Ch. 6 Notes KEY PC-11 Spring 2019

6.1 – Properties of Rational Expressions

A rational expression is ... an algebraic fraction with a numerator and or denominator that are polynomials

ex $\frac{1}{x}$, $\frac{y}{y-2}$, $\frac{x+2}{x^2+4x+4}$, $\frac{m^2-9}{3}$

how zero affects division

Evaluate $\frac{0}{3} = 0$ Think: If you have zero items and split them into 3 groups, how many items are in each group?

When zero is divided by any non-zero real number, ... the result is zero

Evaluate $\frac{7}{0}$ = undefined

Division by zero is undefined because... if you have 7 items, you cannot put them into zero groups

undefined values

For the expression $\frac{3}{x-2}$, what value for x is undefined? $x \neq 2$

What is an **undefined value**?

any value that will make the denominator zero, as this will cause the expression to be undefined

Write a rule that explains how to determine undefined values:

set the denominator expression equal to zero. The result of solving that equation is/are the undefined value(s).

Example 1 - Determine the undefined values for each rational expression

a) $\frac{4a}{3b}$

$b \neq 0$

$\frac{\cancel{3}b}{\cancel{3}} = \frac{0}{3}$

$b = 0$

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

$x \neq -2, 3$

c) $\frac{2y^2}{y^2-4}$

$\frac{2y^2}{(y+2)(y-2)}$

$y \neq \pm 2$

simplifying rational expressions

When simplifying rational expressions:

1) Factor as much as possible

2) Reduce/cancel common factors

Example 2 - Simplify the rational expressions. Keep a running list of undefined values.

a) $\frac{3x-3}{6x-6}$ $\boxed{x \neq 1}$

$\frac{3\cancel{(x-1)}}{6\cancel{(x-1)}}$

$\frac{3}{6} = \frac{1}{2}$

b) $\frac{x-2}{x^2-4}$ $\boxed{x \neq \pm 2}$

$\frac{\cancel{x-2}}{(x+2)\cancel{(x-2)}}$

$\frac{1}{x+2}$

c) $\frac{3x-6}{2x^2+x-10}$ $\boxed{x \neq 2, -\frac{5}{2}}$

$2x^2+x-10$

$2x^2-4x+5x-10$

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

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

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

$\frac{3}{2x+5}$

d) $\frac{2y^2+y-10}{y^2+3y-10}$ $\boxed{y \neq -5, 2}$

$\frac{\cancel{(y-2)}(2y+5)}{(y+5)\cancel{(y-2)}}$

$\frac{2y+5}{y+5}$

e) $\frac{6-2m}{m^2-9}$ $\boxed{m \neq \pm 3}$

$\frac{2(3-m)}{(m+3)(m-3)}$

Now, factor -1 out of $(3-m) \Rightarrow -1(-3+m)$

now rearrange bracket: $-(m-3)$

So: $\frac{-2\cancel{(m-3)}}{(m+3)\cancel{(m-3)}}$

$\frac{-2}{m+3}$

f) $\frac{x^2y+xy^2}{xy+y^2}$ $\boxed{\begin{matrix} y \neq 0 \\ y \neq -x \end{matrix}}$

$\frac{xy\cancel{(x+y)}}{y\cancel{(x+y)}}$

$= x$

*See the bottom of page 1 for *Common Errors*

6.2 – Multiplying & Dividing Rational Expressions

multiplication & division review

Warmup – Simplify

a) $\left(\frac{3}{-4}\right)\left(\frac{1}{2}\right)$

$\frac{-3}{8}$

b) $\left(\frac{\cancel{8}}{\cancel{8}}\right)\left(\frac{-\cancel{1}}{\cancel{18}}\right)$

$= \frac{-1}{6}$

c) $\frac{2}{3} \div \frac{3}{4}$

$= \frac{2}{3} \times \frac{4}{3}$

$= \frac{8}{9}$

d) $\frac{\frac{2}{5}}{\frac{-1}{10}} = \frac{2}{5} \div \frac{-1}{10}$

$= \frac{2}{\cancel{5}} \times \frac{-\cancel{10}}{1}$

$= -4$

Explain how to multiply fractions: ① Look to reduce ② Multiply numerators ③ Multiply denominators ④ Look to reduce

Explain how to divide fractions: ① Flip the 2nd fraction and change ÷ to × Follow the 4 multiply steps above.

