Q1.

9	(i)	State or imply partial fractions of the form $\frac{A}{1-2x}+\frac{B}{2+x}+\frac{C}{(2+x)^2}$	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 $\frac{A}{1-2x}+\frac{Dx+E}{(2+x)^2}$, 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 $1+\frac{9}{4}x+\frac{15}{4}x^2$, or equivalent	A1	[5]
		[Symbolic binomial coefficients, e.g. $\binom{-1}{1}$, 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)**.]		

Q2.

1	Either:	Obtain $1+\frac{1}{3}kx$, where $k=\pm 6$ or ± 1	M1	
		Obtain $1-2x$	A1	
		Obtain $-4x^2$	A1	
		Obtain $-\frac{40}{3}x^3$ or equivalent	A1	
	Or:	Differentiate expression to obtain form $k(1-6x)^{-\frac{2}{3}}$ and evaluate f(0) and f′(0)	M1	
		Obtain $f'(x)=-2(1-6x)^{-\frac{2}{3}}$ and hence the correct first two terms $1-2x$	A1	
		Obtain $f''(x)=-8(1-6x)^{-\frac{5}{3}}$ and hence $-4x^2$	A1	
		Obtain $f'''(x)=-80(1-6x)^{-\frac{8}{3}}$ and hence $-\frac{40}{3}x^3$ or equivalent	A1	[4]

Q3.

2	**(i)** Either	Obtain correct (unsimplified) version of x or x^2 term from $(1-4x)^{\frac{1}{2}}$	M1	
		Obtain $1 + 2x$	A1	
		Obtain $+ 6x^2$	A1	
	Or	Differentiate and evaluate f(0) and f′(0) where $f'(x) = k(1-4x)^{-\frac{3}{2}}$	M1	
		Obtain $1 + 2x$	A1	
		Obtain $+ 6x^2$	A1	[3]
	(ii)	Combine both x^2 terms from product of $1 + 2x$ and answer from part **(i)**	M1	
		Obtain 5	A1	[2]

Q4.

1	*EITHER*:	Obtain a correct unsimplified version of the x or x^2 term of the expansion of $(4+3x)^{-\frac{1}{2}}$ or $(1+\frac{3}{4}x)^{-\frac{1}{2}}$	M1	
		State correct first term $\frac{1}{2}$	B1	
		Obtain the next two terms $-\frac{3}{16}x + \frac{27}{256}x^2$	A1 + A1	
	OR:	Differentiate and evaluate f(0) and f′(0), where $f'(x) = k(4+3x)^{-\frac{3}{2}}$	M1	
		State correct first term $\frac{1}{2}$	B1	
		Obtain the next two terms $-\frac{3}{16}x + \frac{27}{256}x^2$	A1 + A1	[4]
		[Symbolic coefficients, e.g. $\begin{pmatrix} -\frac{1}{2} \\ 2 \end{pmatrix}$ are not sufficient for the M or B mark.]		

Q5.

2	Obtain $1-x$ as first two terms of $(1+2x)^{-\frac{1}{2}}$	B1	
	Obtain $+\frac{3}{2}x^2$ or unsimplified equivalent as third term of $(1+2x)^{-\frac{1}{2}}$	B1	
	Multiply $1+3x$ by attempt at $(1+2x)^{-\frac{1}{2}}$, obtaining sufficient terms	M1	
	Obtain final answer $1+2x-\frac{3}{2}x^2$	A1	[4]

Q6.

3	State or imply correct form $\frac{A}{x} + \frac{Bx+C}{x^2+1}$	B1	
	Use any relevant method to find at least one constant	M1	
	Obtain $A = 2$	A1	
	Obtain $B = 5$	A1	
	Obtain $C = -3$	A1	[5]

Q7.

