Geometry B: Skills Practice – Proportions and Simplifying Square Root Expressions

Name:_____

A **proportion** is an equation stating two fractions are equal.

Example: $\frac{8}{x} = \frac{4}{7}$

To solve proportions, we cross-multiply and solve the resulting equation normally.

Example: Solve the proportion written above.

Examples: Solve each proportion.

A. $\frac{x}{5} = \frac{200}{x}$

B. $\frac{x-3}{4} = \frac{9}{2}$

C. $\frac{x-3}{9} = \frac{4}{x-3}$

Simplifying Square Roots: Removing the Perfect Square Factor

- Square roots have been simplified when all perfect square factors have been removed from the root. To do this, a list of perfect squares is helpful (shown below).

Example: Simplify the following roots:

$\sqrt{500}$ $\sqrt{3179}$ $\sqrt{112}$

$\sqrt{100} \cdot \sqrt{5}$

$10\sqrt{5}$

The First 20 Perfect Squares

$1^2 = 1$	$6^2 = 36$	$11^2 = 121$	$16^2 = 256$
$2^2 = 4$	$7^2 = 49$	$12^2 = 144$	$17^2 = 289$
$3^2 = 9$	$8^2 = 64$	$13^2 = 169$	$18^2 = 324$
$4^2 = 16$	$9^2 = 81$	$14^2 = 196$	$19^2 = 361$
$5^2 = 25$	$10^2 = 100$	$15^2 = 225$	$20^2 = 400$

Square Root Arithmetic: Adding, Subracting, Multiplying, Dividing

- To add or subtract roots, only roots with the same **radicand** (the number inside the root) can be simplified. All final answers should be simplified as well.

Example: Simplify $4\sqrt{3} - 10\sqrt{3} + 2\sqrt{6}$

- Multiplying or dividing square roots is done regardless of the radicand.

Example: Simplify the following expressions.

$\sqrt{6}\sqrt{10} =$ $\sqrt{\frac{24}{3}} =$

Skills Practice: Proportions and Square Roots Name:_____

A. Solve each proportion.

#1 $\frac{-2}{11} = \frac{x}{22}$ #2 $\frac{3}{7} = \frac{x+2}{15}$ #3 $\frac{27}{x} = \frac{x}{3}$

#4 $\frac{x-6}{14} = \frac{4}{x-6}$ #5 $\frac{x-1}{40} = \frac{1}{6}$ #6 $\frac{8}{22} = \frac{1}{x-4}$

B. Simplify each square root expression.

#7 $\sqrt{392}$ #8 $\sqrt{52}$ #9 $\sqrt{5687}$

#10 $\sqrt{1183}$ #11 $\sqrt{252}$ #12 $\sqrt{675}$

C. Simplify each square root expression

#13 $2\sqrt{2} - 5\sqrt{2}$

#14 $10\sqrt{3} + 5\sqrt{2} - \sqrt{3}$

#15 $8\sqrt{6} - 5\sqrt{3} + 4\sqrt{6}$

#16 $\sqrt{\frac{56}{7}}$

#17 $\sqrt{\frac{44}{11}}$

#18 $\sqrt{\frac{26}{2}}$

#19 $\sqrt{22}\sqrt{10}$

#20 $5\sqrt{3}\sqrt{7}$

#21 $\sqrt{20}\sqrt{5}$

Simplifying Square Roots: Rationalizing the Denominator

- In most cases, it is preferable to remove square roots from the denominator of a fraction. This process is known as **rationalizing the denominator.** A walkthrough of how to do this is shown below:

Example: Simplify $\frac{3}{\sqrt{6}}$

First multiply the numerator and denominator by the root in the denominator:

$\frac{3}{\sqrt{6}} \cdot \frac{\sqrt{6}}{\sqrt{6}}$ Now simplify → $\frac{3\sqrt{6}}{\sqrt{36}}$ → the denominator is now a perfect square so take the square root:

$\frac{3\sqrt{6}}{6}$ → Simplify any non-root terms: $\frac{\sqrt{6}}{2}$ and that's it!

