

Simplify each rational expression.

$$1. \frac{\left(12 + \frac{6}{x}\right) x^2}{\left(12 - \frac{3}{x^2}\right) x^2} = \frac{12x^2 + 6x}{12x^2 - 3}$$

$$\frac{6x(2x+1)}{3(4x^2-1)} = \frac{\cancel{6}x(2x+1)}{\cancel{3}(2x+1)(2x-1)}$$

$$\boxed{\frac{2x}{2x-1}}$$

$$3. \frac{4 - \frac{12}{x+2}}{2 + \frac{4}{x-3}} \frac{(x+2)(x-3)}{(x+2)(x-3)} =$$

$$\frac{4(x+2)(x-3) - 12(x-3)}{2(x+2)(x-3) + 4(x+2)}$$

$$\frac{4(x^2 - x - 6) - 12x + 36}{2(x^2 - x - 6) + 4x + 8} = \frac{4x^2 - 4x - 24 - 12x + 36}{2x^2 - 2x - 12 + 4x + 8}$$

$$\frac{4x^2 - 16x + 12}{2x^2 + 2x - 4} = \frac{4(x^2 - 4x + 3)}{2(x^2 + x - 2)} = \frac{\cancel{4}(x-1)(x-3)}{\cancel{2}(x+2)(x-1)} = \boxed{\frac{2(x-3)}{x+2}}$$

$$5. \frac{3}{x-1} + \frac{1}{1-x} \frac{(-1)}{(-1)}$$

$$\frac{3}{x-1} + \frac{-1}{x-1} = \boxed{\frac{2}{x-1}}$$

$$2. \frac{\left(x+3+\frac{5}{x-3}\right)(x-3)}{\left(x+2+\frac{4}{x-3}\right)(x-3)} =$$

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

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

$$4. \frac{4 \cdot \frac{(x-3)(x-4) \cdot 3}{3 \cdot 4 \cdot 3}}{4 \cdot 3} = \frac{4x-12-3(x-4)}{12}$$

$$= \frac{4x-12-3x+12}{12} = \boxed{\frac{x}{12}}$$

$$6. \frac{(x-1)(2x-1)(2x-1)(x+1)}{(x-1)(x+1)(x-1)(x+1)}$$

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

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

$$7. \frac{5}{3(a-b)} + \frac{3(-1)}{2(b-a)(-1)}$$

$$\frac{2 \cdot 5}{2 \cdot 3(a-b)} + \frac{-3 \cdot 3}{2(a-b) \cdot 3}$$

$$\frac{10-9}{6(a-b)} = \boxed{\frac{1}{6(a-b)}}$$

$$8. \frac{(x+4)2}{(x+4)x-4} - \frac{x+12}{x^2-16}$$

$$\frac{2x+8-(x+12)}{(x+4)(x-4)} = \frac{x-4}{(x+4)(x-4)}$$

$$\boxed{\frac{1}{x+4}}$$

$$9. \frac{x^2+5x+4}{x+4} - \frac{x^2-5x+6}{x-2}$$

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

$$(x+1) - (x-3)$$

$$\boxed{4}$$

$$10. \frac{3}{x+6} - \frac{4x}{x^2-36} - \frac{2(-1)}{6-x(-1)}$$

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

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

$$\frac{3x-18-4x+2x+12}{(x+6)(x-6)} = \frac{x-6}{(x+6)(x-6)} = \boxed{\frac{1}{x+6}}$$

$$11. \frac{3x+13}{x^2-3x-10} - \frac{16}{x^2-6x+5}$$

$$\frac{(x-1)(3x+13)}{(x-1)(x-5)(x+2)} - \frac{16(x+2)}{(x-5)(x-1)(x+2)}$$

$$\frac{(x-1)(3x+13) - 16(x+2)}{(x-1)(x-5)(x+2)}$$

$$\frac{3x^2+10x-13-16x-32}{(x-1)(x-5)(x+2)} = \frac{3x^2-6x-45}{(x-1)(x-5)(x+2)} = \frac{3(x^2-2x-15)}{(x-1)(x-5)(x+2)}$$

$$= \frac{3(x-5)(x+3)}{(x-1)(x-5)(x+2)} = \boxed{\frac{3(x+3)}{(x-1)(x+2)}}$$

$$12. \frac{x+4}{x^2-3x-28} - \frac{x-5}{x^2+2x-35}$$

$$\frac{x+4}{(x-7)(x+4)} - \frac{x-5}{(x+7)(x-5)} = \frac{(x+7)1}{(x+7)(x-7)} - \frac{1(x-7)}{x+7(x-7)}$$

$$\frac{(x+7) - (x-7)}{(x+7)(x-7)} = \boxed{\frac{14}{(x+7)(x-7)}}$$