8	(i)	State or imply partial fractions are of the form $\frac{A}{x+1}+\frac{B}{(x+1)^2}+\frac{C}{3x+2}$	B1	
		Use any relevant method to obtain a constant	M1	
		Obtain one of the values $A = 1$, $B = 2$, $C = -3$	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 $(x + 1)^{-1}$, $(x + 1)^{-2}$, $(3x + 2)^{-1}$ or $(1 + \frac{3}{2}x)^{-1}$	M1	
		Obtain correct unsimplified expansion up to the term in x^2 of each partial fraction	A1√ + A1√ + A1√	
		Obtain answer $\frac{3}{2}-\frac{11}{4}x+\frac{29}{8}x^2$, or equivalent	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.]

[The form $\frac{Dx+E}{(x+1)^2}+\frac{C}{3x+2}$, where $D = 1$, $E = 3$, $C = -3$, is acceptable. In part **(i)** give B1M1A1A1A1.
In part **(ii)** give M1A1√A1√ for the expansions, and, if $DE \neq 0$, M1 for multiplying out fully and A1 for the final answer.]
[If B or C omitted from the form of fractions, give B0M1A0A0A0 in **(i)**; M1A1√A1√ in **(ii)**, max 4/10]
[If D or E omitted from the form of fractions, give B0M1A0A0A0 in **(i)**; M1A1√A1√ in **(ii)**, max 4/10]
[In the case of an attempt to expand $(5x + 3)(x + 1)^{-2}(3x + 2)^{-1}$, give M1A1A1 for the expansions, M1 for multiplying out fully, and A1 for the final answer.]
[Allow use of Maclaurin, giving M1A1√A1√ for differentiating and obtaining $f(0) = \frac{3}{2}$ and $f'(0) = -\frac{11}{4}$, A1√ for $f''(0) = \frac{29}{4}$, and A1 for the final answer (the f.t. is on A, B, C if used).]

Q8.

8	**(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.]

Q9.

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

Q10.

1	**Either** Obtain correct unsimplified version of x or x^2 term in expansion of $(2+x)^{-2}$ or $(1+\frac{1}{2}x)^{-2}$	M1	
	Correct first term 4 from correct work	B1	
	Obtain $-4x$	A1	
	Obtain $+ 3x^2$	A1	
	Or Differentiate and evaluate f(0) and f′ (0) where f′ $(x) = k(2+x)^{-3}$	M1	
	State correct first term 4	B1	
	Obtain $-4x$	A1	
	Obtain $+ 3x^2$	A1	[4]

Q11.

4 **(i)** Obtain correct unsimplified terms in x and x^3 — B1 + B1

Equate coefficients and solve for a — M1

Obtain final answer $a = \frac{1}{\sqrt{2}}$, or exact equivalent — A1 [4]

(ii) Use correct method and value of a to find the first two terms of the expansion $(1 + ax)^{-2}$ — M1

Obtain $1 - \sqrt{2}x$, or equivalent — A1 √

Obtain term $\frac{3}{2}x^2$ — A1 √ [3]

[Symbolic coefficients, e.g. a, are not sufficient for the first B marks]

[The f.t. is solely on the value of a.]

Q12.

9 (i)	State or imply form $\dfrac{A}{3-x}+\dfrac{Bx+C}{1+x^2}$	B1	
	Use relevant method to determine a constant	M1	
	Obtain $A=6$	A1	
	Obtain $B=-2$	A1	
	Obtain $C=1$	A1	[5]
(ii)	Either Use correct method to obtain first two terms of expansion of $(3-x)^{-1}$ or $\left(1-\frac{1}{3}x\right)^{-1}$ or $(1+x^2)^{-1}$	M1	
	Obtain $\frac{A}{3}\left(1+\frac{1}{3}x+\frac{1}{9}x^2+\frac{1}{27}x^3\right)$	A1	
	Obtain $(Bx+C)(1-x^2)$	A1	
	Obtain sufficient terms of the product $(Bx+C)(1-x^2)$, $B, C \neq 0$ and add the two expansions	M1	
	Obtain final answer $3-\frac{4}{3}x-\frac{7}{9}x^2+\frac{56}{27}x^3$	A1	
	Or Use correct method to obtain first two terms of expansion of $(3-x)^{-1}$ or $\left(1-\frac{1}{3}x\right)^{-1}$ or $(1+x^2)^{-1}$	M1	
	Obtain $\frac{1}{3}\left(1+\frac{1}{3}x+\frac{1}{9}x^2+\frac{1}{27}x^3\right)$	A1	
	Obtain $(1-x^2)$	A1	
	Obtain sufficient terms of the product of the three factors	M1	
	Obtain final answer $3-\frac{4}{3}x-\frac{7}{9}x^2+\frac{56}{27}x^3$	A1	[5]

