## Q1.

(a) $12x^2 + 18x - 2x - 3$

*Must have four terms, one in $x^2$, 2 in $x$ and a constant term. 3 terms correct*

*Terms may be in box method but must have correct signs*

**M1**

$12x^2 + 16x - 3$

**A1**

**Additional Guidance**

$8x^2 + 18x - 2x - 3$

**M1**

$12x^2 + 18x + 2x - 3$

**M1**

$8x^2 + 18x + 2x - 3$

**M0**

$12x + 18x - 2x - 3$

**M0**

| | $6x$ | $-1$ |
|---|---|---|
| $2x$ | $12x^2$ | $-2x$ |
| $3$ | $18x$ | $-3$ |

**M1**

| | $6x$ | $-1$ |
|---|---|---|
| $2x$ | $12x^2$ | $2x$ |
| $3$ | $18x$ | $3$ |

**M1**
**(but can be recovered)**

(b) **Alternative method 1**

$(ax \pm c)(bx \pm d)$

$ab = 4$ ***and*** $cd = \pm 3$

**M1**

$(4x - 3)(x + 1)$

**A1**

$\frac{3}{4}$ and $-1$

*ft their brackets if M1 awarded*

**A1ft**

**Alternative method 2**

$$\frac{-1\pm\sqrt{1^2-4\times4\times-3}}{2\times4}$$

*Allow one error from wrong sign for $-b$, wrong signs for $-4ac$, $b^2$ as – 1*

*Do not accept wrong formula, ie + not ±, 2 not $2a$ or only dividing root by 2a*

**M1**

$$\frac{-1\pm\sqrt{49}}{8}$$

**A1**

$$\frac{3}{4}\text{ and }-1$$

*oe ft on wrong sign for $-b$ only eg* $-\frac{3}{4}$ and $-1$

**A1**

**Alternative method 3**

$$(x+\frac{1}{8})^2=\frac{49}{64}$$

**M1**

$$x=\pm\sqrt{\frac{49}{64}}-\frac{1}{8}$$

**A1**

$$\frac{3}{4}\text{ and }-1$$

*oe*

**A1ft**

**Alternative method 4**

Writes $x^2 + x - 12$ **and** writes

$$\left(x\pm\frac{a}{4}\right)\left(x\pm\frac{b}{4}\right)\text{ where }ab=-12$$

*(4x ± 4)(4x ± 3)*

**M1**

$$\left(x+\frac{4}{4}\right)\left(x-\frac{3}{4}\right)$$

*oe eg (4x + 4)(4x – 3)*

**A1**

$\frac{3}{4}$ and $-1$

*oe ft their brackets if M1 awarded*

**A1ft**

**Additional Guidance**

$(2x - 1)(2x + 3)$, $\frac{1}{2}$ and $-1\frac{1}{2}$

**M1, A0, A1 ft**

$\frac{1 \pm \sqrt{1^2 - 4 \times 4 \times -3}}{2 \times 4}$, $-\frac{3}{4}$ and $1$

**M1, A0, A1 ft**

$(4x + 3)(x - 1)$, $-\frac{3}{4}$ and $-1$

**M1, A0, A1 ft**

$x^2 + x - 12$

**M1**

$\left(x + \frac{2}{4}\right)\left(x - \frac{6}{4}\right)$

**A0**

$1\frac{1}{2}$ and $-\frac{1}{2}$

**A1ft**

**[5]**

## Q2.

(−3, 5)

**B1**

**[1]**

## Q3.

use of $(x - 4)^2$

**M1**

$(x - 4)^2 - 16$ (+ 20)

