

4.1: Simplifying Rational Expressions

A Rational Expression is:

A fraction w/polynomials
in the numerator and/or
denominator

$$\frac{x^2 + 5}{x + 2}$$

← numerator
← denominator

A Rational Expression
because it is a ratio
of two polynomials

Excluded Values: #s that make the
bottom of the fraction = 0

* Always state the excluded values
when simplifying Rational expressions

To **Simplify** a rational expression

- 1) Factor the numerator and denominator.
- 2) Divide out the common factors
- 3) Simplify & State any excluded values

have to come from original problem

*NOTE! Consider the following; which one is correctly simplified?

$$\frac{\cancel{2} + \cancel{2} + 5}{\cancel{2}} = 7$$

$$\frac{\cancel{2} \cdot \cancel{2} \cdot 5}{\cancel{2}} = 10$$

The same is true when you are simplifying rational expressions with polynomials. You **CAN NOT** cancel any of the terms out unless they are connected with a multiplication!! (!!!)

EXAMPLE

Simplify the following rational expressions and state any excluded values.

A. $\frac{x-1}{5x-5} = \frac{1(x-1)}{5(x-1)}$

$\frac{1}{5}, x \neq 1$

B. $\frac{21a^2}{7a^3} = \frac{7 \cdot 3a^2}{7a^2 \cdot a}$

$= \frac{3}{a}, a \neq 0$

$$C. \frac{2n-3}{6n-9} = \frac{1(2n-3)}{3(2n-3)}$$

$$\neq \frac{1}{3}, n \neq \frac{3}{2}$$

$$D. \frac{3x^2-9x}{x-3} = \frac{3x(x-3)}{(x-3)}$$

$$3x, x \neq 3$$

$$\text{E. } \frac{3x-6}{x^2+x-6} = \frac{3(x-2)}{(x+3)(x-2)}$$

$\frac{3}{x} \frac{-2}{-2} = -6$
 $\frac{3}{3} + \frac{-2}{-2} = 1$

$$\frac{3}{x+3}, x \neq -3, 2$$

$$\text{F. } \frac{x-3}{3-x} = \frac{x-3}{-x+3}$$

$$= \frac{1(x-3)}{-1(x-3)}$$

$$-1, x \neq 3$$

$$\begin{aligned} \text{G. } \frac{4-x^2}{7x-14} &= \frac{-x^2+4}{7(x-2)} \\ &= \frac{-1(x^2-4)}{7(x-2)} \\ &= \frac{-1(x-2)(x+2)}{7(x-2)} \\ &= \frac{-1(x+2)}{7} \end{aligned}$$

$$\frac{-x-2}{7}, x \neq 2$$

$$\text{H. } \frac{y^2-16}{4-y} = \frac{\cancel{(y-4)}(y+4)}{-1(y-4)}$$

$$\frac{y+4}{-1} = -y-4, y \neq 4$$

1. $\frac{4-w}{w^2-8w+16}$

$= \frac{-1(w-4)}{(w-4)(w-4)}$

$= \frac{-1}{w-4}, w \neq 4$

$\frac{1}{4-w}$

There are 4 major things to consider when trying to tackle a word problem.

1) What is the problem asking?

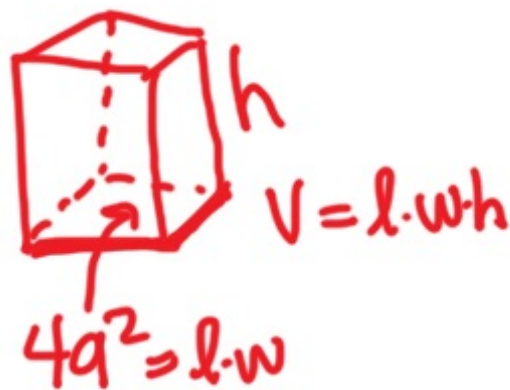
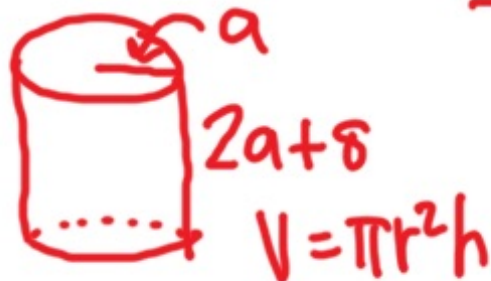
2) What information is given?

3) What do I already know that I can use?

4) Does my answer make sense?

EXAMPLE

- J. You are choosing between two wastebaskets. One is cylindrical with a height of $(2a + 8)$ and a radius of a . The other one is a rectangular prism with a square base area of $4a^2$ and a height of h . If both wastebaskets have the same volume what is the height of the rectangular wastebasket? Give your height in terms of a .



$$V_{\text{cyl}} = \pi (a)^2 (2a + 8)$$

$$V_{\text{prism}} = 4a^2 \cdot h$$

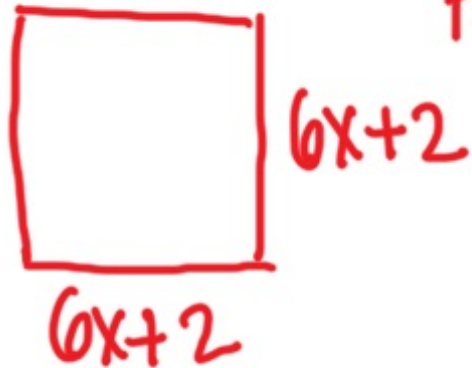
$$\frac{\pi a^2 (2a + 8)}{4a^2} = \frac{4a^2 \cdot h}{4a^2}$$

$$\frac{\pi \cdot \cancel{a^2} \cdot 2(a + 4)}{2 \cdot \cancel{2a^2}} = \frac{\pi (a + 4)}{2}$$

EXAMPLE

K. A square has side length $6x + 2$. A rectangle with width $3x + 1$ has the same area as the square. What is the length of the rectangle?

$$\text{Area} = (6x+2)(6x+2)$$



$$\frac{(6x+2)(6x+2)}{3x+1} = \frac{(3x+1)l}{3x+1}$$

$$\frac{2(3x+1)(6x+2)}{3x+1}$$

$$l = 2(6x+2)$$

$$l = 12x + 4$$