Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
1	Makes an attempt to factor all the quadratics on the left-hand side of the identity.	**M1**	2.2a	5th Simplify algebraic fractions.
	Correctly factors each expression on the left-hand side of the identity: $\frac{(x-6)(x+6)}{(x-5)(x-6)}\times\frac{(5-x)(5+x)}{Ax^2+Bx+C}\times\frac{(3x-1)(2x+3)}{(3x-1)(x+6)}$	**A1**	2.2a	
	Successfully cancels common factors: $\frac{(-1)(5+x)(2x+3)}{Ax^2+Bx+C}\equiv\frac{x+5}{(-1)(x-6)}$	**M1**	1.1b	
	States that $Ax^2+Bx+C\equiv(2x+3)(x-6)$	**M1**	1.1b	
	States or implies that $A = 2$, $B = -9$ and $C = -18$	**A1**	1.1b	
				(5 marks)

Notes

Alternative method

Makes an attempt to substitute $x = 0$ (**M1**)

Finds $C = -18$ (**A1**)

Substitutes $x = 1$ to give $A + B = -7$ (**M1**)

Substitutes $x = -1$ to give $A - B = 11$ (**M1**)

Solves to get $A = 2$, $B = -9$ and $C = -18$ (**A1**)

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
2	Correctly factorises the denominator of the left-hand fraction: $\dfrac{6}{(2x+5)(2x-1)}+\dfrac{3x+1}{2x-1}$	M1	2.2a	4th Add, subtract, multiply and divide algebraic fractions.
	Multiplies the right-hand fraction by $\dfrac{2x+5}{2x+5}$ For example: $\dfrac{6}{(2x+5)(2x-1)}+\dfrac{(3x+1)(2x+5)}{(2x-1)(2x+5)}$ is seen.	M1	1.1b	
	Makes an attempt to distribute the numerator of the right-hand fraction. For example: $\dfrac{6+6x^2+17x+5}{(2x+5)(2x-1)}$ is seen.	M1	1.1b	
	Fully simplified answer is seen. Accept either $\dfrac{6x^2+17x+11}{(2x+5)(2x-1)}$ or $\dfrac{(6x+11)(x+1)}{(2x+5)(2x-1)}$	A1	1.1b	
				(4 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
3	States that: $A(2x+5)+B(5x-1)\equiv 6x+42$	**M1**	2.2a	5th Decompose algebraic fractions into partial fractions − two linear factors.
	Equates the various terms. Equating the coefficients of x: $2A+5B=6$ Equating constant terms: $5A-B=42$	**M1***	2.2a	
	Multiplies both of the equations in an effort to equate one of the two variables.	**M1***	1.1b	
	Finds $A = 8$	**A1**	1.1b	
	Find $B = -2$	**A1**	1.1b	
				(5 marks)

Notes

Alternative method

Uses the substitution method, having first obtained this equation: $A(2x+5)+B(5x-1)\equiv 6x+42$

Substitutes $x=-\frac{5}{2}$ to obtain $-\frac{27}{2}B = 27$ (**M1**)

Substitutes $x=\frac{1}{5}$ to obtain $\frac{27}{5}A = 43.2$ (**M1**)

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
4	States that: $A(4-x)(x+5)+B(x-3)(x+5)+C(x-3)(4-x)\equiv 4x^2+x-23$	**M1**	2.2a	6th Decompose algebraic fractions into partial fractions – three linear factors.
	Further states that: $A(-x^2-x+20)+B(x^2+2x-15)+C(-x^2+7x-12)\equiv 4x^2+x-23$	**M1**	1.1b	
	Equates the various terms. Equating the coefficients of x^2: $-A+B-C=4$ Equating the coefficients of x: $-A+2B+7C=1$ Equating constant terms: $20A-15B-12C=-23$	**M1***	2.2a	
	Makes an attempt to manipulate the expressions in order to find A, B and C. Obtaining two different equations in the same two variables would constitute an attempt.	**M1***	1.1b	
	Finds the correct value of any one variable: either $A = 2$, $B = 5$ or $C = -1$	**A1***	1.1b	
	Finds the correct value of all three variables: $A = 2$, $B = 5$, $C = -1$	**A1**	1.1b	
				(6 marks)

Notes

Alternative method

Uses the substitution method, having first obtained this equation:

$A(4-x)(x+5)+B(x-3)(x+5)+C(x-3)(4-x)\equiv 4x^2+x-23$

Substitutes $x = 4$ to obtain $9B = 45$ (**M1**)

Substitutes $x = 3$ to obtain $8A = 16$ (**M1**)

Substitutes $x = -5$ to obtain $-72C = 72$ (**A1**)

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
5	States that: $A(x-4)(3x+1)+B(3x+1)+C(x-4)(x-4)\equiv 18x^2-98x+78$	M1	2.2a	7th Decompose algebraic fractions into partial fractions – repeated factors.
	Further states that: $A(3x^2-11x-4)+B(3x+1)+C(x^2-8x+16)\equiv 18x^2-98x+78$	M1	1.1b	
	Equates the various terms. Equating the coefficients of x^2: $3A+C=18$ Equating the coefficients of x: $-11A+3B-8C=-98$ Equating constant terms: $-4A+B+16C=78$	M1	2.2a	
	Makes an attempt to manipulate the expressions in order to find A, B and C. Obtaining two different equations in the same two variables would constitute an attempt.	M1	1.1b	
	Finds the correct value of any one variable: either $A = 4$, $B = -2$ or $C = 6$	A1	1.1b	
	Finds the correct value of all three variables: $A = 4$, $B = -2$, $C = 6$	A1	1.1b	
				(6 marks)