Example 1 - Simplify and keep a running list of undefined values

a) $\left(\frac{x+3}{2}\right)\left(\frac{x+1}{4}\right)$

$\frac{(x+3)(x+1)}{8}$

OR

$\frac{x^2+4x+3}{8}$

b) $\left(\frac{4x^2}{3xy}\right)\left(\frac{y^2}{8x}\right)$ $\boxed{x \neq 0,\ y \neq 0}$

$\frac{\cancel{4}x^{\cancel{2}}y^{\cancel{2}}}{6\cancel{24}x^{\cancel{2}}\cancel{y}}$

$\frac{y}{6}$

c) $\left(\frac{d}{2\pi r}\right)\left(\frac{2\pi rh}{d-2}\right)$

$\frac{\cancel{2}\cancel{\pi}\cancel{r}hd}{\cancel{2}\cancel{\pi}\cancel{r}(d-2)}$ $\boxed{r \neq 0,\ d \neq 2}$

$\frac{hd}{d-2}$

Example 2 - Simplify and keep a running list of undefined values

a) $\frac{y^2-9}{r^3-r} \times \frac{r^2-r}{y+3}$ $\boxed{r \neq \pm 1, 0,\ y \neq -3}$

$\frac{(y+3)(y-3)r(r-1)}{r(r^2-1)(y+3)}$

$\frac{\cancel{r}\cancel{(r-1)}\cancel{(y+3)}(y-3)}{\cancel{r}(r+1)\cancel{(r-1)}\cancel{(y+3)}}$

$\frac{y-3}{r+1}$

b) $\left(\frac{x^2-x-12}{x^2-9}\right)\left(\frac{x^2-4x+3}{x^2-4x}\right)$ $\boxed{x \neq \pm 3, 0, 4}$

$\frac{\cancel{(x-4)}\cancel{(x+3)}\cancel{(x-3)}(x-1)}{\cancel{(x+3)}\cancel{(x-3)}x\cancel{(x-4)}}$

$\frac{x-1}{x}$

$3x^2-5x-12$

$3x^2-9x+4x-12$

$3x(x-3)+4(x-3)$

$(x-3)(3x+4)$

Example 3 - Simplify and keep a running list of undefined values

a) $\frac{m^2-6m-7}{m^2-49} \div \frac{m^2+8m+7}{m^2+7m}$ $\boxed{m \neq 0, \pm 7, -1}$

b) $\frac{3x+12}{3x^2-5x-12} \div \frac{12}{3x+4} \times \frac{2x-6}{x+4}$ $\boxed{x \neq -\frac{4}{3}, 3, -4}$

$$\frac{(m-7)(m+1)}{(m+7)(m-7)} \div \frac{(m+7)(m+1)}{m(m+7)}$$

$$\frac{(m-7)(m+1)}{(m+7)(m-7)} \times \frac{m(m+7)}{(m+7)(m+1)}$$

$$\frac{\cancel{(m-7)}\cancel{(m+1)}m\cancel{(m+7)}}{\cancel{(m+7)}\cancel{(m-7)}(m+7)\cancel{(m+1)}}$$

$$\frac{m}{m+7}$$

$$\frac{3(x+4)}{(3x+4)(x-3)} \div \frac{12}{3x+4} \times \frac{2(x-3)}{x+4}$$

$$\frac{3(x+4)}{(3x+4)(x-3)} \times \frac{3x+4}{12} \times \frac{2(x-3)}{x+4}$$

$$\frac{6\cancel{(x+4)}\cancel{(3x+4)}\cancel{(x-3)}}{12\cancel{(3x+4)}\cancel{(x-3)}\cancel{(x+4)}}$$