**A1**

$(x - 4)^2 - 16 + 20 = (x - 4)^2 + 4$

*Strand (ii)*

*Complete and correct algebraic explanation*

**Q1**

**Alternative method 1**

use of $(x - 4)^2$

**M1**

$= x^2 - 8x + 16$

**A1**

$(x - 4)^2 + 4 = x^2 - 8x + 20$

*Strand (ii)*

*Complete and correct algebraic explanation*

**Q1**

**Alternative method 2**

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

**M1**

$a = 4$

**A1**

Also $4^2 + 4 = 20$

*Strand (ii)*

*Complete and correct algebraic explanation*

**Q1**

(b) explains that a square is always positive (or zero) *oe*

**B1**

and a positive number is added so is always positive *oe*

**B1**

**[5]**

## Q4.

(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]**

## Q5.

**Alternative method 1**

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

or

$2x \times 4$ or $8x$

or
$4(x + 2)$ or $4x + 8$

**M1**

$x(x + 2)$ or $x^2 + 2x$
and
$2x \times 4$ or $8x$
and
$4(x + 2)$ or $4x + 8$

*oe*

eg $\frac{x(x+2)-2x\times4}{4(x+2)}$

**M1dep**

$x(x + 2) - 2x \times 4 = 4(x + 2)$

*oe equation with fractions eliminated*
*dep on M2*

**M1dep**

$x^2 - 10x - 8 (= 0)$

*oe 3-term quadratic equation with terms collected*

**A1**

$\frac{--10 \pm \sqrt{(-10)^2 - 4\times1\times-8}}{2\times1}$

or $\frac{10 \pm \sqrt{100+32}}{2}$ or $\frac{10 \pm \sqrt{132}}{2}$

or $5 \pm \sqrt{5^2+8}$ or $5 \pm \sqrt{33}$

or

[10.744, 10.745] and [–0.745, –0.744]

*oe*
*Correct for their 3-term quadratic*
*Allow correct factorisation of their 3-term quadratic*

**M1**

10.74 and –0.74
with $x^2 - 10x - 8 (= 0)$ oe seen

*Must both be to 2 decimal places*

**A1**

**Alternative method 2** (from $\frac{x}{4} - 1 = \frac{2x}{x+2}$)

$x(x + 2)$ or $x^2 + 2x$
or
$(x + 2) + 2x$ or $3x + 2$
or
$12x + 8$

**M1**

$\frac{x(x+2)}{4}$ or $\frac{x^2+2x}{4}$

and

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

**M1dep**

$x(x + 2) = 4(x + 2 + 2x)$
or
$x(x + 2) = 4(3x + 2)$

*oe equation with fractions eliminated*
*dep on M2*

**M1dep**

$x^2 - 10x - 8$ (= 0)

*oe 3-term quadratic equation with terms collected*

**A1**

$$\frac{--10 \pm \sqrt{(-10)^2 - 4 \times 1 \times -8}}{2 \times 1}$$

or $\frac{10 \pm \sqrt{100+32}}{2}$ or $\frac{10 \pm \sqrt{132}}{2}$

or $5 \pm \sqrt{5^2+8}$ or $5 \pm \sqrt{33}$

or

[10.744, 10.745] and [–0.745, –0.744]

*oe*
*Correct for their 3-term quadratic*
*Allow correct factorisation of their 3-term quadratic*

**M1**

10.74 and –0.74
with $x^2 - 10x - 8$ (= 0) oe seen

*Must both be to 2 decimal places*

**A1**

**Alternative method 3** (from $\frac{x}{4} - 1 = \frac{2x}{x+2}$)

$\frac{x-4}{4}$

**M1**

$(x – 4)(x + 2)$ or $x^2 – 4x + 2x – 8$
or $x^2 – 2x – 8$
and
$2x \times 4$ or $8x$

**M1dep**

$(x - 4)(x + 2) = 2x \times 4$
or
$x^2 - 4x + 2x - 8 = 8x$

*oe equation with fractions eliminated*
*dep on M2*

**M1dep**

$x^2 - 10x - 8\ (= 0)$

*oe 3-term quadratic equation with terms collected*

**A1**

$$\frac{--10 \pm \sqrt{(-10)^2 - 4 \times 1 \times -8}}{2 \times 1}$$

or $\frac{10 \pm \sqrt{100 + 32}}{2}$ or $\frac{10 \pm \sqrt{132}}{2}$

or $5 \pm \sqrt{5^2 + 8}$ or $5 \pm \sqrt{33}$

or
[10.744, 10.745] and [–0.745, –0.744]

*oe*
*Correct for their 3-term quadratic*
*Allow correct factorisation of their 3-term quadratic*

