

7.3 - Multiplying and Dividing Rational Expressions

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Warmup

$$1. \frac{a^{2m}b^{2m+1}}{(a^2b^2)^m} \quad b$$

$$2. \frac{x^{n+1}y^n}{x^ny^{n-1}} \quad xy$$

$$3. \frac{(pq)^n}{pq^n} \quad p^{n-1}$$

$$4. \frac{(z^n)^3}{z^nz^3} \quad z^{2n-3}$$

$$5. \frac{t^{n+1}t^{n-1}}{t^n} \quad t^n$$

$$6. \frac{a^{n-1}b^{2n}}{a^{n+1}(b^2)^{n-1}} \quad \frac{b^2}{a^2}$$

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Rational Expressions

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

Restrictions? $x \neq 1, -1$ ← Hole in the graph

Practice

1. $\frac{x^2 - 9}{x^2 + x - 12}$

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

$$x \neq -4, 3$$

2. $\frac{-3x^2 - 6x}{5x + 10}$

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

$$x \neq -2$$

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Multiply Rational Expressions

$$\frac{x^2 - 3x - 4}{x^2 - 1} \cdot \frac{x^2 - 2x + 1}{x^2 - 2x - 8} = \frac{(x - 4)(x + 1)}{(x - 1)(x + 1)} \cdot \frac{(x - 1)(x - 1)}{(x - 4)(x + 2)}$$
$$= \frac{x - 1}{x + 2}$$

Restrictions? $x \neq 1, -1, 4, -2$ ← Holes in the graph

Practice

1. $\frac{3x + 15}{2} \cdot \frac{8}{x^2 + 4x - 5}$

$$\frac{12}{x - 1} \quad x \neq -5, 1$$

Hole -5

2. $\frac{x^2 - 8x - 48}{2(12 - x)} \cdot \frac{4x + 4z}{x + z}$

$$-2(x + 4)$$
$$x \neq 12, -z$$

Hole 12

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Rational Expressions

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

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

$$\frac{x^2 - z^2}{(z - x)^2}$$

$$= \frac{(x - z)(x + z)}{(z - x)(z - x)}$$

$$= \frac{(x - z)(x + z)}{-(x - z)(z - x)}$$

$$= \frac{x + z}{-(z - x)}$$

$$= \frac{x + z}{x - z}$$

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Reducing Rational Expressions

$$\frac{x^2 - 3x - 4}{x^2 - 1} \cdot \frac{x^2 - 2x + 1}{x^2 - 2x - 8} = \frac{(x - 4)(x + 1)}{(x - 1)(x + 1)} \cdot \frac{(x - 1)(x - 1)}{(x - 4)(x + 2)}$$
$$= \frac{x - 1}{x + 2}$$

Restrictions? $x \neq 1, -1, 4, -2$

Practice

1. $\frac{x^3 - 27}{-x^3 + 9x}$

$$\frac{x^2 + 3x + 9}{-x(x + 3)}$$

$$x \neq 0, -3, 3$$

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

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

$$x \neq \pm\sqrt{2}$$

Not graphed



$$x \neq \pm i\sqrt{2}$$

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Domain and Zeros

$$\frac{x^2 - 3x - 4}{x^2 - 1}$$

What is the domain? $x \neq 1, -1$

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

What are the zeros? $x = 4, -\cancel{1}$

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Domain and Zeros

$$\frac{x^2 - 3x - 4}{x^2 - 1}$$

What is the domain? $x \neq 1, -1$

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

What are the zeros? $x = 4, -1$

Practice

1. $\frac{x^2 - 4}{x^2 - 9}$

Domain : $x \neq 3, -3$

Zeros : $x = 2, -2$

2. $\frac{x^2 - 8x - 48}{x^2 + 4}$

Domain : $x \neq \pm 2i$

Zeros : $x = -4, 12$

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Dividing Rational Expressions

$$\begin{aligned}\frac{\frac{x^2 - 3x - 4}{x^2 - 1}}{\frac{x^2 - 2x - 8}{x^2 - 2x + 1}} &= \frac{x^2 - 3x - 4}{x^2 - 1} \div \frac{x^2 - 2x - 8}{x^2 - 2x + 1} \\ &= \frac{x^2 - 3x - 4}{x^2 - 1} \cdot \frac{x^2 - 2x + 1}{x^2 - 2x - 8} \\ &= \frac{(x - 4)(x + 1)}{(x - 1)(x + 1)} \cdot \frac{(x - 1)(x - 1)}{(x - 4)(x + 2)} = \frac{x - 1}{x + 2}\end{aligned}$$

Practice

$$1. \frac{\frac{6s^2t}{r}}{\frac{3st^2}{r}} \quad \frac{2s}{t}$$

$$2. \frac{\frac{a^2 - 4ab + 3b^2}{a + 2b}}{a^2 - ab - 6b^2} \quad \frac{a - b}{(a + 2b)^2}$$

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Rational Expressions

$$\begin{aligned}\frac{6p^2q}{r} \div \frac{3pq^2}{r} \cdot \frac{2q^2}{pr} &= \frac{6p^2q}{r} \cdot \frac{r}{3pq^2} \cdot \frac{2q^2}{pr} \\ &= \frac{12p^2q^3r}{3p^2q^2r^2} = \frac{4q}{r}\end{aligned}$$

Practice

1. $\frac{r^4s}{t} \cdot \frac{t^3}{r^2s} \div \frac{rs}{t}$

$$\frac{rt^3}{s}$$

2. $\frac{x^2 - 1}{x + 2} \div \frac{x + 1}{x - 2} \cdot \frac{x^2 - 4}{x - 1}$

$$x^2 - 4x + 4$$

