



## Basics

### Arithmetic Operations

$$a(b + c) = ab + ac$$
$$\frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}$$
$$\frac{a + c}{b} = \frac{a}{b} + \frac{c}{b}$$
$$\frac{\frac{a}{b}}{\frac{c}{d}} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$$

### Factoring Special Polynomials

$$x^2 - y^2 = (x + y)(x - y)$$
$$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$$
$$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$$

### Exponents and Radicals

$$x^m x^n = x^{m+n}$$
$$\frac{x^m}{x^n} = x^{m-n}$$
$$(x^m)^n = x^{mn}$$
$$x^{-n} = \frac{1}{x^n}$$
$$(xy)^n = x^n y^n$$
$$\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$$
$$x^{1/n} = \sqrt[n]{x}$$
$$x^{m/n} = \sqrt[n]{x^m} = (\sqrt[n]{x})^m$$
$$\sqrt[n]{xy} = \sqrt[n]{x} \sqrt[n]{y}$$
$$\sqrt[n]{\frac{x}{y}} = \frac{\sqrt[n]{x}}{\sqrt[n]{y}}$$



## Greek Alphabet

Greek name	Greek letter	
	Lower case	Capital
Alpha	$\alpha$	A
Beta	$\beta$	B
Gamma	$\gamma$	$\Gamma$
Delta	$\delta$	$\Delta$
Epsilon	$\epsilon$	E
Zeta	$\zeta$	Z
Eta	$\eta$	H
Theta	$\theta$	$\Theta$
Iota	$\iota$	I
Kappa	$\kappa$	K
Lambda	$\lambda$	$\Lambda$
Mu	$\mu$	M

Greek name	Greek letter	
	Lower case	Capital
Nu	$\nu$	N
Xi	$\xi$	$\Xi$
Omicron	$\omicron$	O
Pi	$\pi$	$\Pi$
Rho	$\rho$	P
Sigma	$\sigma$	$\Sigma$
Tau	$\tau$	T
Upsilon	$\upsilon$	Y
Phi	$\phi$	$\Phi$
Chi	$\chi$	X
Psi	$\psi$	$\Psi$
Omega	$\omega$	$\Omega$



**Example1:**

$$X^2(x+y) = x^2*x + x^2*y = x^3 + x^2y$$

$$X^2y^3(xy-x^2) = x^2y^3*xy - x^2y^3*x^2 = x^3y^4 - x^4y^3$$

**Example2:** find//  $f(x)+g(x)$ ,  $f(x)*g(x)$ ,  $f(x)/g(x)$ ,  $g(x)/f(x)$ ,  $f(x)+g(x)/f(x)g(x)$ ,  $(f(x))^2g(x)$ ,  $(f(x))^3/(g(x))^2$

1- If  $f(x) = 4x$  ,  $g(x) = 2x+3$

2- If  $f(x) = x^2-7x$  ,  $g(x) = 8x^2-1$

3- If  $f(x) = 5x-4$  ,  $g(x) = 9x+6$

**Solutions:**

**1-** If  $f(x) = 4x$  ,  $g(x) = 2x+3$

$$f(x)+g(x) = 4x+2x+3 = 6x+3$$

$$f(x)*g(x) = 4x*(2x+3) = 8x^2+12x$$

$$f(x)/g(x) = \frac{4x}{2x+3}$$

$$g(x)/f(x) = \frac{2x+3}{4x} = \frac{2x}{4x} + \frac{3}{4x} = \frac{1}{2} + \frac{3}{4x}$$

$$f(x)+g(x)/f(x)g(x) = \frac{4x+2x+3}{4x(2x+3)} = \frac{6x+3}{8x^2+12x}$$

$$(f(x))^2g(x) = (4x)^2(2x+3) = 16x^2(2x+3) = 32x^3 + 48x^2$$

$$(f(x))^3/(g(x))^2 = \frac{(4x)^3}{(2x+3)^2} = \frac{64x^3}{(2x+3)(2x+3)} = \frac{64x^3}{4x^2+6x+6x+9} = \frac{64x^3}{4x^2+12x+9}$$



**2-** If  $f(x) = x^2 - 7x$  ,  $g(x) = 8x^2 - 1$

$$f(x) + g(x) = x^2 - 7x + 8x^2 - 1 = 9x^2 - 7x - 1$$

$$f(x) * g(x) = (x^2 - 7x)(8x^2 - 1) = 8x^4 - x^2 - 56x^3 + 7x = 8x^4 - 56x^3 - x^2 + 7x$$

$$f(x)/g(x) = \frac{x^2 - 7x}{8x^2 - 1}$$

$$g(x)/f(x) = \frac{8x^2 - 1}{x^2 - 7x}$$

$$f(x) + g(x)/f(x)g(x) = \frac{9x^2 - 7x - 1}{8x^4 - 56x^3 - x^2 + 7x}$$

$$(f(x))^2 g(x) = (x^2 - 7x)^2 (8x^2 - 1) = ((x^2 - 7x)(x^2 - 7x))(8x^2 - 1)$$

$$= (x^4 - 14x^3 + 49x^2)(8x^2 - 1)$$

$$= (x^4 - 14x^3 + 49x^2)(8x^2 - 1)$$

$$= 8x^6 - x^4 - 112x^5 + 14x^3 + 392x^4 - 49x^2 = 8x^6 - 112x^5 + 392x^4 + 14x^3 - 49x^2$$

$$(f(x))^3 / (g(x))^2 = \frac{(x^2 - 7x)^3}{(8x^2 - 1)^2} = \frac{(x^2 - 7x)(x^2 - 7x)^2}{64x^4 - 16x^2 + 1}$$

$$= \frac{(x^2 - 7x)(x^4 - 14x^3 + 49x^2)}{64x^4 - 16x^2 + 1}$$

$$= \frac{x^6 - 14x^5 + 49x^4 - 7x^5 + 98x^4 - 343x^3}{64x^4 - 16x^2 + 1}$$

$$= \frac{x^6 - 21x^5 + 147x^4 - 343x^3}{64x^4 - 16x^2 + 1}$$



**3-** If  $f(x)=5x-4$  ,  $g(x)= 9x+6$

$$f(x)+g(x) = 5x- 4 + 9x+6 = 14x+2$$

$$f(x)*g(x) = (5x-4)*(9x+6) = 45x^2 +30x-36x-24= 45x^2-6x-24$$

$$f(x)/g(x)= \frac{(5x-4)}{(9x+6)}$$

$$g(x)/f(x)= \frac{(9x+6)}{(5x-4)}$$

$$f(x)+g(x)/f(x)g(x)= \frac{14x+2}{45x^2-6x-24}$$

$$(f(x))^2g(x)= (5x-4)^2(9x+6)$$

$$= (25x^2-40x+16) (9x+6)$$

$$= 225x^3 -360x^2+144x+150x^2-240x+96$$

$$=510x^2-96x+96$$

$$(f(x))^3/(g(x))^2= \frac{(5x-4)^3}{(9x+6)^2} = \frac{(5x-4)(5x-4)^2}{81x^2+108x+36} = \frac{(5x-4)(25x^2-40x+16)}{81x^2+108x+36}$$

$$= \frac{125x^3 - 200x^2 + 80x - 100x^2 + 160x}{81x^2 + 108x + 36}$$

$$= \frac{125x^3 - 300x^2 + 240x}{81x^2 + 108x + 36}$$