

6.1 Simplifying & Restrictions

Rational Numbers are numbers that can be written in the form $\frac{a}{b}$, for example

$$\frac{2}{3}, 5, -\frac{319}{685}, 0, 0.42$$

... as opposed to **Irrational Numbers** like

$$\pi, \sqrt{2}, \sqrt{5x+1}$$

A Rational Expression is an algebraic fraction that has polynomials in the numerator and denominator.

e.g. $\frac{x^2+10}{3x+7}, \frac{14x}{x^2-2x-12}$

Radicals from the last chapter may be Irrational, so they are not rational expressions.

When dealing with rational expressions, we must identify any non-permissible values which are values that make the denominator zero.

Example 1: p.312 - determine the non-permissible values for the rational expressions:

a) $\frac{5t}{4sr^2} \rightarrow 4sr^2 \neq 0$
 $\swarrow \quad \searrow$
 $s \neq 0$ or $r \neq 0$

b) $\frac{3x}{x(2x-3)} \rightarrow x(2x-3) \neq 0$
 $\swarrow \quad \searrow$
 $x \neq 0$ $x \neq \frac{3}{2}$

c) $\frac{2p-1}{p^2-p-12}$
 $\downarrow$
 $p^2-p-12 \neq 0$
 $(p-4)(p+3) \neq 0$
 $p \neq 4$ or $p \neq -3$

d) $\frac{2x^3-50x}{-5} \rightarrow -5 \neq 0$
 $\therefore$ No Restrictions

Just like fractions, we can simplify rational expressions by cancelling factors out of both the numerator and denominator, so we will need to factor.

Example 2: p.314 – Simplify each rational expression and state the non-permissible values:

$$\begin{aligned} \text{a) } \frac{3x-6}{2x^2+x-10} &\rightarrow \frac{3(x-2)}{(2x+5)(x-2)} \rightarrow \frac{3}{2x+5} \\ &\quad 2x^2+5x-4x-10 \\ &\quad x(2x+5)-2(2x+5) \end{aligned}$$

with restrictions $x \neq 2 \text{ or } -\frac{5}{2}$

$$\text{b) } \frac{1-t}{t^2-1} \rightarrow \frac{-1(t-1)}{(t+1)(t-1)} \rightarrow \frac{-1}{t+1}$$

with restrictions $t \neq \pm 1$

$$\begin{aligned} \text{c) } \frac{2y^2+y-10}{y^2+3y-10} &\rightarrow \frac{(2y+5)(y-2)}{(y-2)(y+5)} \\ &= \frac{2y+5}{y+5} \end{aligned}$$

& $y \neq \underline{2} \text{ or } \underline{-5}$

Example 3: p.315

$$\frac{16x^2 - 9y^2}{8x - 6y}$$

a) Give the non-permissible values for x

$$\begin{aligned} 8x - 6y &\neq 0 \\ 8x &\neq 6y \\ x &\neq \frac{3}{4}y \end{aligned}$$

$\therefore$ points like
 $(\frac{3}{4}, 1)$
 $(3, 4)$
 $(6, 8)$
 $(-9, -12)$ etc. $(0, 0)$

b) Simplify the rational expression

$$\begin{aligned} &= \frac{(4x + 3y)(4x - 3y)}{8x - 6y} \\ &= \frac{(4x + 3y)(4x - 3y)}{2(4x - 3y)} \rightarrow \frac{4x + 3y}{2} \end{aligned}$$

c) Evaluate the expression for $x = 2.6$ and $y = 1.2$

$$\begin{aligned} &= \frac{4(2.6) + 3(1.2)}{2} \\ &= \frac{10.4 + 3.6}{2} \\ &= \frac{14}{2} \\ &= \underline{\underline{7}} \end{aligned}$$

Assignment: p. 317 # 1-4(abcd), 6, 8, 11, 13, 22