2\sqrt[3]{9}$
(e) Mixed; $\sqrt{432}$ **(f) Mixed;** $\sqrt{1250}$

3. **(a)** $\frac{3}{4}$ **(b)** $\frac{6}{5}$ **(c) 343** **(d)** $\frac{8}{27}$ **(e)** $\frac{9}{4}$

4. **(a)** $\sqrt[5]{4}$ **(b)** $\left(\sqrt[2]{4}\right)^3$ **(c)** $\frac{1}{\sqrt[3]{3}}$ **(d)** $\left(\sqrt[6]{2}\right)^5$

5. **(a) 243** **(b)** $\frac{1}{25}$ **(c) 32** **(d) 49** **(e)** $\frac{9}{4}$ **(f)** $\frac{1}{3}$

6. **(a)** a^5b^3 **(b)** $-64p^9q^6$ **(c)** a^3b **(d)** $\frac{z^6}{x^4}$ **(e)** $\frac{1}{m^4}$ **(f) 1**
(g) $\frac{1}{b^5}$ **(h)** $\frac{1}{x^6}$ **(i)** $\frac{x}{y^2}$ **(j)** $\frac{1}{b}$ **(k) 1** **(l)** $2x^2$
(m) $\frac{9x^2y^{10}}{4}$ **(n)** $\frac{4x^2z^{12}}{9}$

7. **(a)** x^4 **(b)** $3m^{\frac{3}{4}}$ **(c)** $\frac{x}{2}$ **(d)** x^2y^4

8. **(a)** $y^{\frac{1}{2}}$ **(b)** $\frac{-2}{x^2}$ **(c)** $\frac{1}{x^4y^6}$ **(d)** $\frac{1}{4x^{\frac{1}{4}}}$ **(e)** $\frac{1}{r^4s^2}$

9. **(a)** $27x^{\frac{3}{2}}$ **(b)** $8x^3$ **(c)** $4x^2$ **(d)** $y^{\frac{1}{2}}$

10. **(a) Bacteria quadruples every 40 hours** **(b) 4000** **(c) 2000** **(d) 62.5**
(e) beginning of experiment

11. **(a) Rational** **(b) Irrational** **(c) Rational** **(d) Irrational**

12. **(a) Natural, Whole, Integer, Rational, Real** **(b) Rational, Real** **(c) Irrational, Real**
(d) Rational, Real **(e) Rational, Real** **(f) Integer, Rational, Real**

13. **(a)** $\frac{5}{3}$, $\sqrt[3]{45}$, $\sqrt{21}$, $\sqrt{35}$ **Estimating** **(b)** $2\sqrt{13}$, $\sqrt{60}$, $6\sqrt{2}$, $4\sqrt{5}$ **Entire Radicals**

25