Warm Up

Complete the table summarizing the notes on 5.1 Variation Functions

Type of Variation	Equation that describes relationship
y* varies directly as *x	$y = kx$
y* varies inversely as *x	$y = \frac{k}{x}$
y* varies jointly as *x* and *z	$y = kxz$
y* varies inversely as *x* and directly as *z	$y = \frac{kz}{x}$

1. The volume V of a pyramid varies jointly as the area of the base B and the height h, and $V = 24$ ft^3 when $B = 12$ ft^2 and $h = 6$ ft. Find B when $V = 54$ ft^3 and $h = 9$ ft.

18 ft^2

2. The cost per person c of chartering a tour bus varies inversely as the number of passengers n. If it costs \$22.50 per person to charter a bus for 20 passengers, how much will it cost per person to charter a bus for 36 passengers?

\$12.50

3. The pressure P of a gas varies inversely as its volume V and directly as the temperature T. A certain gas has a pressure of 2.7 atm, a volume of 3.6 L, and a temperature of 324 K. If the volume of the gas is kept constant and the temperature is increased to 396 K, what will the new pressure be?

3.3 atm

(3) $P = \frac{kT}{V}$

$2.7 = \frac{k(324)}{3.6}$ (3.6)

$9.72 = 324k$

$\frac{9.72}{324} = \frac{324k}{324}$

$k = 0.03$

$P = \frac{0.03(396)}{3.6}$

$k = \frac{PV}{T}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

$\frac{2.7(3.6)}{324} = \frac{P(3.6)}{396}$

39. $y = kxz$

$I = kdt$

$12.50 = 2500(.14) \cdot k$

$k = 0.02$

$y = kxz^2$

$\frac{y_1}{x_1 z_1^2} = \frac{y_2}{x_2 z_2^2}$

$\frac{18}{7(9^2)} = \frac{y}{2(6^2)}$

5.2 Multiplying & Dividing Rational Expressions

A **rational expression** is a quotient of two polynomials.

Before we can multiply and divide rational expressions, let's first see how we *simplify* rational expressions.

Simplifying Rational Expressions
To simplify a rational expression, divide out common factors that appear in the numerator and denominator. Because you're looking for common factors, always remember to FACTOR FIRST!! Also make note of when the expression is undefined.

Caution!

When identifying values for which a rational expression is undefined, identify the values of the variable that make the original denominator equal to 0.

Examples: Simplify. Identify any values for which the expression is undefined.

(1) When does the denom = 0?

$$\frac{x^2-4x-12}{x^2-4} = \frac{(x-6)(x+2)}{(x+2)(x-2)}$$

(2) $\frac{(x-6)}{(x-2)}$, undefined when $x=2$ or $x=-2$

(3) $\frac{3x+4}{3x^2+x-4} = \frac{(3x+4)}{(3x+4)(x-1)} = \frac{1}{x-1}$ undefined when $x=1, -\frac{4}{3}$

(4) $\frac{4x-x^2}{x^2-2x-8} = \frac{x(4-x)}{(x-4)(x+2)} = \frac{-x(x-4)}{(x-4)(x+2)}$

$\frac{-x}{x+2}$ undefined when $x=-2, 4$

Multiplying Rational Expressions

- factor all numerators and denominators completely
- simplify as you go by dividing out common factors of the numerators and denominators
- multiply ACROSS
- leave answers in factored form

Examples
Assume that all expressions are defined.

(1) $\frac{n^5}{n-6} \cdot \frac{n^2-6n}{n^8}$ $= \frac{n^5}{n-6} \cdot \frac{n(n-6)}{n^8 n^3} = \frac{1}{n^2}$

(2) $\frac{x^2-5x-24}{6x+2x^2} \cdot \frac{5x^2}{x-8}$ $= \frac{(x-8)(x+3)}{2x(3+x)} \cdot \frac{5x^2}{(x-8)}$ $\frac{5x^2}{2x} = \frac{5x}{2}$

(3) $\frac{40-10x}{x^2-6x+8} \cdot \frac{x+3}{5x+15}$ $\frac{-10(4-x)}{(x-4)(x-2)} \cdot \frac{(x+3)}{5(x+3)} = \frac{-10}{5(x-2)} = \frac{-2}{x-2}$

Dividing Rational Expressions

- rewrite problem as a multiplication problem

"keep-change-flip"

Examples
Assume that all expressions are defined.

(1) $\frac{x+2}{x+3} \div \frac{x^2+x-12}{x^2-9}$ $\frac{(x+2)}{(x+3)} \cdot \frac{(x-3)(x+3)}{(x+4)(x-3)} = \frac{x+2}{x+4}$

(2) $\frac{3x+6}{x^2-9} \div \frac{6x^2+12x}{4x+12}$

(3) $\frac{2x^2-7x-4}{x^2-9} \div \frac{4x^2-1}{8x^2-28x+12}$ $= \frac{4(x-4)}{x+3}$