

6.1 Rational Expressions

Rational Expression:

the quotient of two polynomials, in the form $\frac{P(x)}{Q(x)}$, where $Q(x) \neq 0$.

Examples:

$$\frac{1}{x}, \frac{m}{m+1}, \frac{y^2-1}{y^2+2y+1}, \frac{x}{2y}, x^2-1$$

Non-permissible values

values that make the denominator of a rational expression equal zero.

What are the non permissible values for $\frac{x}{x+2}$?

What values of x will make $x+2=0$?

Examples:

What are the non-permissible values (restrictions) for the following:

a) $\frac{x-1}{3x^2-12}$

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

Substitute the non-permissible value(s) of x back into the denominator to verify that the denominator results in zero.

c) $\frac{2x-1}{x^2-x-12}$

d) $\frac{5t}{4st^2}$

Turn over

Your Turn

Determine the non-permissible value(s) for each rational expression

(i) $\frac{x-1}{x^2-x-6}$

(ii) $\frac{4a}{3bc}$

(iii) $\frac{2y^2}{y^2-4}$

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

Example:

What are the non-permissible values for $\frac{x+3}{x^2-16}$?

The image shows three stick figures holding signs with the following text:

- Figure 1: *I think the non-permissible value is 4.*
- Figure 2: *I think the non-permissible values are -4 and 4.*
- Figure 3: *I think the non-permissible values are -4, -3 and 4.*

Who is correct? Justify your answer by solving the problem.

Equivalent Rational Expressions

↳ If you multiply an expression by 1, you do not change its value, you simply create an equivalent expression.

Examples: Are the following equivalent:

(i) $\frac{1}{3}$ and $\frac{6}{18}$

(ii) $\frac{7}{x}, x \neq 0$ and $\frac{7x}{x^2}, x \neq 0$

(iii) $\frac{7x}{x-2}, x \neq 2$ and $\frac{7x^2}{x(x-2)}, x \neq 0, 2$

Note: *Non-permissible values* and *inadmissible values* are not the same.

↑
Unit: Quadratics

Non - permissible values are values that make the denominator of a rational expression zero.

Inadmissible values are values that do not make sense in a given context. For example, you cannot have a negative length.

Simplifying Rational Expressions

- Rational expressions can be reduced to lowest terms if they have common factors. The common factors will end up canceling.
- To get them to cancel we try to factor both the numerator and denominator.

Review of Factoring:

Completely factor each of the following.

a) $2x^2 + 4x$

b) $x^2 - 16$

c) $x^2 - x - 12$

d) $2x^2 + 22x + 60$

e) $2x^2 - 5x - 3$

f) $4x^2 - 36$

Turn Over

Example 1:

Simplify each of the following and state the non-permissible values.

a) $\frac{x+3}{2x+6}$

b) $\frac{x-4}{x^2-16}$

c) $\frac{3x-6}{2x^2+x-10}$

d) $\frac{1-x}{x^2-1}$

e) $\frac{2y^2+y-10}{y^2+3y-10}$

f) $\frac{6-2x}{x^2-9}$

Turn Over

Example 2:

Rational Expressions With Pairs of Non-Permissible Values

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

- What expression represents the non-permissible values for x ?
- Simplify the rational expression.
- Evaluate the expression for $x = 2.6$ and $y = 1.2$.

Example 3: Identify and correct the errors.

$$\begin{aligned} & \frac{8x-12}{6x^2-4x}, \quad x \neq 0, \frac{2}{3} \\ &= \frac{4(2x-3)}{2x(3x-2)} \\ &= \frac{4}{2x} (1) \\ &= 2x, \quad x \neq 0, \frac{2}{3} \end{aligned}$$

Key Ideas p. 317

Assign p. 317 - 321

**questions 1(bdf), 4(bcef), 6(bcd), 7, 8(bcde),
9, 10, 13, 14, 15, 19, 21, 22, 24, 25**