

GOOD MORNING!

Simplify.

$$\textcircled{1} \frac{\cancel{x}(x-2)}{\cancel{x}(x+2)} = \boxed{\frac{(x-2)}{(x+2)}}$$

$$\textcircled{2} \frac{(x-1)\cancel{(x+2)}}{\cancel{2+x} \pm x-1} = \boxed{x-1}$$

$$\textcircled{3} \frac{\cancel{x}(x-1)}{\cancel{x}} = \boxed{x-1}$$

$$\textcircled{4} \frac{2-x}{x-2} = \frac{-1(x-2)}{\cancel{x-2}} = \boxed{-1}$$

$$\begin{aligned} \textcircled{5} \frac{x-2}{x^2-4} &= \frac{\cancel{x-2}}{(x+2)\cancel{(x-2)}} \\ &= \boxed{\frac{1}{x+2}} \end{aligned}$$

$$\begin{aligned} \textcircled{6} \frac{x^2+x}{x^2-1} &= \frac{x\cancel{(x+1)}}{\cancel{(x+1)}(x-1)} = \boxed{\frac{x}{x-1}} \end{aligned}$$

## SIMPLIFYING RATIONAL EXPRESSIONS

①  $\frac{x^3 + 6x^2 + 9x}{x^3 - 9x}$  FACTOR FIRST

$$\frac{x(x^2 + 6x + 9)}{x(x^2 - 9)} = \frac{x(x+3)(x+3)}{x(x+3)(x-3)}$$

Diff. of  
↓ cubes

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

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

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

③  $(x^4 - 5x^3 + 6x^2) \cdot (9x - x^3)^{-1}$

$$\frac{x^4 - 5x^3 + 6x^2}{1} \cdot \frac{1}{9x - x^3} \quad \frac{x^2}{-x^1} = -x^1$$

$$\frac{x^2(x^2 - 5x + 6)}{-x(x^2 - 9)} = \frac{x^2(x-3)(x-2)}{-x(x+3)(x-3)}$$

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

$$(4) \frac{30p^2 - 12p}{5p^2 + 38p - 16} \cdot \frac{3p^2 - 15p}{6p}$$

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$$(5) \frac{2m^2 - 18m}{m^2 + 3m + 2} \div \frac{m-9}{m^2 + m - 2}$$

$$\frac{2m^2 - 18m}{m^2 + 3m + 2} \cdot \frac{m^2 + m - 2}{m-9}$$

FACTOR

$$\frac{2m(m-9)}{(m+1)(m+2)} \cdot \frac{(m-1)(m+2)}{m-9} = \frac{2m(m-1)}{(m+1)}$$

Honors Math III - 5.4/5.5 Class Examples

Simplify.

$$1. \frac{8x^2 - 6x}{4x^2} = \frac{2x(4x-3)}{2x^2} = \boxed{\frac{4x-3}{2x}}$$

$$① 2. (x^2 + x - 6)(x+3)^{-2} = \frac{(x-2)(x+3)}{(x+3)(x+3)} = \boxed{\frac{x-2}{x+3}}$$

$$3. \frac{(k+1)(k^2-1)}{(k-1)(k+1)^2} = \frac{(k+1)(k+1)(k-1)}{(k-1)(k+1)(k+1)} = \boxed{1}$$

$$4. \frac{a^3 - 6a^2}{a^2 + 2a - 3} \cdot \frac{a^2 - 2a + 1}{a^3} = \frac{a^2(a-b)}{(a-1)(a+3)} \cdot \frac{(a-1)(a-1)}{a^3} = \boxed{\frac{(a-b)(a-1)}{a(a+3)}}$$

$$5. \frac{1-x^2}{3x+4} \div \frac{x^2+x-2}{9x^2+24x+16} = \frac{-1(x^2-1)}{3x+4} \cdot \frac{(3x+4)(3x+4)}{(x-1)(x+2)} = \boxed{\frac{-1(x+1)(3x+4)}{x+2}}$$

$$6. \frac{y^2 - 5py + 6p^2}{y^2 - 4p^2} = \frac{(y-2p)(y-3p)}{y+2p} \cdot \frac{1}{(y+2p)(y-2p)} = \boxed{\frac{y-3p}{(y+2p)^2}}$$

Give the (a) the domain and (b) the zeros of the function.

$$7. f(x) = \frac{x^3 + 27}{x^2 + 9} = \frac{(x+3)(x^2 - 3x + 9)}{x^2 + 9}$$

- a)  $\mathbb{R}$
- b)  $x = -3$

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

- a)  $x = 0, -\frac{2}{3}, 1$
- b)  $\mathbb{R} \neq 0, -1$   
 $\{x \mid x \neq 0, -1\}$

# Rational Algebraic Expressions

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Simplify each rational expression.

