

## Math 96--Calculator and Exponent Key and Root Key--page 1

**Part A--Exponent Key, using fractions.** We already know that a fraction exponent represents a radical. Sometimes when we work with a fractional exponent, the base is a “perfect” and factors so we actually get a result that has no radical. For example,

$$a. \quad 125^{\frac{2}{3}} = \left(\sqrt[3]{125}\right)^2 = \left(\sqrt[3]{5 \cdot 5 \cdot 5}\right)^2 = 5^2 = 25$$

You could also use the power chart (on the back of the multiplication table) to avoid the prime factoring. From the chart,  $\sqrt[3]{125} = 5$ ; then  $5^2 = 25$ . The exponent key on your calculator, along with the fraction key (a b/c), will allow you to key in the above problem and get 25 for an answer. In general, you key in the base, the exponent key, the fractional exponent (numerator, a b/c key, denominator), and the equal sign.

On the TI30Xa, this is the exponent key:  $y^x$ . Some calculators use this for the exponent:  $\wedge$ . Other calculators use this for the exponent key:  $x^y$ . Look at your calculator to know what your exponent key looks like. On the first examples, I’ll show the various ways to key in the problem, based on the various exponent keys available.

b.	$125^{\frac{2}{3}}$	Key in 125, $y^x$ , 2, a b/c, 3, = . The display should read 25. Key in 125, $\wedge$ , 2, a b/c, 3, = . The display should read 25. Key in 125, $x^y$ , 2, a b/c, 3, = . The display should read 25.
c.	$64^{\frac{3}{2}}$	Key in 64, $y^x$ , 3, a b/c, 2, = . The display should read 512. Key in 64, $\wedge$ , 3, a b/c, 2, = . The display should read 512. Key in 64, $x^y$ , 3, a b/c, 2, = . The display should read 512.

**Now you try these on the calculator.** Use the exponent key ( $y^x$ ,  $\wedge$ , or  $x^y$ ) and the fraction key (a b/c).

1.	$49^{\frac{5}{2}}$	2.	$16^{\frac{7}{4}}$	3.	$8^{\frac{4}{3}}$	4.	$125^{\frac{2}{3}}$
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**Part B--The Root Key.** We also know how to simplify radicals using prime factors and the index to count the number of identical primes to make a “perfect”. For example,

$$d. \quad \sqrt[3]{27} = \sqrt[3]{3 \cdot 3 \cdot 3} = 3$$

$$e. \quad \sqrt[5]{32} = \sqrt[5]{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} = 2$$

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You could also use your power chart (on the back of your multiplication table). Could we do this on the calculator? Yes! We could use the root key. On the TI30Xa calculator, the root key is in yellow above the exponent key. The root key looks like this:  $\sqrt[x]{y}$ . On some calculators, the root key looks like this:  $\sqrt[x]{\phantom{y}}$  and is located above the  $x^y$  key.

On the TI30Xa, here is how to use the root key. Key in the radicand, the root key  $\sqrt[x]{y}$  (so you have to press the yellow 2<sup>nd</sup> button and  $x^y$  to get to the root key  $\sqrt[x]{y}$ ), the index, = . For example,  $\sqrt[5]{32}$  would be keyed in like this: radicand 32, 2<sup>nd</sup>  $x^y$  to use  $\sqrt[x]{y}$ , index 5, = , 2.

On other calculators, here is how to use the root key. Key in the index, the root key  $\sqrt[x]{\phantom{y}}$  (so you have to press the shift key and  $x^y$  to get to the root key  $\sqrt[x]{\phantom{y}}$ ), the radicand, = . For example,  $\sqrt[5]{32}$  would be keyed in like this: index 5, 2<sup>nd</sup>  $x^y$  to use  $\sqrt[x]{\phantom{y}}$ , radicand 32, = , 2.

Play with your calculator until you know the keystrokes! Practice with the following examples.

- f.  $\sqrt[3]{27}$  Key in 27, root key, index 3, = . The display should read 3.  
Key in 3, root key, radicand 27, = . The display should read 3.
- g.  $\sqrt[3]{125}$  Key in 125, root key, index 3, = . The display should read 5.  
Key in 3, root key, radicand 125, = . The display should read 5.
- h.  $\sqrt[4]{256}$  Key in 256, root key, index 4, = . The display should read 4.  
Key in 4, root key, radicand 256, = . The display should read 4.
- i.  $\sqrt[4]{625}$  Key in 625, root key, index 4, = . The display should read 5.  
Key in 4, root key, radicand 625, = . The display should read 5.

Now you try these using the root key on your calculator.

5.  $\sqrt[3]{64}$       6.  $\sqrt[3]{216}$       7.  $\sqrt[4]{81}$       8.  $\sqrt[5]{243}$

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**Part C--Two ways to work “perfect” radicals.** You now have two ways to work radicals that are “perfect”. One way is to use the root key ( $\sqrt[x]{y}$  or  $\sqrt[x]{\phantom{y}}$ , both of which are located above the exponent key so you have to use the 2<sup>nd</sup> button or shift button to use the root key). The other way would be to re-write the radical as a base and a fractional exponent. Then you could use the exponent key ( $y^x$ ,  $\wedge$ , or  $x^y$ ) and the fraction key (a b/c). Look at a couple of examples, done two ways.