**M1**

10.74 and –0.74
with $x^2 - 10x - 8\ (= 0)$ oe seen

*Must both be to 2 decimal places*

**A1**

**Additional Guidance**

10.74 and –0.74 from T & I or with no working

**6 marks**

10.74 or –0.74 from T & I or with no working

**Zero**

In quadratic formula, do not allow $-10^2$ for $(-10)^2$ unless recovered

**[6]**

## Q6.

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

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]**

## Q7.

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

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]**

## Q8.

(a) **Alternative method 1**

$(x + 3)^2 + \ldots$ or $a = 3$

**M1**

$(x + 3)^2 + 1$

*Accept $a = 3$ and $b = 1$*

**A1**

**Alternative method 2**

$2a = 6$ and $a^2 + b = 10$

**M1**

$(x + 3)^2 + 1$

*Accept $a = 3$ and $b = 1$*

**A1**

(b) $(-3, 1)$

*oe*

*ft their $a$ and their $b$*

**B1ft**

**[3]**

## Q9.

$x^2 + ax + ax + a^2$ (– 7)
or $x^2 + 2ax + a^2$ (– 7)
or $2ax = 10x$
or $2a = 10$
or $a = 5$

or $a^2 - 7 = b$

or $(x + 5)^2$

*oe*

**M1**

$a = 5$ and $b = 18$

**A1**

**Additional Guidance**

$(x + 5)^2 - 7 = x^2 + 10x + 18$

**M1A1**

$a = 7$ and $b = 18$

**M0**

**[2]**

## Q10.

(a) $(x - 5)^2$ or $2a = 10$ or $a = 5$
or $a^2 + b = 29$

**M1**

$(x - 5)^2 + 4$
or $a = 5$ and $b = 4$

**A1**

(b) **Alternative method 1**

$(x - 3)^2 + 5$

**M1**

$x^2 - 3x - 3x + 9 + 5$
or $x^2 - 6x + 14$

*Correct expansion of their $(x + m)^2 + n$*

**M1**

$c = -6$ and $d = 14$

**A1**

**Alternative method 2**

$\left(x + \frac{c}{2}\right)^2 + d - \frac{c^2}{4}$

**M1**

$\frac{c}{2} = -3$ and $d - \frac{c^2}{4} = 5$

*Equates coefficients for their $(x + a)^2 + b$*

**M1**

$hc = -6$ and $d = 14$

**A1**

**Additional Guidance**

$9 + 3c + d = 5$

**M0**

**[5]**

## Q11.

$6(2x + 5) + 1(x + 3)$ or $3(x + 3)(2x + 5)$

*oe*

*May be seen as part of a fraction or fractions with denominator $(x + 3)(2x + 5)$*

**M1**

$6(2x + 5) + 1(x + 3) = 3(x + 3)(2x + 5)$

*oe*

**M1dep**

$6x^2 + 20x + 12 \ (= 0)$

or

$3x^2 + 10x + 6 \ (= 0)$

*Simplifying the expression to three terms*

**A1**

$$\frac{-20 \pm \sqrt{20^2 - 4 \times 6 \times 12}}{2 \times 6}$$

$$\text{or } \frac{-10 \pm \sqrt{10^2 - 4 \times 3 \times 6}}{2 \times 3}$$

*oe*

*Allow one error*

*–2.548... or –0.784...*

*Strictly ft their quadratic*

**M1**

$$\frac{-20 \pm \sqrt{20^2 - 4 \times 6 \times 12}}{2 \times 6}$$

$$\text{or } \frac{-10 \pm \sqrt{10^2 - 4 \times 3 \times 6}}{2 \times 3}$$

*oe*

*fully correct*

**A1ft**

–0.78 and –2.55

**A1**

**Additional Guidance**

One correct solution to 2 or more dp implies 4 marks

Two correct solutions to more than 2 dp implies 5 marks

$3x^2 + 10x = -6$

**M1M1A1**

ft their quadratic for the 4th and 5th marks

If no real roots M1A1ft can still be awarded

If quadratic factorises, must see correct factors for M1 and correct solutions for A1ft