$$1. \frac{5z^3 + z^2 - z}{3z} = \frac{5z^2 + z - 1}{3} \cdot \frac{z(5z^2 + z^2 - 1)}{3z}$$

$$3. \frac{12b - 6}{6b^2 - b - 1} = \frac{6}{3b+1}$$

$$5. \frac{m^2 - 25}{m^2 + 5m} = \frac{m-5}{m}$$

$$7. \frac{e^2 + 10e + 25}{5e + e^2} = \frac{e+5}{e}$$

$$9. \frac{s^2 + 4(1+s)}{s^2 - 4} = \frac{s+2}{s-2}$$

$$11. \frac{v^2 - u^2}{u^2 + 2uv + v^2} = \frac{v-u}{v+u}$$

$$2. \frac{4a^2 - 9}{10a + 15} = \frac{2a-3}{5}$$

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

$$6. \frac{3a^2 + 6a + 3}{3a^2 - 3} = \frac{a+1}{a-1}$$

$$8. \frac{h^2 - 3(h+6)}{18 + h(3-h)} = \frac{-1}{-1}$$

$$10. \frac{3a^3 + 3b^3}{5a^2 - 5ab + 5b^2} = \frac{3(a+b)}{5}$$

$$12. \frac{cd - 2d^2 + c^2}{c^2 - 4cd + 3d^2} = \frac{c+2d}{c-3d}$$

In Exercises 13-24 a rational function is defined. Determine the domain of the function. Find the zeros of the function.

$$13. f(a) = \frac{a-1}{a-2} \{a | a \neq 2\} \quad a=1$$

$$15. h(b) = \frac{3b-9}{4b+3} \{b | b \neq -\frac{3}{4}\} \quad b=3$$

$$17. G(x) = \frac{3x^2 - 11x + 6}{x^2 + x} \{x | x \neq 0, -1\} \quad x = \frac{2}{3}, 3$$

$$19. z(e) = \frac{e^3 + 2e^2 + e}{3 + e^2} \{e | e \in \mathbb{R}\} \quad e = 0, -1$$

$$21. Q(n) = \frac{n^4 - 16}{n + 2n^2} \{n | n \neq 0, -\frac{1}{2}\} \quad n = 2, -2$$

$$23. d(h) = \frac{h^4 + 6h^2 + 8}{h^4 - 5h^2 + 4} \{h | h \neq \pm 1, \pm 2\} \quad \text{none}$$

$$14. k(x) = \frac{4-x}{x^2-9} \{x | x \neq \pm 3\} \quad x = 4$$

$$16. F(c) = \frac{c^2 - c - 2}{c^2 - c} \{c | c \neq 0, 1\} \quad c = 2, -1$$

$$18. E(y) = \frac{2y^2 - 13y - 15}{3y + 5} \{y | y \neq -\frac{5}{3}\} \quad y = -1, \frac{15}{2}$$

$$20. c(j) = \frac{2j^2 - 5j + 2}{j^3 - 36j} \{j | j \neq 0, -6, 6\} \quad j = \frac{1}{2}, 2$$

$$22. e(t) = \frac{t^4 - t^2 - 12}{t^3 - 16t} \{t | t \neq 0, 4, -4\} \quad t = 2, -2$$

$$24. H(d) = \frac{d^4 - 10d^2 + 9}{2d^3 - 32d} \{d | d \neq 0, 4, -4\} \quad d = \pm 3, \pm 1$$

## Products and Quotients

$$\frac{x^2 - 25}{x^2 + 5x}$$

$$x^2 + 5x = 0 \implies x = 0, -5$$

Simplify. Write answers without negative or zero exponents.

$$1. \frac{10r^5}{21s^2} \cdot \frac{3s}{5r^2} = \frac{2r^2}{7s}$$

$$2. \frac{9a}{10b} \div \frac{3a^3}{20b} = \frac{6}{a^2}$$

$$3. \frac{4p^4q}{9r} \cdot \frac{9r^3}{10p^2q^2} \cdot \frac{15pq}{2r} = \frac{3p^3r}{10}$$

$$4. \frac{25u^6v}{4w^5} \cdot \frac{9v}{10u^2w} \div \frac{15u^3v}{2w^7} = \frac{3uvw}{4}$$

$$5. \frac{a^2 - 5a + 6}{a+4} \cdot \frac{3a+12}{a-2} = \frac{3a-9}{a-2} = \frac{3(a-3)}{a-2}$$

$$6. \frac{6b^2 + 5b + 1}{3b-6} \div \frac{4b^2 + 4b + 1}{2-b} = \frac{3b+1}{3(2b+1)}$$

$$7. \frac{6d-9}{5d+1} \div \frac{6-13d+6d^2}{15d^2-7d-2} = \frac{3}{15d^2-7d-2}$$

$$8. \frac{25h^2 + 10h + 1}{12h-18} \cdot \frac{10h-15}{25h^2-1} = \frac{5(5h+1)}{6(5h-1)}$$

$$9. \frac{n^2-1}{n^2-3n-10} \cdot \frac{n^2+5n+6}{n^2-3n-4} \cdot \frac{n^2-n-20}{n^2+2n-3} = \frac{n+4}{n-4}$$

$$10. \frac{3z^2 + 6z - 45}{z^2 - 2z} \cdot \frac{10 - 7z + z^2}{6z^2 + 33z + 15} \div \frac{15 - 8z + z^2}{10z^2 + 5z} = \frac{5}{10z^2 + 5z}$$