Mark schemes

Q1.

Alternative method 1

$y = 5x - 5$

M1

$2(5x - 5) - x^2 = 11$ or
$10x - 10 - x^2 = 11$

Eliminating a variable
oe

M1

$x^2 - 10x + 21 = 0$

Collecting terms

A1

$(x - 3)(x - 7)$ $(= 0)$

Correct and accurate method to solve their 3-term quadratic equation

$$\frac{10 \pm \sqrt{(-10)^2 - 4 \times 1 \times 21}}{2 \times 1}$$

M1

$x = 3$ and $x = 7$
or
$x = 3$ and $y = 10$
or
$x = 7$ and $y = 30$

A1

$x = 3$, $y = 10$ and $x = 7$, $y = 30$

A1

Alternative method 2

$10x - 2y = 10$

Equating coefficients

M1

$10x - x^2 = 21$

Eliminating a variable
oe

M1

$x^2 - 10x + 21 = 0$

Collecting terms

A1

$(x - 3)(x - 7)$ $(= 0)$

Correct and accurate method to solve their 3-term quadratic equation

$$\frac{10 \pm \sqrt{(-10)^2 - 4 \times 1 \times 21}}{2 \times 1}$$

M1

$x = 3$ and $x = 7$
or
$x = 3$ and $y = 10$
or
$x = 7$ and $y = 30$

A1

$x = 3$, $y = 10$ and $x = 7$, $y = 30$

A1

Alternative method 3

$x = \frac{5 + y}{5}$

M1

$2y - \left(\frac{5 + y}{5}\right)^2 = 11$

Eliminating a variable
oe

M1

$y^2 - 40y + 300 = 0$

Collecting terms

A1

$(y - 10)(y - 30)$ (= 0)

Correct and accurate method to solve their 3-term quadratic equation

$$\frac{-(-40) \pm \sqrt{(-40)^2 - 4 \times 1 \times 300}}{2 \times 1}$$

M1

$y = 10$ and $y = 30$
or
$x = 3$ and $y = 10$
or
$x = 7$ and $y = 30$

A1

$x = 3$, $y = 10$ and $x = 7$, $y = 30$

A1

[6]

Q2.

(a) $(3x + 1)^2 = 9x^2 + 3x + 3x + 1$

B1

(b) $9x^2 + 3x + 3x + 1 = 4x^2 - x + 7$ or $9x^2 + 6x + 1 = 4x^2 - x + 7$

oe

B1

$5x^2 + 7x - 6 = 0$

ft their expansion of $(3x + 1)^2$ with all terms correctly collected on one side of the equation

M1

$(5x - 3)(x + 2)$ (= 0) or $(5x + a)(x + b)$ (= 0)

$ab = \pm 6$ or $5b + a = \pm 7$ ft their quadratic

or quadratic formula allowing one substitution error

M1

$x = 0.6$ and $x = -2$ or $x = 0.6$ and $y = 2.8$

oe

A1

$y = 2.8$ and $y = -5$ or $x = -2$ and $y = -5$

oe

A1

[6]

Q3.

Alternative method 1

$y = -3 - 4x$

B1

$x^2 + 2x + 5 =$ their $-3 - 4x$

M1

$x^2 + 6x + 8 = 0$

ft their $-3 - 4x$

A1ft

$(x + 4)(x + 2)$ (= 0)

Correct method to solve their quadratic equation

M1

$x = -4, -2$

ft their quadratic equation

A1ft

$y = 13, 5$

SC2 Both pairs of correct values without valid working

A1

Alternative method 2

$x =$ (their $\frac{-3-y}{4})^2 + 2(\frac{-3-y}{4})$

B1

$y = (\text{their } \frac{-3-y}{4})^2 + 2(\frac{-3-y}{4}) + 5$

M1

$y^2 - 18y + 65 = 0$

ft their $\frac{-3-y}{4}$

oe may have common denominator 16

A1ft

$(y - 5)(y - 13)$ (= 0)

Correct method to solve their quadratic equation

M1

$y = 13, 5$

ft their quadratic equation

A1ft

$x = -4, -2$

SC2 Both pairs of correct values without valid working

A1

Alternative method 3

$4x + x^2 + 2x + 5 = -3$

oe

B1

$x^2 + 6x + 5 = -3$

M1

$x^2 + 6x + 8 = 0$

A1

$(x + 4)(x + 2)$ (= 0)

Correct method to solve their quadratic equation

M1

$x = -4, -2$

ft their quadratic equation

A1ft

$y = 13, 5$

SC2 Both pairs of correct values with no valid working

A1

Alternative method 4

$4x + y = -3$ and

$y - x^2 - 2x = 5$

or

$4x + y = -3$ and

$-2x + y = x^2 + 5$

oe

the equations must be used as simultaneous equations

B1

$4x + x^2 + 2x = -8$ or $x^2 + 6x = -8$

or

$6x = -3 - x^2 - 5$

oe

M1

$x^2 + 6x + 8 = 0$

A1

$(x + 4)(x + 2)$ (= 0)

Correct method to solve their quadratic equation

M1

$x = -4, -2$

ft their quadratic equation

A1ft

$y = 13, 5$

SC2 Both pairs of correct values with no valid working

A1

[6]

Q4.

