



Additional Math with Ali Hashir  
**Polynomial Long Division**  
 Answers

CIE O Level Additional Mathematics 4037 • Total: 52 marks

**Easy (Q1–Q2)**

**Q1.**  $x^3 + 2x^2 - 5x - 6 = (x - 2)(x^2 + 4x + 3) + 0$

**Q2.**  $2x^3 - 3x^2 + 4x - 1 = (x + 1)(2x^2 - 5x + 9) - 10$

**Medium (Q3–Q7)**

**Q3.**  $x^3 - 4x^2 + 6x - 4 = (x - 2)(x^2 - 2x + 2) + 0$ ;  $f(x) = (x - 2)(x^2 - 2x + 2)$

**Q4.**  $6x^3 + 11x^2 - 4x - 4 = (2x + 1)(3x^2 + 4x - 4) + 0$ ;  $f(x) = (2x + 1)(3x - 2)(x + 2)$

**Q5.**  $x^4 - 3x^2 + 2x + 5 = (x + 2)(x^3 - 2x^2 + x) + 5$

**Q6.**  $x^4 + 2x^3 - 3x^2 - 4x + 3 = (x^2 + x - 1)(x^2 + x - 3) + 0$

**Q7.**  $2x^4 - x^3 + 3x - 7 = (x^2 + 2)(2x^2 - x - 4) + (5x + 1)$ ; remainder is of degree 1

**Hard (Q8–Q10)**

**Q8.**  $3x^4 - 2x^3 + x - 5 = (x^2 - 2x + 3)(3x^2 + 4x - 1) + (-13x - 2)$

**Q9 (i).** Quotient  $2x^2 + (a + 6)x + (3a + 13)$ , remainder  $9a + 45$

**Q9 (ii).**  $a = -3$ ;  $2x^3 - 3x^2 - 5x + 6 = (x - 3)(2x^2 + 3x + 4) + 18$

**Q10 (i).** Quotient  $x^2 + (p + 1)x + (p - 4)$ , remainder  $(3p + q - 2)x + (2p + 4)$

**Q10 (ii).**  $p = -2$ ,  $q = 8$ ;  $x^4 - 2x^3 - 7x^2 + 8x + 12 = (x^2 - x - 2)(x^2 - x - 6) + 0$

**Q10 (iii).**  $f(x) = (x - 2)(x + 1)(x - 3)(x + 2)$

**Extra Challenge**

(i). The remainder must have degree less than 2, so it is at most linear, i.e. of the form  $\alpha x + \beta$

(ii).  $a = 11$ ,  $b = 6$ ;  $2x^4 - 3x^3 + 11x^2 + 6x - 6 = (x^2 - 1)(2x^2 - 3x + 13) + (3x + 7)$

(iii).  $Q_2(x) = 2x + 1$  and  $c = 15$ , giving

$$f(x) = (x^2 - 1)(x - 2)(2x + 1) + 15(x^2 - 1) + 3x + 7$$

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Full worked solutions available at the website.

$\begin{smallmatrix} 1 & 0 \\ 0 & 1 \end{smallmatrix}$  Instagram: **@vectorspacepk**  
Website: **www.vectorspace.pk**

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