$$= \frac{1}{2}$$

6.3 – Adding & Subtracting Rational Expressions

adding & subtracting review

Warmup – Simplify each expression

a) $\frac{5^{\times 4}}{6_{\times 4}} - \frac{3^{\times 3}}{8_{\times 3}}$

$\frac{20}{24} - \frac{9}{24}$

$= \frac{11}{24}$

b) $-\frac{2^{\times 5}}{3_{\times 5}} + \frac{4^{\times 3}}{5_{\times 3}}$

$\frac{-10}{15} + \frac{12}{15}$

$= \frac{2}{15}$

c) $\frac{7x+1}{x} + \frac{5x-2}{x}$ $\boxed{x \neq 0}$

$\frac{7x+1+(5x-2)}{x}$

$\frac{7x+1+5x-2}{x}$

$\frac{12x-1}{x}$

d) $\frac{7^{\times 4x}}{6x^2_{\times 4x}} - \frac{3^{\times 3}}{8x^3_{\times 3}}$ $\boxed{x \neq 0}$

$\frac{28x}{24x^3} - \frac{9}{24x^3}$

$\frac{28x-9}{24x^3}$

Write the steps to adding/subtracting fractions:

1. Get common denominators
2. Add or subtract numerators (and leave the denominator the same)
3. Look to reduce.

Example 1 - Simplify and identify all undefined values

a) $\frac{10y-1}{4y-3} - \frac{8-2y}{4y-3}$ $\boxed{y \neq \frac{3}{4}}$

$\frac{10y-1-(8-2y)}{4y-3}$

$\frac{10y-1-8+2y}{4y-3}$

$\frac{12y-9}{4y-3}$

$\frac{3(4y-3)}{4y-3}$

$= 3$

b) $\frac{2x^{\cdot x}}{xy_{\cdot x}} + \frac{4^{\cdot y}}{x^2_{\cdot y}} - \frac{3^{\cdot x^2y}}{1_{\cdot x^2y}}$ $\boxed{x \neq 0, y \neq 0}$

$\frac{2x^2}{x^2y} + \frac{4y}{x^2y} - \frac{3x^2y}{x^2y}$

$\frac{2x^2+4y-3x^2y}{x^2y}$

c) $\frac{3}{3x+6} + \frac{1}{x+2}$ $\boxed{x \neq -2}$

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

$\frac{1}{x+2} + \frac{1}{x+2}$

$= \frac{1+1}{x+2}$

$= \frac{2}{x+2}$

Steps: 1) Factor as much as possible. Do any relevant reducing.

2) List undefined values

3) Get common denominators.

4) Add or subtract numerators

5) Do any further factoring and/or reducing.

Example 2 - Simplify and identify all undefined values

a) $\frac{4}{p^2-1}+\frac{3}{1-p}$ $\boxed{p\neq\pm1}$

$$\frac{4}{(p+1)(p-1)}+\frac{3}{-1(-1+p)}$$

$$\frac{4}{(p+1)(p-1)}+\frac{-3}{(p-1)}\frac{(p+1)}{(p+1)}$$

$$\frac{4-3(p+1)}{(p+1)(p-1)}$$

$$\frac{4-3p-3}{(p+1)(p-1)}=\frac{-3p+1}{(p+1)(p-1)}$$

b) $\frac{x-2}{x^2+x-6}-\frac{x^2+6x+5}{x^2+4x+3}$ $\boxed{x\neq-3,-1,2}$

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

$$\frac{1}{x+3}-\frac{x+5}{x+3}$$

$$\frac{1-(x+5)}{x+3}$$

$$\frac{1-x-5}{x+3}=\frac{-x-4}{x+3}=-\frac{x+4}{x+3}$$

c) $\frac{1}{x^2-1}-\frac{2}{x^2+x}$ $\boxed{x\neq0,\pm1}$

$$\frac{1}{(x+1)(x-1)}\frac{x}{x}-\frac{2}{x(x+1)}\frac{(x-1)}{(x-1)}$$

$$\frac{x-2(x-1)}{x(x+1)(x-1)}$$

$$\frac{x-2x+2}{x(x+1)(x-1)}$$

$$\frac{-x+2}{x(x+1)(x-1)}$$

d) $\frac{3x+9}{x^2+7x+10}+\frac{14}{x^2+3x-10}$ $\boxed{x\neq-5,\pm2}$

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

$$\frac{3(x^2+x-6)+14(x+2)}{(x+5)(x+2)(x-2)}$$

$$\frac{3x^2+3x-18+14x+28}{(x+5)(x+2)(x-2)}$$

$$\frac{3x^2+17x+10}{(x+5)(x+2)(x-2)}$$

$$3x^2+15x+2x+10$$
$$3x(x+5)+2(x+5)$$
$$(x+5)(3x+2)$$

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

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

6.4 – Mixed Operations

When simplifying rational expressions with mixed operations, ORDER OF OPERATIONS is to be followed (**BEDMAS**).

