Algebra 2 - Marking Scheme

Q1.

EITHER:	State or imply non-modular inequality $(x+3a)^2 > (2(x-2a))^2$, or corresponding quadratic equation, or pair of linear equations $(x+3a) = \pm 2(x-2a)$	B1	
	Make reasonable solution attempt at a 3-term quadratic, or solve two linear equations	M1	
	Obtain critical values $x = \frac{1}{3}a$ and $x = 7a$	A1	
	State answer $\frac{1}{3}a < x < 7a$	A1	
OR:	Obtain the critical value $x = 7a$ from a graphical method, or by inspection, or by solving a linear equation or inequality	B1	
	Obtain the critical value $x = \frac{1}{3}a$ similarly	B2	
	State answer $\frac{1}{3}a < x < 7a$	B1	[4]
	[Do not condone $\leqslant$ for $<$; accept 0.33 for $\frac{1}{3}$.]		

Q2.

(i)	State or imply the form $\frac{A}{x+1} + \frac{B}{x+3}$ and use a relevant method to find A or B	M1	
	Obtain $A = 1$, $B = -1$	A1	[2]
(ii)	Square the result of part **(i)** and substitute the fractions of part **(i)**	M1	
	Obtain the given answer correctly	A1	[2]

Q3.

EITHER:	Attempt to solve for 2^x	M1	
	Obtain $2^x = 6/4$, or equivalent	A1	
	Use correct method for solving an equation of the form $2^x = a$, where $a > 0$	M1	
	Obtain answer $x = 0.585$	A1	
OR:	State an appropriate iterative formula, e.g. $x_{n+1} = \ln((2^{x_n} + 6)/5)/\ln 2$	B1	
	Use the iterative formula correctly at least once	M1	
	Obtain answer $x = 0.585$	A1	
	Show that the equation has no other root but 0.585	A1	[4]

[For the solution 0.585 with no relevant working, award B1 and a further B1 if 0.585 is shown to be the only root.]

Q4.

(i)	Substitute $x = -\frac{1}{2}$, equate to zero and obtain a correct equation, e.g. $-\frac{1}{4} + \frac{5}{4} - \frac{1}{2}a + b = 0$	B1	
	Substitute $x = -2$ and equate to 9	M1	
	Obtain a correct equation, e.g. $-16 + 20 - 2a + b = 9$	A1	
	Solve for a or for b	M1	
	Obtain $a = -4$ and $b = -3$	A1	[5]

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(ii)	Attempt division by $2x + 1$ reaching a partial quotient of $x^2 + kx$	M1	
	Obtain quadratic factor $x^2 + 2x - 3$	A1	
	Obtain factorisation $(2x+1)(x+3)(x-1)$	A1	[3]

[The M1 is earned if inspection has an unknown factor of $x^2 + ex + f$ and an equation in e and/or f, or if two coefficients with the correct moduli are stated without working.]
[If linear factors are found by the factor theorem, give B1 + B1 for $(x - 1)$ and $(x + 3)$, and then B1 for the complete factorisation.]

Q5.

(i) *EITHER*:	Divide by denominator and obtain quadratic remainder	M1	
	Obtain $A = 1$	A1	
	Use any relevant method to obtain B, C or D	M1	
	Obtain one correct answer	A1	
	Obtain $B = 2$, $C = 1$ and $D = -3$	A1	
OR:	Reduce RHS to a single fraction and equate numerators, or equivalent	M1	
	Obtain $A = 1$	A1	
	Use any relevant method to obtain B, C or D	M1	
	Obtain one correct answer	A1	
	Obtain $B = 2$, $C = 1$ and $D = -3$	A1	[5]
	[SR: If $A = 1$ stated without working give B1.]		

Q6.

EITHER:	State or imply non-modular inequality $(x - 3)^2 > (2(x + 1))^2$, or corresponding quadratic equation, or pair of linear equations $(x - 3) = \pm 2(x + 1)$	B1	
	Make reasonable solution attempt at a 3-term quadratic, or solve two linear equations	M1	
	Obtain critical values -5 and $\frac{1}{3}$	A1	
	State answer $-5 < x < \frac{1}{3}$	A1	
OR:	Obtain the critical value $x = -5$ from a graphical method, or by inspection, or by solving a linear equation or inequality	B1	
	Obtain the critical value $x = \frac{1}{3}$ similarly	B2	
	State answer $-5 < x < \frac{1}{3}$	B1	[4]
	[Do not condone $\le$ for $<$; accept 0.33 for $\frac{1}{3}$.]		

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Q7.

(i) State or imply partial fractions of the form $\dfrac{A}{1-2x}+\dfrac{B}{2+x}+\dfrac{C}{(2+x)^2}$ B1

Use any relevant method to determine a constant M1
Obtain one of the values $A = 1$, $B = 1$, $C = -2$ A1
Obtain a second value A1
Obtain the third value A1 [5]

[The form $\dfrac{A}{1-2x}+\dfrac{Dx+E}{(2+x)^2}$, where $A = 1$, $D = 1$, $E = 0$, is acceptable scoring B1M1A1A1A1 as above.]