Q13.

7 (i)	State or imply partial fractions are of the form $\dfrac{A}{x-2}+\dfrac{Bx+C}{x^2+3}$	B1	
	Use a relevant method to determine a constant	M1	
	Obtain one of the values $A=-1$, $B=3$, $C=-1$	A1	
	Obtain a second value	A1	
	Obtain the third value	A1	**[5]**
(ii)	Use correct method to obtain the first two terms of the expansions of $(x-2)^{-1}$, $\left(1-\frac{1}{2}x\right)^{-1}$, $(x^2+3)^{-1}$ or $\left(1+\frac{1}{3}x^2\right)^{-1}$	M1	
	Substitute correct unsimplified expansions up to the term in x^2 into each partial fraction	A1√+A1√	
	Multiply out fully by $Bx+C$, where $BC \neq 0$	M1	
	Obtain final answer $\frac{1}{6}+\frac{5}{4}x+\frac{17}{72}x^2$, 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*.]

[In the case of an attempt to expand $(2x^2-7x-1)(x-2)^{-1}(x^2+3)^{-1}$, give M1A1A1 for the expansions, M1 for multiplying out fully, and A1 for the final answer.]

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

Q14.

8	**(i)**	<u>Either</u>	State or imply form $\dfrac{A}{1+x}+\dfrac{B}{(1+x)^2}+\dfrac{C}{2-3x}$	B1	
			Use any relevant method to find at least one constant	M1	
			Obtain $A=-1$	A1	
			Obtain $B=3$	A1	
			Obtain $C=4$	A1	
		<u>Or</u>	State or imply form $\dfrac{A}{1+x}+\dfrac{Bx}{(1+x)^2}+\dfrac{C}{2-3x}$	B1	
			Use any relevant method to find at least one constant	M1	
			Obtain $A=2$	A1	
			Obtain $B=-3$	A1	
			Obtain $C=4$	A1	
		<u>Or</u>	State or imply form $\dfrac{Dx+E}{(1+x)^2}+\dfrac{F}{2-3x}$	B1	
			Use any relevant method to find at least one constant	M1	
			Obtain $D=-1$	A1	
			Obtain $E=2$	A1	
			Obtain $F=4$	A1	[5]