Example 1 – Simplify & identify all undefined values

a) $\frac{x+5}{x+6} + \left(\frac{1}{x+4} \div \frac{x+6}{x^2-x-20}\right)$ $x \neq -6, -4, 5$

$\frac{x+5}{x+6} + \left(\frac{1}{x+4} \div \frac{x+6}{(x-5)(x+4)}\right)$

$\frac{x+5}{x+6} + \frac{1}{x+4} \times \frac{(x-5)(x+4)}{(x+6)}$

$\frac{x+5}{x+6} + \frac{(x-5)\cancel{(x+4)}}{\cancel{(x+4)}(x+6)}$

$\frac{x+5}{x+6} + \frac{x-5}{x+6}$

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

$\frac{x+5+x-5}{x+6}$

$\frac{2x}{x+6}$

b) $\left(\frac{x-3}{x^2-9} + \frac{x+3}{x^2+6x+9}\right)\left(\frac{x+3}{x+1}\right)$ $x \neq \pm 3, -1$

$\left(\frac{\cancel{x-3}}{(x+3)\cancel{(x-3)}} + \frac{\cancel{x+3}}{\cancel{(x+3)}(x+3)}\right)\left(\frac{x+3}{x+1}\right)$

$\left(\frac{1}{x+3} + \frac{1}{x+3}\right)\left(\frac{x+3}{x+1}\right)$

$\left(\frac{2}{\cancel{x+3}}\right)\left(\frac{\cancel{x+3}}{x+1}\right)$

$\frac{2}{x+1}$

Complex Fractions – Rational Expressions that contain fractions in the numerators and/or denominators.

Example 2 - Simplify and identify all undefined values

$\boxed{y \neq 0, \pm 2}$

$\frac{2-\frac{4}{y}}{y-\frac{4}{y}}$

Numerator:

$\frac{2 \cdot y}{1 \cdot y} - \frac{4}{y}$

$\frac{2y}{y} - \frac{4}{y}$

$\frac{2y-4}{y}$

$\frac{2(y-2)}{y}$

Denom:

$\frac{y \cdot y}{1 \cdot y} - \frac{4}{y}$

$\frac{y^2-4}{y}$

$\frac{(y+2)(y-2)}{y}$

$\frac{2(y-2)}{y} \div \frac{(y+2)(y-2)}{y}$

$\frac{2\cancel{(y-2)}}{\cancel{y}} \times \frac{\cancel{y}}{(y+2)\cancel{(y-2)}}$

$\frac{2}{y+2}$

Steps:

1) Get a common denominator for the numerator and then the denominator of the complex fraction.

2) Write each as one fraction.

3) Rewrite the division in a side-by-side manner and simplify.

Example 3 – Simplify and identify all undefined values

a) $\dfrac{\frac{2}{5x}-\frac{3}{x^2}}{\frac{7}{2x}+\frac{3}{4x^2}}$ $\boxed{x \neq 0, \frac{-3}{14}}$

Num:

$\dfrac{2 \cdot x}{5x \cdot x} - \dfrac{3 \cdot 5}{x^2 \cdot 5}$

$\dfrac{2x}{5x^2} - \dfrac{15}{5x^2}$

$\dfrac{2x-15}{5x^2}$

Denom:

$\dfrac{7 \cdot 2x}{2x \cdot 2x} + \dfrac{3}{4x^2}$

$\dfrac{14x}{4x^2} + \dfrac{3}{4x^2}$

$\dfrac{14x+3}{4x^2}$

$\dfrac{2x-15}{5x^2} \div \dfrac{14x+3}{4x^2}$

$\dfrac{2x-15}{5x^2} \times \dfrac{4x^2}{14x+3}$

$\dfrac{4\cancel{x^2}(2x-15)}{5\cancel{x^2}(14x+3)}$

$\dfrac{4(2x-15)}{5(14x+3)}$

b) $\dfrac{\frac{1}{x-1}+\frac{2}{x+2}}{\frac{2}{x+2}-\frac{1}{x-3}}$ $\boxed{x \neq 1, 3, -2, 8}$