(ii) Use correct method to obtain the first two terms of the expansion of $(1-2x)^{-1}$, $(2+x)^{-1}$, $(2+x)^{-2}$, $(1+\frac{1}{2}x)^{-1}$, or $(1+\frac{1}{2}x)^{-2}$ M1
Obtain correct unsimplified expansions up to the term in x^2 of each partial fraction A1√ + A1√ + A1√
Obtain answer $1+\dfrac{9}{4}x+\dfrac{15}{4}x^2$, or equivalent A1 [5]

[Symbolic binomial coefficients, e.g. $\begin{pmatrix}-1\\1\end{pmatrix}$, are not sufficient for the M1. The f.t. is on A, B, C.]

[For the A, D, E form of partial fractions, give M1A1√A1√ for the expansions then, if $D \neq 0$, M1 for multiplying out fully and A1 for the final answer.]

[In the case of an attempt to expand $(4+5x-x^2)(1-2x)^{-1}(2+x)^{-2}$, give M1A1A1 for the expansions, M1 for multiplying out fully, and A1 for the final answer.]
[SR: If B or C omitted from the form of fractions, give B0M1A0A0A0 in **(i)**; M1A1√A1√ in **(ii)**.]
[SR: If D or E omitted from the form of fractions, give B0M1A0A0A0 in **(i)**; M1A1√A1√ in **(ii)**.]

Q8.

EITHER: State or imply non-modular inequality $(2(x-3))^2 > (3x+1)^2$, or corresponding quadratic equation, or pair of linear equations $2(x-3) = \pm(3x+1)$ B1
Make reasonable solution attempt at a 3-term quadratic, or solve two linear equations M1
Obtain critical values $x = -7$ and $x = 1$ A1
State answer $-7 < x < 1$ A1

OR: Obtain critical value $x = -7$ or $x = 1$ from a graphical method, or by inspection, or by solving a linear equation or inequality B1
Obtain critical values $x = -7$ and $x = 1$ B2
State answer $-7 < x < 1$ B1 [4]

[Do not condone: ≤ for <.]

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Q9.

(i)	State or imply the form $\dfrac{A}{1+x}+\dfrac{Bx+C}{1+2x^2}$	B1	
	Use any relevant method to evaluate a constant	M1	
	Obtain one of $A = -1$, $B = 2$, $C = 1$	A1	
	Obtain a second value	A1	
	Obtain the third value	A1	[5]

(ii)	Use correct method to obtain the first two terms of the expansion of $(1+x)^{-1}$ or $(1+2x^2)^{-1}$	M1	
	Obtain correct expansion of each partial fraction as far as necessary	A1√ + A1√	
	Multiply out fully by $Bx + C$, where BC þ 0	M1	
	Obtain answer $3x - 3x^2 - 3x^3$	A1	[5]

[Symbolic binomial coefficients, e.g., $\begin{pmatrix}-1\\1\end{pmatrix}$ are not sufficient for the first M1. The f.t. is on A, B, C.]

[If B or C omitted from the form of fractions, give B0M1A0A0A0 in **(i)**; M1A1√A1√ in **(ii)**, max 4/10.]

[If a constant D is added to the correct form, give M1A1A1A1 and B1 if and only if $D = 0$ is stated.]

[If an extra term $D/(1 + 2x^2)$ is added, give B1M1A1A1, and A1 if $C + D = 1$ is resolved to $1/(1 + 2x^2)$.]

[In the case of an attempt to expand $3x(1 + x)^{-1}(1 + 2x^2)^{-1}$, give M1A1A1 for the expansions up to the term in x^2, M1 for multiplying out fully, and A1 for the final answer.]

[For the identity $3x \equiv (1 + x + 2x^2 + 2x^3)(a + bx + cx^2 + dx^3)$ give M1A1; then M1A1 for using a relevant method to find two of $a = 0$, $b = 3$, $c = -3$ and $d = -3$; and then A1 for the final answer in series form.]

Q10.

Obtain $1 - 6x$	B1	
State correct unsimplified x^2 term. Binomial coefficients must be expanded.	M1	
Obtain … $+ 24x^2$	A1	[3]

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Q11.

(i)		Attempt to solve for m the equation $p(-2) = 0$ or equivalent	M1	
		Obtain $m = 6$	A1	[2]
		Alternative:		
		Attempt $p(z) \div (z + 2)$, equate a constant remainder to zero and solve for m.	M1	
		Obtain $m = 6$	A1	
(ii)	**(a)**	State $z = -2$	B1	
		Attempt to find quadratic factor by inspection, division, identity, …	M1	
		Obtain $z^2 + 4z + 16$	A1	
		Use correct method to solve a 3-term quadratic equation	M1	
		Obtain $-2 \pm 2\sqrt{3}i$ or equivalent	A1	[5]
	(b)	State or imply that square roots of answers from part **(ii)(a)** needed	M1	
		Obtain $\pm i\sqrt{2}$	A1	
		Attempt to find square root of a further root in the form $x + iy$ or in polar form	M1	
		Obtain $a^2 - b^2 = -2$ and $ab = (\pm)\sqrt{3}$ following their answer to part **(ii)(a)**	A1√	
		Solve for a and b	M1	
		Obtain $\pm(1 + i\sqrt{3})$ and $\pm(1 - i\sqrt{3})$	A1	[6]