Trigonometry Name________________________

Operations With Radical Expressions

⇒ Like radicals add and subtract in the same manner as like terms in algebra:

$$3x + 2x = 5x \qquad 7y - 3y = 4y$$

$$3\sqrt{2} + 2\sqrt{2} = 5\sqrt{2} \qquad 7\sqrt{5} - 3\sqrt{5} = 4\sqrt{5}$$

⇒ Distribute the values outside of the parentheses:

$3(2x + 7)$ simplifies to $6x + 21$

$4\sqrt{3}(2\sqrt{2} - 5)$ simplifies to $8\sqrt{6} - 20\sqrt{3}$

⇒ To rationalize the denominator, multiply both numerator and denominator by the radical being eliminated. Then simplify:

$$\frac{8\sqrt{3}}{\sqrt{2}} \bullet \frac{\sqrt{2}}{\sqrt{2}} = \frac{8\sqrt{6}}{\sqrt{4}} = \frac{8\sqrt{6}}{2} = 4\sqrt{6}$$

Remember: In fractions, reduce whole numbers with whole numbers and radicals with radicals—never mix!

Simplify the radical expressions completely. Use the decoder to reveal the first civilization to compute with radicals.

1. $4\sqrt{3} + 7\sqrt{3}$
2. $7(8\sqrt{3} + 2\sqrt{2})$
3. $5\sqrt{2}(3 - 2\sqrt{2})$
4. $10\sqrt{2} - 2\sqrt{8}$
5. $\sqrt{10} \bullet \sqrt{5}$
6. $\sqrt{75}$
7. $\sqrt{121}$
8. $4\sqrt{2} + 7\sqrt{2} - 3\sqrt{2}$
9. $\sqrt{6} \bullet \sqrt{15}$
10. $\sqrt{\frac{4}{9}}$
11. $\frac{5}{\sqrt{10}}$
12. $\frac{2\sqrt{3}}{\sqrt{6}}$
13. $\frac{1}{\sqrt{2}}$
14. $\frac{5}{\sqrt{75}}$

Multiplying and Simplifying Radical Expressions

Many radical expressions contain perfect squares which become whole numbers. To simplify a radical expression, factor the radical into the largest perfect square and another factor. Then simplify.

Example: $\sqrt{48} = \sqrt{16} + \sqrt{3} = 4\sqrt{3}$

↑ perfect square ↑ other factor

To multiply radical expressions, follow these three steps:

I. Multiply whole numbers (if any)
II. Multiply radicals
III. Simplify the results

Example: $(4\sqrt{2})(6\sqrt{2}) = 24\sqrt{4}$
$= 24(2)$
$= 48$

Simplify the following radical expressions and use the decoder to reveal the mathematician who introduced the radical sign.

1. $(3\sqrt{3})(4\sqrt{2})$
2. $(5\sqrt{2})(6\sqrt{2})$
3. $(4\sqrt{3})(4\sqrt{3})$
4. $(9\sqrt{2})^2$
5. $(3\sqrt{3})^2$
6. $(3\sqrt{5})(\sqrt{10})$
7. $\sqrt{90}$
8. $\sqrt{128}$
9. $\sqrt{63}$
10. $(\sqrt{45})(\sqrt{20})$
11. $(\sqrt{200})^2$