Notes

Alternative method

Uses the substitution method, having first obtained this equation:

$A(x-4)(3x+1)+B(3x+1)+C(x-4)(x-4)\equiv 18x^2-98x+78$

Substitutes $x = 4$ to obtain $13B = -26$

Substitutes $x=-\frac{1}{3}$ to obtain $\frac{169}{9}C=\frac{338}{3}\Rightarrow C=\frac{1014}{169}=6$

Equates the coefficients of x^2: $3A+C=18$

Substitutes the found value of C to obtain $3A = 12$

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
6	Makes an attempt to set up a long division. For example: $x+6\overline{)x^3+8x^2-9x+12}$ is seen.	**M1**	2.2a	5th Divide polynomials by linear expressions with a remainder.
	Award 1 accuracy mark for each of the following: x^2 seen, $2x$ seen, -21 seen. For the final accuracy mark either $D = 138$ or $\dfrac{138}{x+6}$ or the remainder is 138 must be seen. $x^2+2x-21$ $x+6\overline{)x^3+8x^2-9x+12}$ $\underline{x^3+6x^2}$ $2x^2-9x$ $\underline{2x^2+12x}$ $-21x+12$ $\underline{-21x-126}$ 138	**A4**	1.1b	
				(5 marks)

Notes

This question can be solved by first writing $(Ax^2+Bx+C)(x+6)+D\equiv x^3+8x^2-9x+12$ and then solving for A, B, C and D. Award 1 mark for the setting up the problem as described. Then award 1 mark for each correct coefficient found. For example:

Equating the coefficients of x^3: $A = 1$

Equating the coefficients of x^2: $6 + B = 8$, so $B = 2$

Equating the coefficients of x: $12 + C = -9$, so $C = -21$

Equating the constant terms: $-126 + D = 12$, so $D = 138$.

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
7	Makes an attempt to set up a long division. For example: $x^2-2x-15\overline{)x^4+2x^3-29x^2-48x+90}$ is seen.	**M1**	2.2a	6th Decompose algebraic fractions into partial fractions – three linear factors.
	Award 1 accuracy mark for each of the following: x^2 seen, $4x$ seen, -6 seen. x^2+4x-6 $x^2-2x-15\overline{)x^4+2x^3-29x^2-47x+77}$ $\underline{x^4-2x^3-15x^2}$ $4x^3-14x^2-47x$ $\underline{4x^3-8x^2-60x}$ $-6x^2+13x+77$ $\underline{-6x^2+12x+90}$ $x-13$	**A3**	1.1b	
	Equates the various terms to obtain the equation: $x-13=V(x-5)+W(x+3)$ Equating the coefficients of x: $V+W=1$ Equating constant terms: $-5V+3W=-13$	**M1**	2.2a	
	Multiplies one or or both of the equations in an effort to equate one of the two variables.	**M1**	1.1b	
	Finds $W=-1$ and $V=2$.	**A1**	1.1b	
				(7 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
8	Equating the coefficients of x^4: $A = 5$	**A1**	2.2a	6th Solve problems using the remainder theorem linked to improper algebraic fractions.
	Equating the coefficients of x^3: $B = -4$	**A1**	1.1b	
	Equating the coefficients of x^2: $2A + C = 17$, $C = 7$	**A1**	1.1b	
	Equating the coefficients of x: $2B + D = -5$, $D = 3$	**A1**	1.1b	
	Equating constant terms: $2C + E = 7$, $E = -7$	**A1**	1.1b	
				(5 marks)

Notes

Q	Scheme	Marks	AOs	Pearson Progression Step and Progress descriptor
9	Makes an attempt to set up a long division. For example: $9x^2+0x-16\overline{)9x^2+25x+16}$ is seen. The '0x' being seen is not necessary to award the mark.	**M1**	2.2a	5th Decompose algebraic fractions into partial fractions − two linear factors.
	Long division completed so that a '1' is seen in the quotient and a remainder of $25x + 32$ is also seen. $$\begin{array}{r} 1 \\ 9x^2+0x-16\overline{)9x^2+25x+16} \\ \underline{9x^2+\ \ 0x-16} \\ 25x+32 \end{array}$$	**M1**	1.1b	
	States $B(3x+4)+C(3x-4)\equiv 25x-32$	**M1**	1.1b	
	Equates the various terms. Equating the coefficients of x: $3B+3C=25$ Equating constant terms: $4B-4C=32$	**M1**	2.2a	
	Multiplies one or both of the equations in an effort to equate one of the two variables.	**M1**	1.1b	
	Finds $B=\frac{49}{6}$	**A1**	1.1b	
	Finds $C=\frac{1}{6}$	**A1**	1.1b	
				(7 marks)

Notes

Alternative method

Writes $A+\frac{B}{3x-4}+\frac{C}{3x+4}$ as $\frac{A(3x-4)(3x+4)}{9x^2-16}+\frac{B(3x+4)}{9x^2-16}+\frac{C(3x-4)}{9x^2-16}$

States $A(3x-4)(3x+4)+B(3x+4)+C(3x-4)\equiv 9x^2+25x+16$

Substitutes $x=\frac{4}{3}$ to obtain: $8B=\frac{196}{3}\Rightarrow B=\frac{49}{6}$

Substitutes $x=-\frac{4}{3}$ to obtain: $-8C=-\frac{4}{3}\Rightarrow C=\frac{1}{6}$

Equating the coefficients of x^2: $9A=9\Rightarrow A=1$