Alternative method 1

$x^2 - 6x - 20 = 4 - x$

M1

$x^2 - 5x - 24$ (= 0)

ft one error in collection of terms with all terms correctly collected on one side

M1

$(x - 8)(x + 3)$ (= 0) or $(x + a)(x + b)$ (= 0)

where ab = ± their 24 or a + b = ± their 5

ft their quadratic

or quadratic formula (allow one error)

M1

$x = 8$ and $y = -4$ **or** $x = -3$ and $y = 7$

A1

$x = 8$ and $y = -4$ **and** $x = -3$ and $y = 7$

SC2 for both (8, −4) and (−3, 7) by trial and improvement

SC1 for either (8, −4) or (−3, 7) by trial and improvement

A1

Alternative method 2

$y = (4 - y)^2 - 6(4 - y) - 20$

or $y = 16 - 8y + y^2 - 24 + 6y - 20$

or $y = y^2 - 2y - 28$

allow one error in rearrangement

of $y = 4 - x$

M1

$y^2 - 3y - 28$ (= 0)

ft one error in expansion and collection of terms with all terms correctly collected on one side

M1

$(y - 7)(y + 4)$ (= 0) or $(y + a)(y + b)$ (= 0)

where ab = ± their 28 or a + b = ± their 3

ft their quadratic

or quadratic formula (allow one error)

M1

$y = -4$ and $x = 8$ **or** $y = 7$ and $x = -3$

A1

$y = -4$ and $x = 8$ **and** $y = 7$ and $x = -3$

SC2 for both (8, −4) and (−3, 7) by trial and improvement

SC1 for either (8, −4) or (−3, 7) by trial and improvement

A1

Additional Guidance

Substituting $x = y - 4$ into quadratic is two errors in rearrangement of $y = 4 - x$

M0

Substituting $x = y - 4$ into quadratic followed by collection of terms with all terms correctly collected on one side $y^2 - 15y + 20$ (= 0) (allow one error)

M0M1

Substituting $x = y - 4$ into quadratic

followed by $y^2 - 15y + 20$ (= 0)

followed by attempt to factorise quadratic where ab = ± their 20 or a + b = ± their 15

M0M1M1

[5]

Q5.

(a) Draws $y = 3x$
and
(x =) [–0.1, 0.1] and (x =) [1.4, 1.6]

B1 Draws $y = 3x$ or states $y = 3x$

$\pm\frac{1}{2}$ square tolerance for drawing graph

Graph must be seen for x values from 0 to 1.5

B2

Additional Guidance

Ignore any y values seen

Solutions from a non-graphical method

B0

Ignore other lines drawn on grid

(b) Full evaluation of method and answer

eg1 Cannot divide by x as it could be zero

eg2 Should have factorised and then he would have also found that $x = 0$

eg3 Should have used the formula and then he would have also found that $x = 0$

eg4 Should have used a graphical method then he would have also found that $x = 0$

eg5 Should have completed the square then he would have also found that $x = 0$

B1 Partial evaluation

eg1 $x = 0$ has been omitted

eg2 Should have factorised

eg3 Should have used the formula

eg4 Should have drawn a graph

eg5 Only found one solution

eg6 Cannot divide by zero

B2

Additional Guidance

For B2 there needs to be an evaluation of the method and an indication that $x = 0$ has been omitted from the answer

$x(2x + 5) = 0$
$x = 0$ and $x = –2.5$

B2

Should be two solutions

B1

What about $x = 0$

B1

The answer is wrong

B0

Ignore non-contradictory further work

[4]

Q6.

