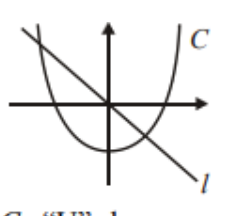
1.

(a) 

C: "U" shape — B1

C: Position — B1

l: Straight line through origin with negative gradient — B1 — 3

(b) (2, 0), (–2, 0), (0, – 4)

2 of these correct: — B1

All 3 correct: — B1 — 2

(c) $x^2 - 4 = -3x$

$x^2 + 3x - 4 = 0 \quad (x+4)(x-1) = 0 \quad x = \dots$

$x = -4 \qquad x = 1$ — A1

$y = 12 \qquad y = -3$ M: Attempt one y value — A1 — 4

[9]

2.

$(x-2)^2 = x^2 - 4x + 4$ or $(y+2)^2 = y^2 + 4y + 4$ M: 3 or 4 terms

$(x-2)^2 + x^2 = 10$ or $y^2 + (y+2)^2 = 10$ M: Substitute

$2x^2 - 4x - 6 = 0$ or $2y^2 + 4y - 6 = 0$ Correct 3 terms — A1

$(x-3)(x+1) = 0, x = \dots$ or $(y+3)(y-1) = 0, y = \dots$

(The above factorisations may also appear as $(2x-6)(x+1)$ or equivalent).

$x = 3$ $x = -1$ or $y = -3$ $y = 1$ — A1

$y = 1$ $y = -3$ or $x = -1$ $x = 3$ — M1M1 — 7

(Allow equivalent fractions such as: $x = \frac{6}{2}$ for $x = 3$).

1st M: 'Squaring a bracket', needs 3 or 4 terms, one of which must be an x^2 or y^2 term.

2nd M: Substituting to get an equation in one variable (awarded generously).

1st A: Accept equivalent forms, e.g. $2x^2 - 4x = 6$.

3rd M: Attempting to solve a 3-term quadratic, to get 2 solutions.

4th M: Attempting at least one y value (or x value).

If y solutions are given as × values, or vice–versa, penalise at the end, so that it is possible to score M1A1 A1 M0 A0.

Strict "pairing of values" at the end is not required.

"Non-algebraic" solutions:

No working, and only one correct solution pair found (e.g. $x = 3, y = 1$): M0 M0 A0 M0 A0 A0

No working, and both correct solution pairs found, but not demonstrated: M0 M0 A0 A1 A1

Both correct solution pairs found, and demonstrated, perhaps in a table of values: Full marks

Squaring individual terms: e.g.

$y^2 = x^2 + 4$ — M0

$x^2 + 4 + x^2 = 10$ — A0 (Eqn. in one variable)

$x = \sqrt{3}$ — M0 A0 (Not solving 3-term quad.)

$y^2 = x^2 + 4 = 7$ $y = \sqrt{7}$ — A0 (Attempting one y value)

[7]

3.

(a) $2x^2 - x(x-4) = 8$

$x^2 + 4x - 8 = 0$ (*) — A1cso — 2

for correct attempt to form an equation in x only. Condone sign errors/slips but attempt at this line must be seen. E.g. $2x^2 - x^2 \pm 4x = 8$ is OK for

A1cso for correctly simplifying to printed form. No incorrect working seen. The = o is required.
These two marks can be scored in part (b). For multiple attempts pick best.

(b) $x = \frac{-4 \pm \sqrt{4^2 - (4\times1\times-8)}}{2}$ or $(x+2)^2 \pm 4 - 8 = 0$

$x = -2 \pm$ (any correct expression) — A1

$\sqrt{48} = \sqrt{16}\sqrt{3} = 4\sqrt{3}$ or $\sqrt{12} = \sqrt{4}\sqrt{3} = 2\sqrt{3}$ — B1

$y = \left(-2 \pm 2\sqrt{3}\right) - 4$ M: Attempt at least one y value

$\underline{x = -2 + 2\sqrt{3}, y = -6 + 2\sqrt{3}}$ $\underline{x = -2 - 2\sqrt{3}, y = -6 - 2\sqrt{3}}$ — A1 — 5

1stM1 for use of correct formula. If formula is not quoted then a fully correct substitution is required. Condone missing x = or just + or – instead of ± for For completing the square must have as printed or better. If they have $x^2 - 4x - 8 = 0$ then can be given for $(x-2)^2 \pm 4 - 8 = 0$.

1stA1 for $-2 \pm$ any correct expression. (The ± is required but x = is not)

B1 for simplifying the surd e.g. $\sqrt{48} = 4\sqrt{3}$. Must reduce to $b\sqrt{3}$ so $\sqrt{16}\sqrt{3}$ or $\sqrt{4}\sqrt{3}$ are OK.

2ndM1 for attempting to find at least one y value. Substitution into one of the given equations and an attempt to solve for y.