If quadratic does not factorise, attempt to factorise scores M0

"Their quadratic" must be in the form $ax^2 + bx + c$ (= 0) or equivalent, no credit for solving a quadratic embedded within fractions etc

**[6]**

## Q12.

**Alternative method 1**

$5x^2 - 10x - 4$ (= 0)
or $-5x^2 + 10x + 4$ (= 0)

*If no rearrangement seen implied by*
*$a = 5$, $b = -10$, $c = -4$*
*or $a = -5$, $b = 10$, $c = 4$*
*seen or used correctly*

**B1**

$$\frac{--10 \pm \sqrt{(-10)^2 - 4 \times 5 \times -4}}{2 \times 5}$$

*ft their 3-term quadratic (equation)* ***seen***
*Allow one sign error*
*Allow $10^2$ for $(-10)^2$*
*(do not count as a sign error)*
*Allow recovery of invisible brackets*
*Conceptual error (omission of square root, incomplete square root symbol, ± not included, short fraction line) is M0 unless recovered*

**M1**

$$\frac{--10 \pm \sqrt{(-10)^2 - 4 \times 5 \times -4}}{2 \times 5}$$

or $\frac{10 \pm \sqrt{100 + 80}}{10}$

or $\frac{10 \pm \sqrt{180}}{10}$ or $\frac{10 \pm 6\sqrt{5}}{10}$

or 2.341(…) or 2.342
and −0.341(…) or −0.342

*Fully correct substitution*

*ft their 3-term quadratic (equation)* ***seen***

*oe eg* $\frac{5 \pm 3\sqrt{5}}{5}$

*Allow* $10^2$ *for* $(-10)^2$

*Allow recovery of invisible brackets*

*Two correct solutions > 2 dp for their 3-term quadratic equation*

**A1ft**

2.34 and −0.34

*ft B0M1A1ft*

*ft answers must be rounded to 2 dp*

**A1ft**

**Alternative method 2**

$5(x^2 - 2x - \frac{4}{5})(=0)$

or $x^2 - 2x - \frac{4}{5}(=0)$

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

*May be implied*

**B1**

$5[(x-1)^2 - 1^2 - \frac{4}{5}](=0)$

or $(x-1)^2 - 1^2 - \frac{4}{5}(=0)$

or $5[(ac - 1)^2 - 1^2] = 4$

or $(x-1)^2 - 1^2 = \frac{4}{5}$

*ft their 3-term quadratic (equation)* ***seen***

*Allow one sign error but* $(x - 1)^2$ *must be correct*

**M1**

$1 \pm \sqrt{1^2 + \frac{4}{5}}$

or 2.341(…) or 2.342
and −0.341(…) or −0.342

*Fully correct*

*ft their 3-term quadratic (equation)* ***seen***

*oe eg* $\frac{5 \pm 3\sqrt{5}}{5}$

*Two correct solutions > 2 dp for their 3-term quadratic equation* ***seen***

**A1ft**

2.34 and −0.34

*ft B0M1A1ft*

*ft answers must be rounded to 2 dp*

**A1ft**

**Additional Guidance**

Do not count a sign error in $a$ (or $b$) as two sign errors
eg If $a$ should be −5 but $a$ = 5 is used in both $4ac$ and $2a$, only count as one sign error

Final A1 mark can be awarded if both answers seen in working but only one is written on answer line

$5x^2 + 10x - 4 (= 0)$ **seen** with solutions −2.34 and 0.34
(no incorrect method seen)

**B0M1A1ftA1ft**

$5x^2 - 10x + 4 (= 0)$ **seen** with solutions 0.55 and 1.45
(no incorrect method seen)

**B0M1A1ftA1ft**

$5x^2 + 10x + 4 (= 0)$ **seen** with solutions −0.55 and −1.45
(no incorrect method seen)

**B0M1A1ftA1ft**

Note that the pairs of solutions seen in the three rows above can come from incorrect method so will not always score 3 marks

2.34 and −0.34 with no working or from T & I

**4 marks**

2.34 or −0.34 with no working or from T & I

**Zero**

2.3 and/or −0.3 with no working or from T & I

**Zero**

**[4]**