

Name: Key Date: _____ Hour: _____

9.1 Adding and Subtracting Rational Expressions

Identify the excluded values for each expression.

1. $\frac{x-7}{9x^2-63x}$ $\frac{x-7}{9x(x-7)}$ $x \neq 0, 7$

2. $\frac{x^2+3x-18}{-x^2+6x-9}$ $-\frac{x^2+3x-18}{x^2-6x+9}$ $\frac{(x-3)(x+6)}{(x-3)(x-3)}$ $x \neq 3$

Simplify the given expression and state any excluded values.

3. $\frac{2x^2-12x+16}{7x^2-28x}$ $= \frac{2(x^2-6x+8)}{7x(x-4)}$
 $\frac{2(x-4)(x-2)}{7x(x-4)}$ $= \frac{2(x-2)}{7x}$ $x \neq 0, 4$

4. $\frac{5x^2+6x-8}{6x^2-24}$ $= \frac{5x^2+4x-10x-8}{6(x^2-4)}$
 $\frac{(5x+4)(x-2)}{6(x+2)(x-2)}$ $= \frac{5x+4}{6(x+2)}$ $x \neq -2$

5. $\frac{9x^3+9x^2}{7x^2-2x-9}$ $\frac{9x^2(x+1)}{7x^2+7x-9x-9}$
 $\frac{9x^2(x+1)}{7x(x+1)-9(x+1)}$ $= \frac{9x^2}{7x-9}$ $x \neq 9, -1$

6. $\frac{2x^2+13x-24}{7x+56}$ $= \frac{2x^2+13x-24}{7(x+8)}$
 $\frac{(2x-3)(x+8)}{7(x+8)}$ $= \frac{2x-3}{7}$ $x \neq -8$

Add or Subtract. Identify any excluded values.

7. $\frac{2x-3}{x+4} + \frac{4x-5}{x+4}$ $x \neq 4$
 $\frac{2x-3+4x-5}{x+4} = \frac{6x-8}{x+4} = \frac{2(3x-4)}{x+4}$

8. $\frac{x+12}{2x-5} - \frac{3x-2}{2x-5}$ $x \neq 5/2$
 $\frac{x+12-3x+2}{2x-5} = \frac{-2x+14}{2x-5}$

9. $\frac{x+4}{x^2-x-12} + \frac{2x}{x-4}$ $\frac{x+4}{(x-4)(x+3)} + \frac{2x}{x-4}$ $\frac{x+4+2x(x+3)}{(x-4)(x+3)}$ $x \neq 4, -3$

10. $\frac{3x^2-1}{x^2-3x-18} - \frac{x+2}{x-6}$ $\frac{3x^2-1}{(x-6)(x+3)} - \frac{(x+2)(x-3)}{(x-6)(x+3)}$
 $\frac{3x^2-1-x^2+x+6}{(x-6)(x+3)} = \frac{2x^2+x+5}{(x-6)(x+3)}$

$\frac{x+4+2x^2+6x}{(x-4)(x+3)}$
 $\frac{2x^2+7x+10}{(x-4)(x+3)}$

$\frac{2x^2+x+5}{(x-6)(x+3)}$

11. $\frac{x+2}{x^2-2x-15} + \frac{x}{x+3}$ $\frac{x+2}{(x-5)(x+3)} + \frac{x}{x+3}$
 $\frac{x+2+x(x-5)}{(x-5)(x+3)} = \frac{x^2-4x+2}{(x-5)(x+3)}$

12. $\frac{x+6}{x^2-7x-18} - \frac{2x}{x-9}$ $\frac{x+6}{(x-9)(x+2)} - \frac{2x}{x-9}$
 $\frac{x+6-2x(x+2)}{(x-9)(x+2)} = \frac{x+6-2x^2-4x}{(x-9)(x+2)} = \frac{-2x^2-3x+6}{(x-9)(x+2)}$

9.2 Multiplying and Dividing Rational Expressions

Multiply. Identify any excluded values.

1. $\frac{5x}{10} \cdot \frac{6x}{8x^2}$ $x \neq 0$
 $\frac{6}{5x}$

2. $\frac{4x}{3} \cdot \frac{8x}{2}$
 $\frac{16x^2}{3}$ $\text{No Excluded Values}$

3. $\frac{1}{x+9} \cdot \frac{7x^3+49x^2}{x+7}$ $x \neq -9, -7$
 $\frac{7x^2(x+7)}{(x+9)(x+7)} = \frac{7x^2}{x+9}$

4. $\frac{6x^2-54x}{x-9} \cdot \frac{7x}{6x}$ $x \neq 9, 0$
 $\frac{6x(x-9)7x}{6x(x-9)} = 7x$

5. $\frac{18x-36}{4x-8} \cdot \frac{2}{9x+18}$ $x \neq 2, -2$
 $\frac{2(x-2)2}{4(x-2)9(x+2)} = \frac{1}{x+2}$

6. $(56+11x-15x^2) \cdot \frac{10}{15x^2-11x-56}$ $x \neq 1, 2, 8$
 $-1(15x^2-11x-56) = 10$
 $(15x^2-11x-56) = -10$

Divide. Identify any excluded values.