D. Simplify

#22 $\frac{5}{\sqrt{10}}$

#23 $\frac{3}{\sqrt{15}}$

#24 $\frac{7}{\sqrt{13}}$

Geometry B: Skills Practice – Proportions and Simplifying Square Root Expressions

Name: Key

A **proportion** is an equation stating two fractions are equal.

Example: $\frac{8}{x} = \frac{4}{7}$

To solve proportions, we cross-multiply and solve the resulting equation normally.

$4x = 7(8)$

Example: Solve the proportion written above.

$\frac{4x}{4} = \frac{56}{4}$

$x = 14$

Examples: Solve each proportion.

A. $\frac{x}{5} = \frac{200}{x}$

$x^2 = 200(5)$

$x^2 = 1000$

$\sqrt{x^2} = \sqrt{1000}$

$x = \pm\sqrt{1000}$

$x = \pm\sqrt{100}\cdot\sqrt{10}$

$x = \pm 10\sqrt{10}$

B. $\frac{x-3}{4} = \frac{9}{2}$

$2(x-3) = 9(4)$

$2x - 6 = 36$

$2x = 42$

$x = 21$

C. $\frac{x-3}{9} = \frac{4}{x-3}$

$(x-3)^2 = 36$

$\sqrt{(x-3)^2} = \sqrt{36}$

$x - 3 = \pm 6$

$x = \pm 6 + 3$

$+6+3 = 9$ $\quad -6+3 = -3$

Simplifying Square Roots: Removing the Perfect Square Factor

- Square roots have been simplified when all perfect square factors have been removed from the root. To do this, a list of perfect squares is helpful (shown below).

Example: Simplify the following roots:

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

$\sqrt{3179}$ $\sqrt{289}\cdot\sqrt{11}$ $17\sqrt{11}$

$\sqrt{112}$ $\sqrt{16}\cdot\sqrt{7}$ $4\sqrt{7}$

The First 20 Perfect Squares

$1^2 = 1$	$6^2 = 36$	$11^2 = 121$	$16^2 = 256$
$2^2 = 4$	$7^2 = 49$	$12^2 = 144$	$17^2 = 289$
$3^2 = 9$	$8^2 = 64$	$13^2 = 169$	$18^2 = 324$
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Square Root Arithmetic: Adding, Subracting, Multiplying, Dividing

- To add or subtract roots, only roots with the same **radicand** (the number inside the root) can be simplified. All final answers should be simplified as well.

Example: Simplify $4\sqrt{3} - 10\sqrt{3} + 2\sqrt{6}$

$-6\sqrt{3} + 2\sqrt{6}$

cannot add further b/c the $\sqrt{}$ #'s are not the same

- Multiplying or dividing square roots is done regardless of the radicand.

Example: Simplify the following expressions.