(ii) Either	Use correct method to find first two terms of expansion of $(1+x)^{-1}$ or $(1+x)^{-2}$ or $(2-3x)^{-1}$ or $\left(1-\frac{3}{2}x\right)^{-1}$	M1	
	Obtain correct unsimplified expansion of first partial fraction up to x^2 term	A1√	
	Obtain correct unsimplified expansion of second partial fraction up to x^2 term	A1√	
	Obtain correct unsimplified expansion of third partial fraction up to x^2 term	A1√	
	Obtain final answer $4-2x+\frac{25}{2}x^2$	A1	
Or 1	Use correct method to find first two terms of expansion of $(1+x)^{-2}$ or $(2-3x)^{-1}$ or $\left(1-\frac{3}{2}x\right)^{-1}$	M1	
	Obtain correct unsimplified expansion of first partial fraction up to x^2 term	A1√	
	Obtain correct unsimplified expansion of second partial fraction up to x^2 term	A1√	
	Expand and obtain sufficient terms to obtain three terms	M1	
	Obtain final answer $4-2x+\frac{25}{2}x^2$	A1	
Or 2	(expanding original expression)		
	Use correct method to find first two terms of expansion of $(1+x)^{-2}$ or $(2-3x)^{-1}$ or $\left(1-\frac{3}{2}x\right)^{-1}$	M1	
	Obtain correct expansion $1-2x+3x^2$ or unsimplified equivalent	A1	
	Obtain correct expansion $\frac{1}{2}\left(1+\frac{3}{2}x+\frac{9}{4}x^2\right)$ or unsimplified equivalent	A1	
	Expand and obtain sufficient terms to obtain three terms	M1	
	Obtain final answer $4-2x+\frac{25}{2}x^2$	A1	
Or 3	(McLaurin expansion)		
	Obtain first derivative $f'(x)=(1+x)^{-2}-6(1+x)^{-3}+12(2-3x)^{-2}$	M1	
	Obtain $f'(0)=1-6+3$ or equivalent	A1	
	Obtain $f''(0)=-2+18+9$ or equivalent	A1	
	Use correct form for McLaurin expansion	M1	
	Obtain final answer $4-2x+\frac{25}{2}x^2$	A1	[5]

Q15.

9 (i)	Either	State or imply partial fractions are of form $\frac{A}{3-x}+\frac{B}{1+2x}+\frac{C}{(1+2x)^2}$	B1	
		Use any relevant method to obtain a constant	M1	
		Obtain $A = 1$	A1	
		Obtain $B=\frac{3}{2}$	A1	
		Obtain $C=-\frac{1}{2}$	A1	[5]
	Or	State or imply partial fractions are of form $\frac{A}{3-x}+\frac{Dx+E}{(1+2x)^2}$	B1	
		Use any relevant method to obtain a constant	M1	
		Obtain $A = 1$	A1	
		Obtain $D = 3$	A1	
		Obtain $E = 1$	A1	[5]

(ii) Obtain the first two terms of one of the expansion of $(3-x)^{-1}, \left(1-\frac{1}{3}x\right)^{-1}$

$(1+2x)^{-1}$ and $(1+2x)^{-2}$ — M1

Obtain correct unsimplified expansion up to the term in x^2 of each partial fraction, following in each case the value of A, B, C — A1√ A1√ A1√

Obtain answer $\frac{4}{3}-\frac{8}{9}x+\frac{1}{27}x^2$ — A1 [5]

[If A, D, E approach used in part (i), give M1A1√A1√ for the expansions, M1 for multiplying out fully and A1 for final answer]

Q16.

2	State a correct unsimplified version of the x or x^2 or x^3 term	M1	
	State correct first two terms $1-x$	A1	
	Obtain the next two terms $2x^2-\frac{14}{3}x^3$	A1 + A1	**4**

[Symbolic binomial coefficients, e.g. $\binom{-\frac{1}{3}}{3}$ are not sufficient for the M mark.]

Q17.

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

Use a correct method to determine a constant M1

Obtain one of $A = 2$, $B = -1$, $C = 3$ A1

Obtain a second value A1

Obtain a third value A1 **[5]**

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

(ii) Use correct method to find the first two terms of the expansion of $(1-x)^{-1}, (2-x)^{-1}, (2-x)^{-2}, (1-\frac{1}{2}x)^{-1}$ 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 final answer $\frac{9}{4}+\frac{5}{2}x+\frac{39}{16}x^2$, or equivalent A1 **[5]**

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

[For the A,D,E form of partial fractions, give M1 A1✓ 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 $(x^2-8x+9)(1-x)^{-1}(2-x)^{-2}$, give M1A1A1 for the expansions, M1 for multiplying out fully, and A1 for the final answer.]