2ndA1 for correct y answers. Pairings need not be explicit but they must say which is x and which is y. Mis-labelling x and y loses final A1 only.

[7]

4.

Forming equation in x or y by attempt to eliminate one variable

$(3-y)^2 + y = 15$ *or* $x^2 + (3-x) = 15$

$y^2 - 5y - 6 = 0$ *or* $x^2 - x - 12 = 0$ (Correct 3 term version) — A1

Attempt at solution i.e. solving 3 term quadratic: $(y-6)(y+1) = 0,\ y = \dots$ or $(x-4)(x+3) = 0,\ x = \dots$ or correct use of formula or correct use of completing the square — A1

$x = 4$ and $x = -3$ **or** $y = -1$ and $y = 6$ — A1 ft — 6

Finding the values of the other coordinates (M attempt one, A both)

[6]

5.

$x = 1 + 2y$ and sub $\rightarrow (1+2y)^2 + y^2 = 29$

$\Rightarrow 5y^2 + 4y - 28 (= 0)$ — A1

i.e. $(5y+14)(y-2) = 0$

$(y =) 2$ or $-\frac{14}{5}$ (o.e.) — (both) A1

$y = 2, \Rightarrow x = 1 + 4 = 5; y = -\frac{14}{5} \Rightarrow x = -\frac{23}{5}$ (o.e)

[6]

1st Attempt to sub leading to equation in 1 variable

1st A1 Correct 3TQ (condone = 0 missing)

2nd Attempt to solve 3TQ leading to 2 values for y.

2nd A1 Condone mislabelling x = for y = ... but then M0A0 in part (c).

3rd Attempt to find at least one x value (must use a correct equation)

3rd A1 f.t. f.t. only in x = 1 + 2y (3sf if not exact) Both values.

N.B False squaring. (e.g. $y = x^2 + 4y^2 = 1$) can only score the last 2 marks.

6.

$y = 3x - 2 \qquad (3x-2)^2 - x - 6x^2 (= 0)$

$9x^2 - 12x + 4 - x - 6x^2 = 0$

$3x^2 - 13x + 4 = 0$ (or equiv., e.g. $3x^2 = 13x - 4$) — A1cso

$(3x-1)(x-4) = 0 \quad x = \dots \qquad x = \frac{1}{3}$ (or exact equivalent) $x = 4$ — A1

$y = -1$ $y = 10$ (Solutions need not be "paired") — A1

Note

1st M: Obtaining an equation in x only (or y only). Condone missing "= 0" Condone sign slips, e.g. $(3x+2)^2 - x - 6x^2 = 0$, but not other algebraic mistakes (such as squaring individual terms... see bottom of page).

2nd M: Multiplying out their $(3x-2)^2$, which must lead to a 3 term quadratic, i.e. $ax^2 + bx + c$, where $a \neq 0, b \neq 0, c \neq 0$, and collecting terms.

3rd M: Solving a 3-term quadratic (see general principles at end of scheme).

2nd A: Both values.

4th M: Using an x value, found algebraically, to attempt at least one y value (or using a y value, found algebraically, to attempt at least one x value)… allow b.o.d. for this mark in cases where the value is wrong but working is not shown.

3rd A: Both values.

If y solutions are given as x values, or vice-versa, penalise at the end, so that it is possible to score M1A1 A1 M0 A0.

"Non-algebraic" solutions:

No working, and only one correct solution pair found (e.g. $x = 4, y = 10$):

M0 M0 A0 M0 A0 A0

No working, and both correct solution pairs found, but not demonstrated:

M0 M0 A0 A1 A1

Both correct solution pairs found, and demonstrated: Full marks

Alternative:

$x = \frac{y+2}{3} \qquad y^2 - \frac{y+2}{3} - 6\left(\frac{y+2}{3}\right)^2 = 0$

$y^2 - \frac{y+2}{3} - 6\left(\frac{y^2+4y+4}{9}\right) = 0 \qquad y^2 - 9y - 10 = 0$ — A1

$(y+1)(y-10) = 0 \quad y = \dots \qquad y = -1$ $y = 10$ — A1

$x = \frac{1}{3}$ $x = 4$ — A1

Squaring each term in the first equation,

e.g. $y^2 - 9x^2 + 4 = 0$, and using this to obtain an equation in x only could score at most 2 marks: M0 M0 A0 A0 A0.

[7]

7.

(a) $3^x = 3^{2(y-1)} \quad x = 2(y-1)$ (*) — A1

(b) $(2y-2)^2 = y^2 + 7, \ 3y^2 - 8y - 3 = 0$ — A1

$(3y+1)(y-3) = 0, y = \dots$ (or correct substitution in formula)

$y = -\frac{1}{3}, \qquad y = 3$ — A1

$x = -\frac{8}{3}, \qquad x = 4$ — A1 ft

[8]

8.

