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| **What is a radical?**An expression that has a square root, cube root, etc. The symbol is $\sqrt{}$**Types of Radicals**An **entire radical** is a radical with a coefficient of 1 (e.g.$\sqrt{40}$)radical.PNGA **mixed radical** has a coefficient other than 1 (e.g.$2\sqrt{5}$). It is 2 times $\sqrt{5}$. |

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| **A. SIMPLIFYING (Reducing) RADICALS**To **simplify** means to find another expression with the same value.  It **does not mean** to find a decimal approximation. |

**Simplify** $\sqrt{48}$

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| **METHOD 1: LARGEST PERFECT SQUARE** | **METHOD 2: PRIME FACTORS** |
| **1.** Find the **largest** perfect square which will divide evenly into the number under your radical sign.  **Dividend****Divisor** 48 16 the largest perfect square  3 3 that divides evenly into 48 is **16** 1 **2.** Write the number appearing under your radical as the product (multiplication) of the perfect square and your answer from dividing.$$\sqrt{48}=\sqrt{16 × 3}$$**3.** Give each number in the product its own radical sign.$$\sqrt{48}=\sqrt{16} × \sqrt{3} $$**4.** Reduce the "perfect" radical which you have now created.$$\sqrt{48}=\sqrt{16 ×3}=\sqrt{16} × \sqrt{3}=4\sqrt{3}$$**5.** You now have your answer.$$\sqrt{48}=4\sqrt{3}$$ | **1.** **Factor** out the number into its prime factors.48 2 24 212 2 4 8 = 2 x 2 x 2 x 2 x 3 6 23 31 **2.** Write all the prime factors under your radical $$\sqrt{48}=\sqrt{2 x 2 x 2 x 2 x 3}$$**3.** Give each twin numbers and single numbers in the product their own radical signs$$\sqrt{48}=\sqrt{2 x 2 } x \sqrt{2 x 2 } x \sqrt{3 }$$**4.** Reduce the "perfect" radical which you have now created$$\sqrt{48}=2 x 2\sqrt{3 }$$**5.** You now have your answer$$\sqrt{48}=4\sqrt{3 }$$ |

i) Simplify the following “**entire”** radicals.

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| **a)** $\sqrt{40}$ | **b)** $ \sqrt{72}$ |
| **c)** $\sqrt{180}$ | **d)** $ \sqrt{288}$ |

ii) Express each of the following as “**entire”** radicals.

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| **a)** $7\sqrt{5}$ | **b)** $-3\sqrt{3}$ |

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| **B. MULTIPLYING/ DIVIDING RADICALS**When **multiplying** radicals, you must multiply the numbers **OUTSIDE (O)** the radicals **AND** then multiply the numbers **INSIDE (I)**the radicals.$O\_{1}\sqrt{I\_{1}} × O\_{2}\sqrt{I\_{2}}=O\_{1} ×O\_{2}\sqrt{I\_{1}×I\_{2}} $ **such as** $2\sqrt{3} × 4\sqrt{5}=2×4\sqrt{3×5}=8\sqrt{15}$When **dividing** radicals, you must divide the numbers **OUTSIDE (O**) the radicals **AND** then divide the numbers**INSIDE (I)**the radicals.$\frac{O\_{1}\sqrt{I\_{1}} }{O\_{2}\sqrt{I\_{2}}} =\frac{O\_{1}}{O\_{2}} \sqrt{\frac{I\_{1}}{I\_{2}}}$ **such as** $\frac{4\sqrt{15} }{2\sqrt{3}} =\frac{4}{2} .\sqrt{\frac{15}{3}}=2\sqrt{5}$**Rationalizing The Denominator**If a radical appears in the denominator of a fraction, it will need to be "removed" if you are trying to simplify the expression. To "remove" a radical from the denominator, multiply the top and bottom of the fraction by that same radical to create a rational number (a perfect square radical) in the denominator. This process is called ***rationalizing the denominator.*****Simplify** $\frac{2}{\sqrt{3}}$**Answer** $\frac{2}{\sqrt{3}}.\frac{\sqrt{3}}{\sqrt{3}}=\frac{2\sqrt{3}}{\sqrt{9}}=\frac{2\sqrt{3}}{3}$ |

**Multiply or divide**, then **simplify** the following radicals

**a)**$ 2\sqrt{18} x 3\sqrt{8}$ **b)** $5\sqrt{3} x 7\sqrt{2}$ **c)** $(\sqrt{3}+5)^{2}$

**d)** $\frac{-12\sqrt{24}}{3\sqrt{2}}$ **e)** $\frac{15}{\sqrt{5}}$

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| **D. ADDING RADICALS**When adding or subtracting radicals, you must use the same concept as that of adding or subtracting "like" variables.  **In other words, the radicals must be the samebefore you add (or subtract) them.****Like Radicals****example** $3\sqrt{6} and 2\sqrt{6}$ **non-example** $3\sqrt{6} and 2\sqrt{5}$ |

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| **Ex1**: Add $3\sqrt{6} +2\sqrt{6}$ | Since the radicals are the same, simply add the numbers **in front** of the radicals (do **NOT** add the numbers under the radicals). **Answer:** $5\sqrt{6}$ |
| **Ex2:** Add $3\sqrt{6} +2\sqrt{5}$ | Since the radicals are not the same, and both are in their simplest form, there is no way to combine these values.  The answer is the same as the problem.**Answer:** $3\sqrt{6} +2\sqrt{5}$ |

Add the following radicals

**a)** $5\sqrt{3} +2\sqrt{75}$ **b)** $5\sqrt{8}-3\sqrt{18}+\sqrt{3} $

**MULTIPLYING BINOMIALS**

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| N | 1. Simplify. Express your answer as a radical in simplest form.
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 | * 1.
 | * 1.
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| * 1.
 | * 1.
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 | * 1.
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|  |
|  | 1. Simplify. Express your answer as a radical in simplest form.
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**SIMPLIFYING RADICALS**

1. Simplify:

 a)  b)  c)

 d)  e)  f)

2. Simplify:

 a)  b)  c)  d) 

3. Solve for *x*.

 a)  b)  c)  d) 

4. Express both roots in decimal form, rounded to 3 decimal places.

 a)  b)  c) 

5. Simplify:

 a)  b) 

 c)  d) 

 e)  f) 

 g)  h) 

 i)  j) 

 e) - 7 f) - 30 g)  h) 