



1. a)  $(2a - 3)(3a + 2)$   
b)  $(x - 3y)(x - 4y)$   
c)  $5ac^2(3a^2bc^2 + 6d - 9ab^2 - 2a^2b^2c)$   
d)  $(4ax^2 + 9by^4)(4ax^2 - 9by^4)$   
e)  $(ab + 5bc - 6ac^2)(3a^2b - 2c^2)$   
f)  $(a - 13)(a + 5)$   
g)  $(x + y)(5x - y)$   
h)  $\left(\frac{c}{2} - \frac{3d}{5}\right)\left(\frac{c}{2} + \frac{3d}{5}\right)$   
i)  $(3x - y)(4x - 3y)$   
j)  $7x(4x^2y^2z + 2x - yz - 10y^2)$   
k)  $(a - 9)(a - 9)$   
l)  $(30 - 1,3x)(30 + 1,3x)$
2. a)  $5(2a^2 - 3)(2a^2 + 3)$   
b)  $2x(x - 6)(x + 4)$   
c)  $4d^2(2c + a)(3a - 4b)$   
d)  $-3xy(5xy - 1)(4x + y)$



e)  $5(2m - 3n)(m + 4n)$

3. a)  $\frac{x^2 - 5x + 4}{2x^2 - 32}$

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

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

b)  $\frac{12a^2 - 48b^2}{2b^2 + 5ab - 3a^2}$

$$\frac{12(a-2b)(a+2b)}{(2b-a)(b+3a)}$$

$$\frac{12\cancel{(a-2b)}(a+2b)}{-\cancel{(a-2b)}(b+3a)}$$

$$\frac{12(a+2b)}{-(b+3a)}$$

$$-\frac{12(a+2b)}{(b+3a)}$$



$$\begin{aligned} 4. \text{ a) } & \frac{a^2 - b^2}{5b - 5a} \times \frac{10 + 15a + 5a^2}{b^2 + 2ab + a^2} \\ & \frac{(a-b)(a+b)}{5(b-a)} \times \frac{5(2+a)(1+a)}{(b+a)(b+a)} \\ & \frac{\cancel{(b-a)}(a+b)}{\cancel{5}(b-a)} \times \frac{\cancel{5}(2+a)(1+a)}{\cancel{(b+a)}(b+a)} \\ & -1 \times \frac{(2+a)(1+a)}{(b+a)} \\ & - \frac{(2+a)(1+a)}{(b+a)} \end{aligned}$$

$$\begin{aligned} \text{b) } & \frac{-x^2 - x + 2}{x^2 - x - 6} \times \frac{18 - 2x^2}{x - 1} \\ & \frac{(x+2)(-x+1)}{(x+2)(x-3)} \times \frac{2(3-x)(3+x)}{(x-1)} \\ & \frac{\cancel{-(x+2)}(\cancel{x-1})}{\cancel{(x+2)}(\cancel{x-3})} \times \frac{\cancel{-2}(\cancel{x-3})(3+x)}{\cancel{(x-1)}} \\ & -1 \times -2(3+x) \\ & 2(3+x) \end{aligned}$$



$$\begin{aligned} 5. \quad a) \quad & \frac{1-2a}{a^2-4ab+3b^2} \div \frac{6a^2-3a}{27ab^2-3a^3} \\ & \frac{(1-2a)}{(a-b)(a-3b)} \div \frac{3a(2a-1)}{3a(3b-a)(3b+a)} \\ & \frac{\cancel{-(2a-1)}}{-(a-b)\cancel{(3b-a)}} \times \frac{\cancel{3a}\cancel{(3b-a)}(3b+a)}{\cancel{3a}\cancel{(2a-1)}} \\ & \frac{1}{(a-b)} \times \frac{(3b+a)}{1} \\ & \frac{(3b+a)}{(a-b)} \end{aligned}$$

$$\begin{aligned} b) \quad & \frac{x-3}{x^2+2x-15} \div \frac{x-5}{25-x^2} \\ & \frac{(x-3)}{(x+5)(x-3)} \div \frac{(x-5)}{(5-x)(5+x)} \\ & \frac{(x-3)}{(x+5)(x-3)} \times \frac{(5-x)(5+x)}{(x-5)} \\ & \frac{\cancel{(x-3)}}{(x+5)\cancel{(x-3)}} \times \frac{\cancel{(5-x)}(5+x)}{-\cancel{(5-x)}} \\ & 1 \times -1 \\ & -1 \end{aligned}$$



$$6. \quad a) \quad \frac{x}{x-1} - \frac{1+x}{x}$$

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

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

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

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

$$b) \quad \frac{2}{x-3} + \frac{x-2}{-x^2+4x-3}$$

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

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

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

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

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

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



$$\begin{aligned} \text{c) } & \frac{1}{a-b} - \frac{3a}{ab-a^2} \\ & \frac{1}{(a-b)} - \frac{3a}{a(b-a)} \\ & \frac{1}{(a-b)} + \frac{3\cancel{a}}{\cancel{a}(a-b)} \\ & \frac{1+3}{(a-b)} \\ & \frac{4}{(a-b)} \end{aligned}$$

$$\begin{aligned} \text{d) } & \frac{5x^2y}{x^3} + \frac{2xy}{2x^2-4x} \\ & \frac{5\cancel{x^2}y}{x^{\cancel{3}}} + \frac{2\cancel{xy}}{2\cancel{x}(x-2)} \\ & \frac{5y}{x} + \frac{y}{(x-2)} \\ & \frac{5y(x-2) + xy}{x(x-2)} \\ & \frac{5xy - 10y + xy}{x(x-2)} \\ & \frac{6xy - 10y}{x(x-2)} \end{aligned}$$



$$\begin{aligned} 7. \quad a) \quad & \frac{a^2 + 3ab + 2b^2}{a^2 - b^2} + \frac{3a - b}{2a} = \frac{5a^2 + b^2}{2a(a - b)} \\ & \frac{\cancel{(a+b)}(a+2b)}{\cancel{(a+b)}(a-b)} + \frac{(3a-b)}{2a} = \frac{5a^2 + b^2}{2a(a-b)} \\ & \frac{2a(a+2b) + (a-b)(3a-b)}{2a(a-b)} = \frac{5a^2 + b^2}{2a(a-b)} \\ & \frac{2a^2 + 4ab + 3a^2 - ab - 3ab + b^2}{2a(a-b)} = \frac{5a^2 + b^2}{2a(a-b)} \\ & \frac{5a^2 + b^2}{2a(a-b)} = \frac{5a^2 + b^2}{2a(a-b)} \end{aligned}$$



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

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

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

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

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

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

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

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





8.

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