$\sqrt{6}\sqrt{10} =$ $\sqrt{60}$ $\sqrt{4}\cdot\sqrt{15}$ $2\sqrt{15}$

$\sqrt{\frac{24}{3}} =$ $\sqrt{8} = \sqrt{4}\cdot\sqrt{2}$ $2\sqrt{2}$

Skills Practice: Proportions and Square Roots Name:_____

A. Solve each proportion.

#1 $\frac{-2}{11} = \frac{x}{22}$

$11x = 22(-2)$

$11x = -44$

$x = -4$

#2 $\frac{3}{7} = \frac{x+2}{15}$

$7(x+2) = 3(15)$

$7x + 14 = 45$

$-14 \quad -14$

$7x = 31$

$x = \frac{31}{7}$

#3 $\frac{27}{x} = \frac{x}{3}$

$x^2 = 3(27)$

$x^2 = 81$

$\sqrt{x^2} = \sqrt{81}$

$x = \pm 9$ ← Two solutions

#4 $\frac{x-6}{14} = \frac{4}{x-6}$

$(x-6)^2 = 14(4)$

$(x-6)^2 = 56$

$\sqrt{(x-6)^2} = \pm\sqrt{56}$

$x-6 = \pm\sqrt{56}$

$x-6 = \pm\sqrt{4}\sqrt{14}$

$x-6 = \pm 2\sqrt{14}$

$+6 \quad +6$

$x = 6 \pm 2\sqrt{14}$

#5 $\frac{x-1}{40} = \frac{1}{6}$

$\frac{6(x-1)}{6} = \frac{40}{6}$

$x-1 = \frac{20}{3}$ +1

$+1 \quad +1$

$x = \frac{20}{3} + \frac{3}{3}$

$x = \frac{23}{3}$

#6 $\frac{8}{22} = \frac{1}{x-4}$

$\frac{8(x-4)}{8} = \frac{22}{8}$

$x-4 = \frac{11}{4}$ +4

$+4 \quad +4$

$x = \frac{11}{4} + \frac{16}{4}$

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

B. Simplify each square root expression.

#7 $\sqrt{392}$

$\sqrt{196} \cdot \sqrt{2}$

$14\sqrt{2}$

#8 $\sqrt{52}$

$\sqrt{4} \cdot \sqrt{13}$

$2\sqrt{13}$

#9 $\sqrt{5687}$

$\sqrt{121} \cdot \sqrt{47}$

$11\sqrt{47}$

#10 $\sqrt{1183}$

$\sqrt{169} \quad \sqrt{7}$

$13\sqrt{7}$

#11 $\sqrt{252}$

$\sqrt{36} \quad \sqrt{7}$

$6\sqrt{7}$

#12 $\sqrt{675}$

$\sqrt{25} \quad \sqrt{27}$

$5\sqrt{27}$

Combine like terms
Combine like radicals

C. Simplify each square root expression

#13 $2\sqrt{2} - 5\sqrt{2}$

$-3\sqrt{2}$

#14 $10\sqrt{3} + 5\sqrt{2} - \sqrt{3}$

$10\sqrt{3} - 1\sqrt{3} + 5\sqrt{2}$

$9\sqrt{3} + 5\sqrt{2}$ or $5\sqrt{2} + 9\sqrt{3}$

#15 $8\sqrt{6} - 5\sqrt{3} + 4\sqrt{6}$

$4\sqrt{6} - 5\sqrt{3}$ or $-5\sqrt{3} + 4\sqrt{6}$

#16 $\sqrt{\frac{56}{7}}$

$\sqrt{8}$

$\sqrt{4}\ \sqrt{2}$

$2\sqrt{2}$

#17 $\sqrt{\frac{44}{11}}$

$\sqrt{4}$

2

#18 $\sqrt{\frac{26}{2}}$

$\sqrt{13}$

#19 $\sqrt{22}\sqrt{10}$

$\sqrt{220}$

$\sqrt{4} \cdot \sqrt{55}$

$2\sqrt{55}$

#20 $5\sqrt{3}\sqrt{7}$

$5\sqrt{21}$

#21 $\sqrt{20}\sqrt{5}$

$\sqrt{100}$

10

Simplifying Square Roots: Rationalizing the Denominator

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$\frac{3\sqrt{6}}{6}$ → Simplify any non-root terms: $\frac{\sqrt{6}}{2}$ and that's it!

D. Simplify

#22 $\frac{5}{\sqrt{10}} \cdot \frac{\sqrt{10}}{\sqrt{10}} = \frac{5\sqrt{10}}{10}$

$\frac{1\sqrt{10}}{2}$

#23 $\frac{3}{\sqrt{15}} \cdot \frac{\sqrt{15}}{\sqrt{15}} = \frac{3\sqrt{15}}{15}$

$\frac{1\sqrt{15}}{3}$

#24 $\frac{7}{\sqrt{13}} \cdot \frac{\sqrt{13}}{\sqrt{13}} = \frac{7\sqrt{13}}{13}$