M1.

(a) **Alternative method 1**

$a = 2$ or $2(x^2 – 3x + 2.5)$ or
$2(x^2 – 3x) + 5$

M1

$x^2 – 3x = (x – 1.5)^2 – 1.5^2$
oe
ft their $x^2 – 3x$

M1dep

$a = 2$ and $b = 1.5$ and $c = 0.5$
oe eg $2(x –1.5)^2 + 0.5$

A1

Alternative method 2

$a = 2$

B1

$x^2 – bx – bx + b^2$ or
$x^2 – 2bx + b^2$ or
$–2ab = –6$ or
$–ab = –3$ or
$b = 1.5$
oe

M1

$a = 2$ and $b = 1.5$ and $c = 0.5$
oe eg $2(x –1.5)^2 + 0.5$

A1

(b) **Alternative method 1**

their $2(x - 1.5)^2 = 8.5 -$ their 0.5

M1

their $(x - 1.5) = \pm \sqrt{\frac{8.5 - \text{their } 0.5}{2}}$

oe

M1dep

3.5 and –0.5

oe

A1

Alternative method 2

$2x^2 - 6x - 3.5 (= 0)$ or
$4x^2 - 12x - 7 (=0)$

oe 3-term quadratic equation or expression

M1

Correct use of quadratic formula

eg $\frac{--12 \pm \sqrt{(-12)^2 - 4 \times 4 \times -7}}{2 \times 4}$

or correct factorisation
eg $(2x - 7)(2x + 1) = 0$

oe

M1dep

3.5 and –0.5

oe

A1

[6]

M2.

$\frac{-8 \pm \sqrt{8^2 - 4 \times 5 \times 2}}{2 \times 5}$

or $\frac{-8 \pm \sqrt{24}}{10}$

Allow one error

M1

$\frac{-8 \pm \sqrt{8^2 - 4 \times 5 \times 2}}{2 \times 5}$

or $\frac{-8 \pm \sqrt{24}}{10}$

oe

A1

−0.3 and −1.3

SC2 for −0.3 or −1.3

A1

[3]

M3.

$\frac{x - 1}{(x - 2)(x - 1)} - \frac{x - 2}{(x - 2)(x - 1)}$

or $x - 1 - (x - 2)$

or $2(x - 2)(x - 1)$

or $x^2 - 2x - x + 2$

oe

M1

their $[\, x - 1 - (x - 2) \,] = 2(x - 1)(x - 2)$

or $x - 1 - x + 2$

or $2(x^2 - 2x - x + 2)$

oe

M1dep

$2x^2 - 6x + 3 (= 0)$

oe Must be three terms

A1

$\frac{--6 \pm \sqrt{(-6)^2 - (4 \times 2 \times 3)}}{2 \times 2}$

or $\frac{6 \pm \sqrt{12}}{4}$

oe

*Allow one error, ft **their** quadratic*

M1

$\frac{--6 \pm \sqrt{(-6)^2 - (4 \times 2 \times 3)}}{2 \times 2}$

or $\frac{6 \pm \sqrt{12}}{4}$

*ft **their** quadratic, fully correct*

oe

2.366(…) and 0.633(…)

A1ft

2.37 and 0.63

SC2 for one correct answer to 2 dp

SC1 for one correct answer to 3 dp or more

A1ft

Additional Guidance

T&I with two correct answers to 2 dp scores full marks
T&I with two correct answers to 3 dp or more loses final A mark
ft is from *their* quadratic (must have three terms)
One error is an incorrect substitution in one position or a short divisor line
A negative discriminant can score M1A1ftA0ft for an attempt at a solution

[6]

M4.

(a) **Alternative method 1**

$(x - 5)^2$

M1

$(x - 5)^2 - 13$ or $a = 5$ and $b = -13$

A1

Alternative method 2

$x^2 - 2ax + a^2 + b = x^2 - 10x + 16$

or $2a = 10$ or $a = 5$ or $b = -13$

M1

$(x - 5)^2 - 13$ or $a = 5$ and $b = -13$

A1

(b) 2

B1

[3]

M5.

$$\frac{-3 \pm \sqrt{3^2 - (4 \times 5 \times -4)}}{2 \times 5}$$

Allow one error

M1

$$\frac{-3 \pm \sqrt{3^2 - (4 \times 5 \times -4)}}{2 \times 5}$$

or $\frac{-3 \pm \sqrt{9 + 80}}{10}$

Fully correct

oe

A1

−1.24 and 0.64

SC2 for either − 1.24 or 0.64

A1

Additional Guidance

−1.24 (…) or 0.64 (…)

M1A1A0

[3]

M6.

(a) $5x^2 + 10xy - 2xy - 4y^2$

Allow one error in their four terms

M1

$5x^2 + 10xy - 2xy - 4y^2$

Fully correct

May be in a grid

A1

$5x^2 + 8xy - 4y^2$

ft their four terms

Do not ignore fw

A1ft

Alternative method 1

(b) $\frac{2 \pm \sqrt{(-2)^2 - (4 \times 1 \times -2)}}{2}$

oe

Allow one error

M1

$\frac{2 \pm \sqrt{(-2)^2 - (4 \times 1 \times -2)}}{2}$

or $\frac{2 \pm \sqrt{4 - -8}}{2}$

oe

Fully correct

A1

2.7 and -0.7

SC2 for either 2.7 or −0.7

A1

Alternative method 2

$(x - 1)^2 - 1 - 2 = 0$

oe

M1

$1 \pm \sqrt{3}$

oe
Fully correct
or 2.7(…) or − 0.7(…)