$(4 - x)^2 = 4x + 5$

M1

$16 - 4x - 4x + x^2 = 4x + 5$

Allow one error but must be a quadratic in x

M1dep

$x^2 - 12x + 11$ (= 0)

oe Must be 3 terms

A1

$(x - 11)(x - 1)$ (= 0)

$\frac{- -12 \pm \sqrt{(-12)^2 - 4(1)(11)}}{2}$ *or*

$(x - 6)^2 - 36 + 11 = 0$ oe

M1

$x = 11$ and $x = 1$

Must have M3 to ft

$x = 11$ and $y = -7$ or $x = 1$ and $y = 3$

A1ft

$x = 11$ and $y = -7$ **and**

$x = 1$ and $y = 3$

A1

Alternative method

$y^2 = 4(4 - y) + 5$

M1

$y^2 = 16 - 4y + 5$

Allow one error but must be a quadratic in y

M1dep

$y^2 + 4y - 21$ (= 0)

oe Must be 3 terms

A1

$(y + 7)(y - 3)$ (= 0)

$\frac{-4 \pm \sqrt{4^2 - 4(1)(-21)}}{2}$ *or*

$(y + 2)^2 - 4 - 21 = 0$ oe

M1

$y = -7$ and $y = 3$

Must have M3 to ft

$x = 11$ and $y = -7$ or

$x = 1$ and $y = 3$

A1ft

$x = 11$ and $y = -7$ **and**

x = 1 and y = 3

A1

[6]

Q7.

$(x + 3)(x - 5) = 4x + 1$

oe

M1

$x^2 + 3x - 5x - 15$

or $x^2 - 2x - 15$

M1

$x^2 - 6x - 16 = 0$

oe

A1

$(x + 2)(x - 8)$

or $x = -2$

or $x = 8$

ft their quadratic

$(x + a)(x + b)$ where $ab = \pm 16$ or $a + b = -6$

Quadratic formula: Allow one error

M1

$x = -2$ and $x = 8$

or $x = -2$ and $y = -7$

or $x = 8$ and $y = 33$

A1

$x = -2$ and $y = -7$

and $x = 8$ and $y = 33$

A1

[6]

Q8.

$y = 2 + x$

$x = y – 2$

B1

$2x^2 + 5x + 1$ = their $(2 + x)$

oe

$y = 2(y – 2)^2 + 5(y – 2) + 1$

$2y^2 – 8y + 8 + 5y – y – 10 + 1 = 0$

M1

$2x^2 + 4x - 1 = 0$

$2y^2 - 4y - 1 = 0$

M1dep

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

or $\frac{-4 \pm \sqrt{24}}{4}$

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

or $\frac{4 \pm \sqrt{24}}{4}$

M1

$x = -2.2(\ldots)$ and $x = 0.2(\ldots)$

or $x = -2.2(\ldots)$ and $y = -0.2(\ldots)$

or $x = 0.2(\ldots)$ and $y = 2.2(\ldots)$

$y = 2.2(\ldots)$ and $y = -0.2(\ldots)$

or $y = 2.2(\ldots)$ and $x = 0.2(\ldots)$

or $y = -0.2(\ldots)$ and $x = -2.2(\ldots)$

A1

$x = -2.2$ and $y = -0.2$

and $x = 0.2$ and $y = 2.2$

$y = 2.2$ and $x = 0.2$

and $y = -0.2$ and $x = -2.2$

A1

Additional Guidance

BEWARE, roots of $2x^2 + 5x + 1 = 0$ are – 0.22 and – 2.28

Correctly substituting their values from their quadratic scores M1, e.g. $2x^2 + 5x + 1 = 0$

$\frac{-5 \pm \sqrt{5^2 - (4 \times 2 \times 1)}}{2 \times 2}$ scores M0M0M1A0A0

All four solutions are required to score full marks

[6]

Q9.

Alternative method 1

$2x^2 + 7x - 1 = 4x + 1$

Eliminates a variable

M1

$2x^2 + 3x - 2 = 0$

or $2x^2 + 3x = 2$

Correctly reduces to three terms

M1dep

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

If quadratic formula used here it must be fully correct

M1dep

$x = \frac{1}{2}, x = -2$

or $x = \frac{1}{2}, y = 3$

or $x = -2, y = -7$

SC3 if from T & I and 2nd answer not obtained

A1

$x = \frac{1}{2}, y = 3$

and $x = -2, y = -7$

A1

Alternative method 2

$y = 2\left(\frac{y-1}{4}\right)^2 + 7\left(\frac{y-1}{4}\right) - 1$

Eliminates a variable

M1

$y^2 + 4y - 21 = 0$

or $y^2 + 4y = 21$

Correctly reduces to three terms

M1dep

$(y - 3)(y + 7)$ (= 0)

If quadratic formula used here it must be fully correct

M1dep

$y = 3, y = -7$

or $y = 3, x = \frac{1}{2}$

or $y = -7, x = -2$

SC3 if from T & I and 2nd answer not obtained

A1

$y = 3, x = \frac{1}{2}$

and $y = -7, x = -2$

A1

[5]