

Remainder/factor Theorem ANSWERS

0606/02/M/J/07

1

120 [10]	(a) (i) $-8 + 4a - 2b + c = (R) = 8 + 4a + 2b + c \Rightarrow b = -4$	M1 A1
	(ii) $1 + a + b + c = (R) = 4a + c \Rightarrow a = -1$	M1 A1
	(iii) $27 - 9 - 12 + c = 4 \Rightarrow c = -2$	A1 c.o.e
	(b) Search $-1 + 3 - 2 = 0 \Rightarrow x = -1$	B1
	Divide or factorise $\Rightarrow (x + 1)(x^2 + 2x - 2)$	M1 A1
	$x = \frac{-2 \pm \sqrt{4 + 8}}{2} = -2.73 \text{ or } 0.73$	DM1 A1

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8	(a) $f(1) = 1 - 11 + k - 30 \rightarrow k - 40$ $f(2) = 8 - 44 + 2k - 30 \rightarrow 2k - 66$ $f(1) = 4f(2)$ $\rightarrow k = 32$	M1 A1 M1 A1 [4]	Uses either $x = 1$ or 2 , not -1 or -2 . Both correct, unsimplified. Linked + solution – allow if 4 on LHS co
	(b) $x^3 - 4x^2 - 8x + 8 = 0$ Tries for a first solution $\rightarrow x = -2$ Divides by $(x - \text{his first solution})$ $\rightarrow x^2 - 6x + 4 = 0$ $\rightarrow x = \frac{6 \pm \sqrt{20}}{2} \rightarrow 3 \pm \sqrt{5}$	M1 A1 M1 DM1 A1 [5]	Search shown for M, $x = -2$ gets M1A1. Correct method. Correct method for soln of quadratic Must be simplified.

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6	$2x^3 + 3x^2 - 17x + 12 = 0$ $f(1) = 0, (x - 1)$ is a factor $(x - 1)(2x^2 + 5x - 12) = 0$ $(x - 1)(2x - 3)(x + 4) = 0$ $x = 1, \frac{3}{2}, -4$	M1 M1 M1 DM1 B1, A1 [6]	M1 for simplification M1 for attempt to find a root M1 for attempt to get quadratic factor DM1 for factorising on all previous M marks B1 for solution from first root A1 for the other pair
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4 Substitution of $x = 1$ leading to $a + b + 4 = 0$	M1	M1 for substitution of $x = 1$ and equated to 3
Substitution of $x = -\frac{1}{2}$ leading to $-a + 2b - 28 = 0$	M1	M1 for substitution of $x = -\frac{1}{2}$ and equated to 6
	A1	A1 for both correct
Leading to $a = -12, b = 8$	M1 A1 [5]	M1 for solution A1 for both

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5

1(i) $2a^3 - 7a^2 + 7a^2 + 16 = 0$ leading to $a^3 = -8, a = -2$	M1 A1 [2]	M1 for use of $x = a$
(ii) $2\left(-\frac{1}{2}\right)^3 - 7\left(-\frac{1}{2}\right)^2 - 14\left(-\frac{1}{2}\right) + 16$ $= 21$	M1 A1 [2]	M1 for substitution of $x = -\frac{1}{2}$

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6

5 $3x^3 + 17x^2 + 18x - 8 = 0$ $f(-2) = 0$ (or other roots) $(x + 2)(3x^2 + 11x - 4) = 0$ $(x + 2)(3x - 1)(x + 4) = 0$ $x = -2, -4, \frac{1}{3}$	M1 M1 M1 DM1 B1, A1 [6]	M1 for simplification = 0 M1 for attempt to find a root M1 for attempt to obtain quadratic factor DM1 for obtaining linear factors or use of quadratic formula B1 for first solution A1 for the other pair
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7

2 $6(-2)^3 + a(-2)^2 - (a + 1)(-2) + b = 15$ $6a + b = 61$ when $x = -1, 2a + b = 29$ leading to $a = 8$ and $b = 13$	M1 A1 A1 M1 A1 [5]	M1 for substitution of $x = -2$ or -1 , or verification A1 for each correct (allow unsimplified) M1 for attempt to solve A1 for $a = 8, b = 13$
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8

<p>2 Find $f(2)$ or $f(-3)$ or long division to remainder $8 + 4a - 30 + b = 0$ or $4a + b = 22$ $-27 + 9a + 45 + b = 75$ or $9a + b = 57$</p> <p>Solve simultaneous equations $a = 7, b = -6$</p>	<p>M1 A1 A1</p> <p>M1 A1</p> <p>[5]</p>
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<p>6 $x = 2$ or -4 or $-\frac{1}{3}$</p> <p>Either $(x-2)(3x^2 + 13x + 4)$ or $(x+4)(3x^2 - 5x - 2)$ or $(3x+1)(x^2 + 2x - 8)$ $(x-2)(x+4)(3x+1)$</p> <p>$x = 2, -4, -\frac{1}{3}$</p>	<p>B1 M1 A1 M1, A1 A1</p> <p>[6]</p>	<p>B1 for spotting a solution</p> <p>M1 for attempt to get quadratic factor</p> <p>A1 for correct quadratic factor M1 for dealing with quadratic factor</p> <p>A1 for correct factors A1 for all solutions</p>
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10

<p>4 $f(2) = 8 + 4k - 10 - 3$ $f(-1) = -1 + k + 5 - 3$ $(4k - 5) = 5(k + 1)$ leading to $k = -10$</p>	<p>M1 M1 M1 A1</p> <p>[4]</p>	<p>M1 for use of $x = 2$ M1 for use of $x = -1$ M1 for attempt to link the two remainders</p>
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<p>4 $x = -1$ or 7 or $-\frac{1}{2}$ seen</p> <p>Either $(x+1)(2x^2 - 13x - 7)$ or $(x-7)(2x^2 + 3x + 1)$ or $(2x+1)(x^2 - 6x - 7)$ leading to $(x+1)(x-7)(2x+1)$</p>	<p>M1 DM1 A1 DM1, A1</p> <p>[5]</p>	<p>M1 for attempt to find a root</p> <p>DM1 for attempt to obtain quadratic factor A1 correct quadratic factor</p> <p>DM1 attempt to factorise quadratic factor</p>
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12

5 Search for first root or factor

M1

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

A1

Attempt to factorise cubic

M1

$$(x + 2)(2x^2 - 7x + 3)$$

$$\text{or } (x - 3)(2x^2 + 3x - 2)$$

A1

$$\text{or } (2x - 1)(x^2 - x - 6)$$

Solve 3 term quadratic

M1

$$x = -2 \text{ and } \frac{1}{2} \text{ and } 3$$

A1 [6]