7. $\frac{4x}{5x} \div \frac{4x}{6}$ $x \neq 0$
 $\frac{4x}{5x} \cdot \frac{6}{4x} = \frac{6}{5x}$

8. $\frac{6(x-2)}{(x-1)(x-10)} \div \frac{x-2}{x-10}$ $x \neq 10, 1, 2$
 $\frac{6(x-2)}{(x-1)(x-10)} \cdot \frac{(x-10)}{(x-2)} = \frac{6}{x-1}$

LCD $(x+2)$
 $x \neq 9, -2$

No Excluded Values

$x = -11 \pm \sqrt{121 - 4(5)(56)}$
 $x = -11 \pm \sqrt{-239}$

$$9. (2x+6) \cdot \frac{14x^2+42x}{10} \quad \boxed{x \neq 0, -3}$$

$$2(x+3) \cdot \frac{10}{5} \cdot \frac{1}{14(x+3)}$$

$$10. \frac{27x+9}{10} \cdot \frac{3x^2-8x-3}{10} \quad \boxed{x \neq -\frac{1}{3}, 3}$$

$$9(3x+1) \cdot \frac{10}{10} \cdot \frac{1}{(3x+1)(x-3)}$$

$$11. \frac{10}{7x} \cdot \frac{24x+56}{10x^3-90x^2} \cdot \frac{15x+35}{5} \quad \boxed{x \neq 0, 9, -\frac{7}{3}}$$

$$4 \cdot \frac{8(3x+7)}{5x^2(x-9)} \cdot \frac{5}{5(3x+7)}$$

$$12. \frac{9}{x-3} \cdot \frac{2x+20}{12x^3-30x^2+14x-35} \cdot \frac{2}{2} \quad \boxed{x \neq 0, \frac{5}{2}}$$

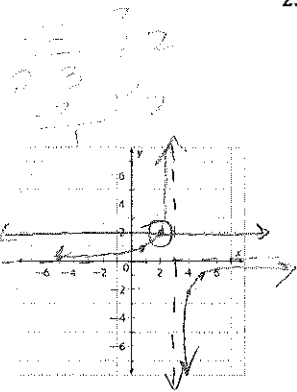
$$\frac{2(x+10)}{6x^2(2x-5)} \cdot \frac{7(2x-5)}{7}$$

9.3 Solving Rational Equations

Graph to solve the equation.

$$1. \frac{2}{x-3} = -2$$

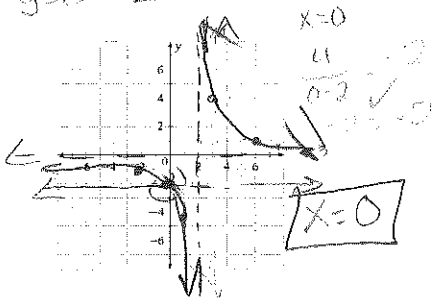
VA $x=3$
HA $y=0$



$$\boxed{x=2}$$

$$2. \frac{4}{x-2} = -2$$

VA $x=2$
HA $y=0$
 $\boxed{x=1}$ $\frac{4}{1-2} = -2$



$$\boxed{x=0}$$

Find the LCD for each pair.

$$3. \frac{13}{4x} \text{ and } \frac{27}{3x^2}$$

$$\boxed{\text{LCD } 4x^2}$$

$$4. \frac{11}{x^2+3x+2} \text{ and } \frac{1}{x+2}$$

$$\boxed{\text{LCD } (x+2)(x+1)}$$

$$\begin{array}{r} 45.5 \\ 22 \overline{) 1000} \\ \underline{88} \\ 120 \\ \underline{110} \\ 100 \end{array}$$

$$3x^2 - 8x - 3 = (3x+1)(x-3)$$

Solve each equation algebraically.

$$3x \cdot 5 \cdot \frac{1}{x} \cdot \frac{3x-2}{3x} - \frac{4}{3x} = \frac{1}{3x} \quad \boxed{x \neq 0}$$

$$3 - x + 2 = 4$$

$$5 - x = 4$$

$$\frac{-5}{-5} = \frac{-5}{-5}$$

$$-x = -1$$

$$\boxed{x=1}$$

$$6. \frac{5x-5}{x^2-4x} - \frac{5}{x^2-4x} = \frac{1}{x} \quad \boxed{x \neq 0, 4}$$

$$5x-5-5 = x-4$$

$$4x-10 = -4$$

$$4x = 6$$

$$\boxed{x = \frac{6}{4} = \frac{3}{2}}$$

$$7. \frac{x^2-7x+10}{x} + \frac{1}{x} = x+4 \quad \text{LCD } x \neq 0$$

$$x^2 - 7x + 10 + 1 = x(x+4)$$

$$x^2 - 7x + 11 = x^2 + 4x$$

$$-x^2 \quad -x^2$$

$$21x \quad -x^2 + 7x$$

$$11 = 11x$$

$$\boxed{x=1}$$

$$8. \frac{4}{x^2-4} = \frac{1}{x-2} \quad \text{LCD } (x-2)(x+2) \quad x \neq 2, -2$$

$$4 = x+2$$

$$\boxed{x=2}$$

No Solution!

Write a rational equation and solve.

9. The time required to deliver and install a computer at a customer's location is $t = 4 + \frac{d}{r}$, where t is time in hours, d is the distance, in miles, from the warehouse to the customer's location, and r is the average speed of the delivery truck. If it takes 6.2 hours for the employee to deliver and install a computer for a customer located 100 miles from the warehouse, what is the average speed of the delivery truck?

$$\left(6.2 = 4 + \frac{100}{r} \right) \cdot r \quad \text{LCD } r \neq 0$$

$$6.2r = 4r + 100$$

$$\frac{-4r}{-4r} = \frac{-4r}{-4r}$$

$$2.2r = 100$$

$$r = \frac{100}{2.2}$$

$$\boxed{r = 45.5 \text{ mph}}$$