

1. Simplify the following expressions.

$$(a) \frac{6(x+2)(3x-4)}{3(x+2)^2}$$

$$(b) \frac{5(x^2-4)}{15(x+2)^2}$$

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

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

$$(e) \frac{y^2-7y+12}{y-3}$$

$$(f) \frac{2x^2+5x-12}{2x+3}$$

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

2. Multiply the rational expressions and simplify.

$$(a) \frac{x+3}{4} \cdot \frac{3(x-6)}{3(x+3)}$$

$$(b) \frac{x-8}{(x+6)(x-8)} \cdot \frac{4x(x+10)}{x+10}$$

$$(c) \frac{28-7y}{y-4} \cdot \frac{6}{y+9}$$

$$(d) \frac{5}{z^2-12z+27} \cdot \frac{z^2-9}{15}$$

$$(e) \frac{8-7x-x^2}{x+8} \cdot \frac{x+5}{9x-9}$$

$$(f) \frac{x^2-16}{9-x} \cdot \frac{x^2+x-90}{x^2+14x+40}$$

$$(g) \frac{10x^2-20x}{40x^3-80x^2} \cdot \frac{8x^3+40x^2}{6x+30}$$

$$(h) \frac{y^2+3y-4}{y^2+6y+8} \cdot \frac{y^2-3y-10}{y^2+y-2}$$

3. Divide the rational expressions and simplify.

$$(a) \frac{6x-3}{5x-2} \div \frac{2x-1}{10x-4}$$

$$(b) \frac{(z-7)(z+8)}{(z+8)(z-12)} \div \frac{1}{z-12}$$

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

$$(d) \frac{4y^2-24y}{y+5} \div \frac{y-6}{y+5}$$

$$(e) \frac{1}{z+9} \div \frac{6-z}{3z-18}$$

$$(f) \frac{1}{5x^2} \div \frac{9x-36}{5x^3-35x^2}$$

4. Perform the indicated operations and simplify.

$$(a) \frac{x^2 - 9}{x^2} \cdot \frac{3x}{x^2 - x - 6}$$

$$(b) \frac{t^2 - 2t}{t^2 + 1} \div (3t^2 - 2t - 8)$$

$$(c) \frac{4y - y^2}{2y + 1} \div \frac{y^2 - 16}{2y^2 - 5y - 3}$$

$$(d) \frac{x}{3x - 1} - \frac{1 - x}{3x - 1}$$

$$(e) \frac{2}{w - 1} - \frac{w^2 + 1}{w - 1}$$

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

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

$$(h) \frac{2x}{x - 4} - \frac{1}{2x + 1}$$

$$(i) \frac{m^2}{m^2 - 4} + \frac{1}{2 - m}$$

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

$$(k) \frac{\frac{3}{2-h} - \frac{3}{2}}{h}$$

$$(l) \frac{\frac{1}{x+h} - \frac{1}{x}}{h}$$

$$(m) 3w^{-1} - (3w)^{-1}$$

$$(n) -2y^{-1} + 2(3 - y)^{-2}$$

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

$$(p) \frac{t^{-1} + t^{-2}}{t^{-3}}$$

$$(q) \frac{2(3 + h)^{-2} - 2(3)^{-2}}{h}$$

$$(r) \frac{(7 - x - h)^{-1} - (7 - x)^{-1}}{h}$$

5. Simplify the following expressions.

$$(a) \frac{\frac{1}{1-x+h} - \frac{1}{1-x}}{h}$$

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

$$(c) \frac{(x + h)^3 - 7(x + h) - (x^3 - 7x)}{h}$$

$$(d) \frac{3(x - 4)^2(x + 5)^2 - (x - 4)^3(2)(x + 5)}{(x + 5)^4}$$

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

$$(f) \frac{6(3x - 2)(2x + 1)^{\frac{1}{2}} - (3x - 2)^2(2x + 1)^{-\frac{1}{2}}}{2x + 1}$$

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

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

$$(i) \frac{5x(5x^2 + 2)^{-\frac{1}{2}}(6x - 2)^3 - (5x^2 + 2)^{\frac{1}{2}}(18)(6x - 2)^2}{(6x - 2)^6}$$

Answers

1. (a) $\frac{2(3x-4)}{x+2}$

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

(c) $\frac{1}{x-3}$

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

(e) $y-4$

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

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

2. (a) $\frac{x-6}{4}$

(b) $\frac{4x}{x+6}$

(c) $-\frac{42}{y+9}$

(d) $\frac{z+3}{3(z-9)}$

(e) $-\frac{1}{9}x - \frac{5}{9}$

(f) $-x+4$

(g) $\frac{x}{3}$

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

3. (a) 6

(b) $z-7$

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

(d) $4y$

(e) $-\frac{3}{z+9}$

(f) $\frac{x-7}{9(x-4)}$

4. (a) $\frac{3(x+3)}{x(x+2)}$

(b) $\frac{t}{(3t+4)(t^2+1)}$

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

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

(e) $-w-1$

(f) $\frac{y}{3}$

(g) $\frac{b^2-5b+7}{b-3}$

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

(i) $\frac{m+1}{m+2}$

(j) $-\frac{2}{x}$

(k) $\frac{3}{4-2h}$

(l) $-\frac{1}{x(x+h)}$

(m) $\frac{8}{3w}$

(n) $-\frac{2(y^2-7y+9)}{y(y-3)^2}$

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

(p) t^2+t

(q) $-\frac{2(h+6)}{9(h+3)^2}$

(r) $\frac{1}{(7-x)(7-x-h)}$

5. (a) $\frac{-1}{(1-x)(1-x+h)}$

(b) $-\frac{h+2x}{x^2(h+x)^2}$

(c) $h^2+3hx+3x^2-7$

(d) $\frac{(x+23)(x-4)^2}{(x+5)^3}$

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

(f) $\frac{(3x-2)(9x+8)}{(2x+1)^{\frac{3}{2}}}$

(g) $\frac{3}{2\sqrt{2x}}$

(h) -1

(i) $\frac{-(60x^2+10x+36)}{\sqrt{5x^2+2}(6x-2)^4}$