Section 1: Polynomial functions and graphs

Solutions to Exercise level 1

1. (i) $f(x)+g(x)=\left(x^3+2x^2-5x+4\right)+\left(x^3-3x^2+1\right)$
$=x^3+2x^2-5x+4+x^3-3x^2+1$
$=x^3+x^3+2x^2-3x^2-5x+4+1$
$=2x^3-x^2-5x+5$

(ii) $f(x)-g(x)=\left(x^3+2x^2-5x+4\right)-\left(x^3-3x^2+1\right)$
$=x^3+2x^2-5x+4-x^3+3x^2-1$
$=x^3-x^3+2x^2+3x^2-5x+4-1$
$=5x^2-5x+3$

2. (i) $q(x)-p(x)=\left(x^3-2x^2+1\right)-\left(2x^3-5x^2+3x-2\right)$
$=x^3-2x^2+1-2x^3+5x^2-3x+2$
$=x^3-2x^3-2x^2+5x^2-3x+1+2$
$=-x^3+3x^2-3x+3$

(ii) $2p(x)+3q(x)=2\left(2x^3-5x^2+3x-2\right)+3\left(x^3-2x^2+1\right)$
$=4x^3-10x^2+6x-4+3x^3-6x^2+3$
$=4x^3+3x^3-10x^2-6x^2+6x-4+3$
$=7x^3-16x^2+6x-1$

3. (i) $g(x)-3f(x)=3x^4-2x^3+x-3\left(x^3+5x^2-3\right)$
$=3x^4-2x^3+x-3x^3-15x^2+9$
$=3x^4-2x^3-3x^3-15x^2+x+9$
$=3x^4-5x^3-15x^2+x+9$

(ii) $(2x+1)f(x)=(2x+1)\left(x^3+5x^2-3\right)$
$=2x\left(x^3+5x^2-3\right)+\left(x^3+5x^2-3\right)$
$=2x^4+10x^3-6x+x^3+5x^2-3$
$=2x^4+10x^3+x^3+5x^2-6x-3$
$=2x^4+11x^3+5x^2-6x-3$

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4. (i) $(x-2)(2x^2-3x+1) = x(2x^2-3x+1)-2(2x^2-3x+1)$

$= 2x^3-3x^2+x-4x^2+6x-2$

$= 2x^3-7x^2+7x-2$

(ii) $(3x-2)(x^3-2x+4) = 3x(x^3-2x+4)-2(x^3-2x+4)$

$= 3x^4-6x^2+12x-2x^3+4x-8$

$= 3x^4-2x^3-6x^2+16x-8$

(iii) $(2x+1)(x^3+2x^2-3x-5)$

$= 2x(x^3+2x^2-3x-5)+(x^3+2x^2-3x-5)$

$= 2x^4+4x^3-6x^2-10x+x^3+2x^2-3x-5$

$= 2x^4+5x^3-4x^2-13x-5$

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

$= (x+3)(2x^2-9x+4)$

$= x(2x^2-9x+4)+3(2x^2-9x+4)$

$= 2x^3-9x^2+4x+6x^2-27x+12$

$= 2x^3-3x^2-23x+12$

5. (i) $p(x)+q(x) = (2x^2+x-1)+(2x-1)$

$= 2x^2+3x-2$

(ii) $p(x)q(x) = (2x^2+x-1)(2x-1)$

$= 4x^3-3x+1$

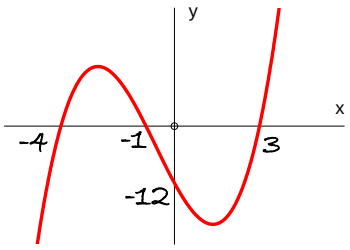
6. (i) $y = (x+1)(x-3)(x+4)$

This is a cubic graph which cuts the x-axis at (-1, 0), (3, 0) and (-4, 0).

When $x = 0$, $y = 1\times-3\times4 = -12$

When x is large and positive, y is positive.

When x is large and negative, y is negative.



(ii) $y = (x+2)^2(2x-1)$

This is a cubic graph which touches the x-axis at (-2, 0) and cuts the x-axis at $(\frac{1}{2}, 0)$.

When $x = 0$, $y = 2^2\times-1 = -4$

When x is large and positive, y is positive.

When x is large and negative, y is negative.