Num:

$\dfrac{1^{(x+2)}}{x-1_{(x+2)}} + \dfrac{2^{(x-1)}}{x+2_{(x-1)}}$

$\dfrac{x+2+2(x-1)}{(x-1)(x+2)}$

$\dfrac{x+2+2x-2}{(x-1)(x+2)}$

$\dfrac{3x}{(x-1)(x+2)}$

Denom:

$\dfrac{2^{(x-3)}}{x+2_{(x-3)}} - \dfrac{1^{(x+2)}}{x-3_{(x+2)}}$

$\dfrac{2(x-3)-1(x+2)}{(x+2)(x-3)}$

$\dfrac{2x-6-x-2}{(x+2)(x-3)}$

$\dfrac{x-8}{(x+2)(x-3)}$

$\dfrac{3x}{(x-1)(x+2)} \div \dfrac{x-8}{(x+2)(x-3)}$

$\dfrac{3x}{(x-1)\cancel{(x+2)}} \times \dfrac{\cancel{(x+2)}(x-3)}{x-8}$

$\dfrac{3x(x-3)}{(x-1)(x-8)}$

6.5 – Rational Equations

A rational equation is an equation containing at least one rational expression. Remember, when working with an equation, whatever you do to one side, you do to the other side.

Steps to solving rational equations:

1) Factor each denominator if possible.
2) Identify any undefined values (and do this throughout).
3) Multiply both sides of the equation by what would be the lowest common denominator in order to eliminate the fractions.
4) Solve the equation.
5) Check your solutions.

Example 1 - Solve

a) $\frac{6x}{2} + \frac{7(6)}{3} = \frac{5(6)}{6}$ * no restrictions

$3x + 14 = 5$

$-14 \quad -14$

$\frac{3x}{3} = \frac{-9}{3}$

$x = -3$

b) $\frac{(9x)5}{3x} - \frac{1^{(9x)}}{9} = \frac{4(9x)}{x}$ $\boxed{x \neq 0}$

$15 - x = 36$

$x = -21$

Example 2 – Solve

a) $\frac{2x^{(x-4)}}{x-4} = \frac{8^{(x-4)}}{x-4} + 1^{(x-4)}$ $\boxed{x \neq 4}$

$2x = 8 + x - 4$

$-x \quad -x$

$x = 4$

But, $x \neq 4$ so

NO SOLUTIONS

EXTRANEOUS!

b) $\frac{9}{y-3} - \frac{4}{y-6} = \frac{18}{y^2-9y+18}$

$\frac{9^{(y-6)}}{y-3} - \frac{4^{(y-3)}}{y-6} = \frac{18}{(y-6)(y-3)}$ $\boxed{y \neq 6, 3}$

$9(y-6) - 4(y-3) = 18$

$9y - 54 - 4y + 12 = 18$

$5y - 42 = 18$

$5y = 60$

$y = 12$

When a solution is the same as an undefined value, it is called an EXTRANEOUS solution.

Example 3 – Solve

a) $\frac{1}{x-4} - \frac{1}{x-2} = \frac{2x}{x^2-6x+8}$

$\boxed{x \neq 4, 2}$

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

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

$x-2-x+4 = 2x$

$2 = 2x$

$1 = x$

b) $\frac{4}{2x-1} = \frac{2}{x+3}$

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

$2(2x-1) = 4(x+3)$

$4x-2 = 4x+12$

$0 = 14$

NO SOLUTIONS

c) $\frac{5}{x-7} - \frac{1}{2x} = \frac{9x+7}{2x^2-14x}$

$\boxed{x \neq 0, 7}$

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

$10x-(x-7) = 9x+7$

$10x-x+7 = 9x+7$

$9x+7 = 9x+7$

$0 = 0$

Infinite Solutions so all values of x except 0 and 7

6.7 – Applications of Rational Equations

There is no fool-proof way to solve a word problem. You should try to read the problem carefully, create a *'Let'* statement for your variable, build your equation (sometimes using a table or diagram for assistance), and solve the equation. Then do a check.