A1

2.7 and − 0.7
SC2 for either 2.7 or − 0.7

A1

Additional Guidance
− 0.73(…) or 2.73(…)

M1A1A0

-2^2 in the discriminant is one error unless recovered

(c) $(ax+b)(cx+d)$

or $(x + 2)(x - 2)$
where $ac = 3$ and $bd = -10$
or $ad + bc = -1$

M1

$(3x + 5)(x - 2)$

A1

$\frac{3x + 5}{x + 2}$

Do not ignore fw

A1

Additional Guidance
$\frac{(3x - 5)(x + 2)}{(x + 2)(x - 2)}$

M1
A0

$= \frac{(3x - 5)}{(x - 2)}$

A0

[9]

M7.

$x^2 - 5x - 5x + 25$

or $x^2 - 10x + c$

x^2 + (term(s) in x) + 25 + 7

or $(x + \frac{a}{2})^2$

M1

$a = -10$

A1

$b = 32$

A1

[3]

M8. $\frac{--12 \pm \sqrt{(-12)^2 - 4 \times 3 \times -5}}{2 \times 3}$

or $\frac{12 \pm \sqrt{144 + 60}}{6}$

Allow one error

M1

$\frac{--12 \pm \sqrt{(-12)^2 - 4 \times 3 \times -5}}{2 \times 3}$

or $\frac{12 \pm \sqrt{144 + 60}}{6}$

oe

A1

4.38 and −0.38

SC2 for 4.38 or −0.38

A1

[3]

M9. $x^2 - cx - cx + c^2$

or $x^2 - 2cx + c^2$

or $a = c^2$

or $12 = 2c$

or $12x = 2cx$

or $-12x = -2cx$

M1

$c = 6$

A1

$a = 36$

ft their c^2

A1ft

Alternative Method

$(x - 6)^2 + a - 36$

M1

$c = 6$

A1

$a = 36$

ft their c^2

A1ft

[3]

)

M10.

Alternative method 1

$$\frac{-(-5) \pm \sqrt{(-5)^2 - 4(2)(-4)}}{2(2)}$$

Allow one error from
Wrong sign for b
−25 for (−5)² if evaluated
−32 for −4ac if evaluated
but M0 for wrong formula, including lack of ±.
***or** Dividing by 2 not 2a*
***or** dividing only square root by 2a, but can be recovered.*

M1

$$\frac{5 \pm \sqrt{57}}{4}$$

A1

3.14 and −0.64
or 3.137458609 and −0.637458609 rounded to any accuracy > 2dp

ft on (rounded to any accuracy > 2dp)
wrong sign for b giving −3.14 and 0.64
−25 for (−5)² giving 1.91 and 0.59
SC1 answers only

A1

Alternative method

$2(x - \frac{5}{4})^2 - \frac{57}{8}$

or $(x - \frac{5}{4})^2 - \frac{57}{16}$

M1

$= \frac{5}{4} \pm \sqrt{(\frac{57}{16})}$

A1

3.14 and −0.64
or 3.137458609 and −0.637458609 rounded to any accuracy > 2dp

A1

[3]

M11. $x^2 + ax + ax + (a^2)$

or $x^2 + 2ax + (a^2)$

or $2a = 8$ or $a^2 + b = 7$

M1

$(x + 4)^2$

or $a = 4$ or $b = -9$

A1

$(x + 4)^2 - 9$

allow $a = 4$ ***and*** *$b = -9$*

A1

[3]

M12. $(x \pm 3)^2 \pm 9$ or ± 7 or ± 11 $(= 0)$

M1

$(x \pm 3)^2 = 7$ or 11

M1dep

$x + 3 = \pm \sqrt{7}$

A1

$-3 \pm \sqrt{7}$

ft on one error, ie $3 \pm \sqrt{7}$ *or* $-3 \pm \sqrt{11}$

SC3 $-3 + \sqrt{7}$

A1ft

Alternative Method

$(x =) \dfrac{-6 \pm \sqrt{6^2 - 4 \times 1 \times 2}}{2}$

Allow one sign error but not partial division or wrong formula

M1

$(x =) \dfrac{-6 \pm \sqrt{6^2 - 4 \times 1 \times 2}}{2}$

No errors

A1

$(x =) \dfrac{-6 \pm \sqrt{28}}{2}$ or $\dfrac{6 \pm \sqrt{28}}{2}$

or $\dfrac{-6 \pm \sqrt{44}}{2}$

M1dep

$-3 \pm \sqrt{7}$

ft on one error, ie $3 \pm \sqrt{7}$ *or* $-3 \pm \sqrt{11}$

SC3 $-3 + \sqrt{7}$

A1ft

[4]

M13.

$\dfrac{-(3) \pm \sqrt{(3)^2 - 4(2)(-7)}}{2(2)}$

Allow one error for M1 from the following

Wrong sign for b, $-4ac$ negative
Denominator of 2
Do not allow M1 for not dividing all top by 2 or 2a
A1 if all correct

M1, A1

1.27 and −2.77

ft on wrong sign for b only −1.27, 2.77

A1ft

Alternative

$2(x + 0.75)^2 - 8.122$

$(x + 0.75)^2 - 4.0625$

M1

$= \pm\sqrt{(4.0625)} - 0.75$

Must have ±

A1

1.27 and −2.77

A1

[3]