- j.  $\sqrt[3]{512}$       512, root key, index 3, = . The display should read 8.  
3, root key, radicand 512, = . The display should read 8.
- k.  $\sqrt[3]{512}$   
 $512^{\frac{1}{3}}$       512, exponent key, 1, a b/c, 3, = . The display should read 8.
- l.  $\sqrt[6]{64}$       64, root key, index 6, = . The display should read 2.  
6, root key, radicand 64, = . The display should read 2.
- m.  $\sqrt[6]{64}$   
 $64^{\frac{1}{6}}$       64, exponent key, 1, a b/c, 6, = . The display should read 2.
- n.  $\sqrt{961}$       961, root key, index 2, = . The display should read 31.
- o.  $\sqrt{961}$   
 $961^{\frac{1}{2}}$       961, exponent key, 1, a b/c, 2, = . The display should read 31.
- p.  $\sqrt{961}$       961, square root key ( $\sqrt{\phantom{y}}$ ). The display should read 31.  
square root key ( $\sqrt{\phantom{y}}$ ), 961, = . The display should read 31.

It’s up to you to decide whether you’d like to use the root key or the exponent key. If you use the root key, you have to remember to key in the radicand, the root key, the index, and the equal sign OR to key in the index, the root key, the radicand and the equal sign. If you use the exponent key, you need to re-write the radical using fractional exponents and then key in the base, the exponent key ( $y^x$ ,  $\wedge$ , or  $x^y$ ), the numerator, the a b/c key, the denominator, and the equal sign.

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Now you work these. Decide whether you want to use the root key or the exponent key.

9.  $\sqrt[5]{1024}$

10.  $\sqrt[3]{1331}$

**Part D--Extra Ideas.** When you get a problem like this:  $9^{-\frac{5}{2}}$ , we would work it like this manually:

q. 
$$9^{-\frac{5}{2}} = \frac{1}{9^{\frac{5}{2}}} = \frac{1}{(\sqrt{9})^5} = \frac{1}{(\sqrt{3 \cdot 3})^5} = \frac{1}{3^5} \text{ or } \frac{1}{243}$$

- r. On the calculator, we would key in 9, y<sup>x</sup> (or ^ or x<sup>y</sup>), 5, a b/c, 2, + to - key (or some calculators use the negative sign first and then 5, a b/c, 2), = . Look at the display; you get a decimal: 0.004115226. Let's convert that to a fraction by using the fraction-to-decimal key (F  $\leftrightarrow$  D). Find that key! Usually, it's above some other key so is accessed by using the 2<sup>nd</sup> key or the Shift key. Now

look at the display. It should show the fraction  $\frac{1}{243}$ .

- s. The problem with using the calculator for these problems is the TI30Xa calculator won't convert all decimals to fractions. Once the denominator of a fraction is above 999, this calculator won't convert. So, if we were working the problem  $36^{-\frac{7}{2}}$ , we would work manually like this:

$$36^{-\frac{7}{2}} = \frac{1}{36^{\frac{7}{2}}} = \frac{1}{(\sqrt{36})^7} = \frac{1}{6^7} \text{ or } \frac{1}{279936}$$

- t. If you try this on the calculator, you would key in 36, exponent key, the negative exponent, = . Look at the display; you get a decimal: 0.000003572. When you try to convert from a decimal to a fraction with the 2<sup>nd</sup> key and F  $\leftrightarrow$  D, nothing happens. That's because the denominator is too big! Most instructors won't accept the decimal because it isn't accurate enough. So...it is important to be able to do these manually. The answer most instructors want is

$$\frac{1}{6^7}$$

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**Now you try these.** Write your answer in fraction form. The first would work with a calculator, but the second will not so work it manually.

11.  $16^{-\frac{7}{4}}$

12.  $81^{-\frac{5}{2}}$

**Answer Key.**

1.  $49^{\frac{5}{2}}$   
16807

2.  $16^{\frac{7}{4}}$   
128

3.  $8^{\frac{4}{3}}$   
16

4.  $125^{\frac{2}{3}}$   
25

5.  $\sqrt[3]{64}$   
4

6.  $\sqrt[3]{216}$   
6

7.  $\sqrt[4]{81}$   
3

8.  $\sqrt[5]{243}$   
3

9.  $\sqrt[5]{1024}$   
4

10.  $\sqrt[3]{1331}$   
11

11.  $16^{-\frac{7}{4}}$

$$\frac{1}{2^7} \text{ or } \frac{1}{128}$$

12.  $81^{-\frac{5}{2}} = \frac{1}{81^{\frac{5}{2}}} = \frac{1}{(\sqrt{81})^5} = \frac{1}{9^5} \text{ or } \frac{1}{59049}$