Example 1 – Stella takes 4 hours to paint a room. It takes Jose 3 hours to paint the same area. How long will the paint job take if they work together?

	Time to Paint (hours)	Fraction of Work Done in 1 hour	Fraction of Work Done in *x* hours
Stella	4	$\frac{1}{4}$	$\frac{x}{4}$
Jose	3	$\frac{1}{3}$	$\frac{x}{3}$
Together	x	$\frac{1}{x}$	$\frac{x}{x} = 1$

$\frac{x}{4} + \frac{x}{3} = 1$

$\frac{x^{(12)}}{4} + \frac{x^{(12)}}{3} = 1^{(12)}$

$3x + 4x = 12$

$7x = 12$

$x = \frac{12}{7}$

$x = 1\frac{5}{7}$ hours

how many minutes is $\frac{5}{7}$ of an hour?

$\frac{5}{7} \times \frac{60}{1} = \frac{300}{7} = 43$

1 hour and 43 minut

Example 2 – Jenny takes 5 hours to install laminate flooring in the kitchen by herself. Mike can do the job alone in 6 hours. How long would it take them if they did it together? Let x = time (in hours) to complete the job together

$\frac{x}{5} + \frac{x}{6} = 1$

$\frac{x^{(30)}}{5} + \frac{x^{(30)}}{6} = 1^{(30)}$

$6x + 5x = 30$

$11x = 30$

$x = \frac{30}{11}$

$x = 2\frac{8}{11}$ hours

$\frac{8}{11} \times \frac{60}{1} = \frac{480}{11} = 44$

2 hours and 44 minutes

Example 3 – Evan works twice as fast as JJ. If it takes them 13 minutes & 20 seconds together to shovel snow from the driveway, how long would it take JJ by himself?

20 seconds is $\frac{1}{3}$ of a minute

$13\frac{1}{3}$ minutes or $\frac{40}{3}$ minutes

Let x = time it takes Evan alone

so $2x$ = " " " JJ "

$\frac{\frac{40}{3}}{x} + \frac{\frac{40}{3}}{2x} = 1$

$\frac{\frac{40}{3}(2x)}{x} + \frac{\frac{40}{3}(2x)}{2x} = 1(2x)$

$\frac{80}{3} + \frac{40}{3} = 2x$

$\frac{120}{3} = 2x$

$40 = 2x$

Evan: $x = 20$ minutes

JJ: $2x = 40$ minutes

It would take JJ 40 mins by himself

Example 4 – A speedboat can travel 108km downstream in the same time it can travel 78km upstream. If the current of the river is 10km/h, what is the speed of the boat in still water?

Let x = speed in still water

$s = \frac{d}{t}$ $\quad d = st$ $\quad t = \frac{d}{s}$

	d (km)	s (km/h)	t (h)	Equation
downstream	108	$x + 10$	$\frac{108}{x+10}$	$\frac{108}{x+10} = \frac{78}{x-10}$
upstream	78	$x - 10$	$\frac{78}{x-10}$	

$\frac{108}{x+10} = \frac{78}{x-10}$ $\quad \boxed{x \neq \pm 10}$

$108(x-10) = 78(x+10)$

$108x - 1080 = 78x + 780$

$-78x \quad +1080 \quad -78x \quad +1080$

$30x = 1860$

$x = \frac{1860}{30} = 62 \text{ km/h}$

The speed of the boat in still water is 62 km/h

Example 5 – A car travels from home to work at an average speed of 80km/h, and because of traffic, returns from work at an average speed of 50km/h. What is the average speed of the entire trip (to work and back) if the distance to work is 20km (to the nearest tenth)?

$t = \frac{d}{s}$

	d (km)	s (km/h)	time (h)	Eqn
home to work	20	80	$\frac{20}{80} = 0.25$	
work to home	20	50	$\frac{20}{50} = 0.4$	

Total distance = $20 + 20 = 40$ km

Total time = $0.25 + 0.4 = 0.65$ h

Avg speed = $\frac{d}{t} = \frac{40}{0.65} = 61.5$ km/h