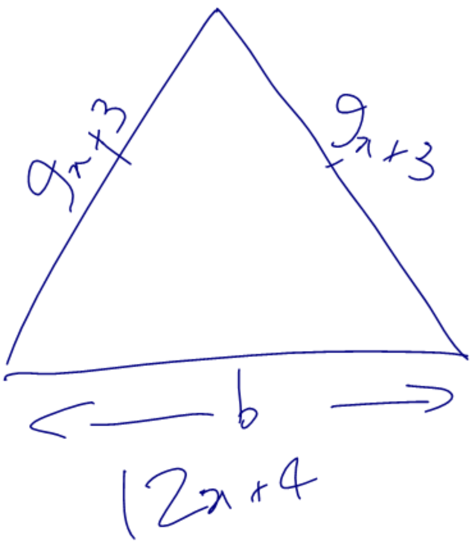
8. An isosceles triangle has two sides of length $9x + 3$. The perimeter of the triangle is $30x + 10$.

A

a) Determine the ratio of the base to the perimeter, in simplified form. State the restriction on x.

b) Explain why the restriction on x in part (a) is necessary in this situation.



P = sum of all side lengths

$$30x+10 = (9x+3) + (9x+3) + b$$

$$30x+10 = 18x+6+b$$

$$\underset{-18x}{30x} \underset{-6}{+10} = \underset{-18x}{18x} \underset{-6}{+6} + b$$

$$\boxed{12x+4} = b$$

$$\frac{b}{P} = \frac{12x+4}{30x+10} = \frac{\overset{2}{\cancel{4}}\cancel{(3x+1)}}{\underset{5}{\cancel{10}}\cancel{(3x+1)}}, \; x \neq -\frac{1}{3}$$

$$= \frac{2}{5}$$

$$\frac{0}{5} = 0$$

$$\cancel{\frac{5}{0}}$$

Unit 1 – Polynomial and Rational Expressions

2.6: Multiplying and Dividing Rational Expressions

Learning Goal: We are learning how to multiply and divide rational expressions

This concept extends what we learned in section **2.4: Simplifying Rational Expressions**., BUT we are adding a small (but **ridiculously fun**) twist.

Now we will consider more than one rational expression at a time, and **MULTIPLY OR DIVIDE** them. Since Rational Expressions are analogous to fractions, we need to remind ourselves of the rules for multiplying and dividing fractions.

MULTIPLYING FRACTIONS

The Rule is: Top x Top over Bottom x Bottom

eg $\frac{5}{9} \times \frac{8}{7} = \frac{40}{63}$

DIVIDING FRACTIONS

The Rule is: $\boxed{\text{You Can't}}$

We reciprocate (flip) the second fraction and multiply by the 1st fraction

eg $\frac{7}{10} \div \frac{3}{5}$

$= \frac{7}{\cancel{10}_2} \times \frac{\cancel{5}^1}{3} = \frac{7}{6}$

When **MULTIPLYING RATIONAL EXPRESSIONS** we need to do the following (familiar) things:

1) Factoring any polynomials which can be factored
2) **Stating any restrictions on the variable(s)**
3) Cancelling any common factors, top to bottom (even from one expression to the other)
4) Writing the rational expression in simplified form

When **DIVIDING RATIONAL EXPRESSIONS**, we do the same four things, **BUT** when stating the restrictions, there is one small twist **BECAUSE WE ARE NOT ALLOWED TO DIVIDE BY ZERO**. (Sorry, I shouldn't be shouting, but this is important. It would be terrible if you divided by zero, and then were taken away by the math-cops for endangering the universe).

Examples

a) $\frac{3\cancel{(x-2)}}{\cancel{2}x} \times \frac{\cancel{6}^{3}}{\cancel{(x-2)}}$ restrictions: $x \neq 0, 2$

$= \frac{9}{x}$

Why have I coloured the denominators?

b) $\frac{x^2-25}{3x^2+x-2} \times \frac{6x^2-13x+6}{2x^2+7x-15}$

$2x-3 \neq 0$

$\frac{2x}{2} \neq \frac{3}{2}$

$x \neq \frac{3}{2}$

$= \frac{(x-5)\cancel{(x+5)}}{(x+1)\cancel{(3x-2)}} \times \frac{\cancel{(2x-3)}\cancel{(3x-2)}}{\cancel{(2x-3)}\cancel{(x+5)}}$

restrictions $x \neq -1, -5, \frac{2}{3}, \frac{3}{2}$

$= \frac{x-5}{x+1}$

$3x^2+1x-2$ × | + : −6 | 1   3, −2

$= 3x^2+3x-2x-2$

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

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

$6x^2-13x+6$ × | + : 36 | −13   −9, −4

$= 6x^2-9x-4x+6$

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

$2x^2+7x-15$ × | + : −30 | +7   10, −3

$= 2x^2-3x+10x-15$

$= x(2x-3)+5(2x-3)$

$\frac{0}{5}=0 \quad \frac{0}{3}=0 \quad \frac{0}{-\pi}=0$

we cannot have zero in the numerator of the expression doing the dividing

c) $\frac{(2x+1)^2}{25x^2-1} \div \frac{-4x-2}{20x+4}$

restrictions

$x \neq \frac{1}{5}, -\frac{1}{5}, -\frac{1}{2}$

$$= \frac{(2x+1)^2}{(5x-1)(5x+1)} \div \frac{-2(2x+1)}{4(5x+1)}$$

$$= \frac{(2x+1)^{\cancel{2}\,1}}{(5x-1)\cancel{(5x+1)}} \times \frac{\cancel{4}^{\,2}\cancel{(5x+1)}}{\cancel{-2}_{\,-1}\cancel{(2x+1)}} = \frac{2(2x+1)}{-(5x-1)} = -\frac{2(2x+1)}{5x-1}$$

d) $\frac{9y^2-4}{4y-12} \div \frac{9y^2+12y+4}{18-6y}$

restrictions

$y \neq 3, -\frac{2}{3}$

$$= \frac{(3y-2)(3y+2)}{4(y-3)} \div \frac{(3y+2)^2}{6(3-y)}$$

$$= \frac{(3y-2)\cancel{(3y+2)}}{\cancel{4}_{\,2}\cancel{(y-3)}_{\,1}} \times \frac{\cancel{6}^{\,3}\cancel{(3-y)}^{\,-1}}{(3y+2)^{\cancel{2}\,1}} = \frac{-3(3y-2)}{2(3y+2)}$$

$9y^2+12y+4$

$\times$	$+$
36	12

$\boxed{6, 6}$

$=(3y+2)^2$

$3y+2 \neq 0$

$3y \neq -2$

$y \neq \frac{-2}{3}$

Success Criteria:

- I can multiply rational expressions by: Factoring the numerators and denominators; Stating restrictions by finding zeros of the denominator; Cancelling common factors (top to bottom); then finally writing the expression in simplified form.
- I can divide rational expressions by: Factoring the numerators and denominators; Stating restrictions by finding zeros of the denominator; Multiplying by the **reciprocal** of the **divisor**; Cancelling common factors (top to bottom); then finally writing the expression in simplified form.

Class/Homework

Pg. 121 – 123 #3, 5, 6abc, 8 – 11