(a) $x^2 - 2X + 3 = 9 - x$

$x^2 - x - 6 = 0 \qquad (x+2)(x-3) = 0 \qquad x = -2,\ 3$ — A1

$y = 11,\ 6$ — A1 ft — 5

(b) $\int (x^2 - 2x + 3)\,dx = \frac{x^3}{3} - x^2 + 3x$ — A1

$\left[\frac{x^3}{3} - x^2 + 3x\right]_{-2}^{3} = (9 - 9 + 9) - \left(\frac{-8}{3} - 4 - 6\right) \qquad \left(= 21\frac{2}{3}\right)$ — A1

Trapezium: $\frac{1}{2}(11 + 6) \times 5 \qquad \left(= 42\frac{1}{2}\right)$ — B1 ft

Area $= 42\frac{1}{2} - 21\frac{2}{3} = 20\frac{5}{6}$ — A1 — 7

Alternative: $(9 - x) - (x^2 - 2x + 3) = 6 + x - x^2$ — A1

$\int (6 + x - x^2)\,dx = 6x + \frac{x^2}{2} - \frac{x^3}{3}$ — A1 ft

$\left[6x + \frac{x^2}{2} - \frac{x^3}{3}\right]_{-2}^{3} = \left(18 + \frac{9}{2} - 9\right) - \left(-12 + 2 + \frac{8}{3}\right), = 20\frac{5}{6}$ — A1, A1

[12]

9.

$x^2 + 2(2-x) = 12$ or $(2-y)^2 + 2y = 12$ (Eqn. in x or y only)

$x^2 - 2x - 8 = 0$ or $y^2 - 2y - 8 = 0$ (Correct 3 term version) — A1

(Allow, e.g. $x^2 - 2x = 8$)

$(x-4)(x+2) = 0 \ x = \dots$ or $(y-4)(y+2) = 0 \ y = \dots$

$x = 4, \ x = -2$ or $y = 4, \ y = -2$ — A1

$y = -2, \ y = 4$ or $x = -2, \ x = 4$ (M: attempt one, A: both) — A1ft — 6

[6]

10.

(a) $y = 8 - 2x \qquad 3x^2 + x(8 - 2x) = 1$

$x^2 + 8x - 1 = 0$ **(*)** — A1 — 2

(b) $x = \frac{-8 \pm \sqrt{64 + 4}}{2} = -4 \pm \dots$ — A1

$\sqrt{68} = 2\sqrt{17}; x = -4 + 2\sqrt{17}$ or $x = -4 - 2\sqrt{17}$ — B1

$y = 8 - 2(-4 + \sqrt{17}) = 16 - 2\sqrt{17}$ or $y = 16 + 2\sqrt{17}$ — A1 — 5

[7]

11.

$x = 3y - 1$ (n.b. Method mark, so allow, e.g. $x = 3y + 1$)

$(3y-1)^2 - 3y(3y-1) + y^2 = 11$ (Substitution, leading to an equation in only one variable)

$y^2 - 3y - 10 = 0$ (3 terms correct, "=0" possibly implied) — A1

$(y-5)(y+2) = 0 \qquad y = 5 \quad y = -2$ — A1

$x = 14 \quad x = -7$ — A1 ft — 7

(If not exact, f.t. requires at least 1 d.p. accuracy).

Alternative approach gives: $y = \frac{x+1}{3}, x^2 - 7x - 98 = 0$.

[7]

12.

(a) (2, 0) (or $x = 2, y = 0$) — B1 — 1

(b) $y^2 = 4\left(\frac{3y+12}{2} - 2\right)$ or $\left(\frac{2x-12}{3}\right)^2 = 4(x-2)$

$y^2 - 6y - 16 = 0$ or $x^2 - 21x + 54 = 0$ (or equiv. 3 terms) — A1

$(y+2)(y-8) = 0, y = \dots$ or $(x-3)(x-18) = 0, x = \dots$ (3 term quad.)

$y = -2, y = 8$ or $x = 3, x = 18$ — A1

$x = 3, x = 18$ or $y = -2, y = 8$ (attempt one for M mark) — A1ft6

(A1ft requires both values)

(c) Grad. of $AQ = \frac{8-0}{18-2}$, Grad. of $AP = \frac{0-(-2)}{2-3}$ — A1ft

(attempt one for M mark)

$m_1 \times m_2 = \frac{1}{2} \times -2 = -1$, so $\angle PAQ$ is a right angle (A1 is c.s.o.) — A1 — 4

Alternative: Pythagoras: Find 2 lengths [
$AQ = \sqrt{320}, AP = \sqrt{5}, PQ = \sqrt{325}$ (O.K. unsimplified)[A1ft]
(if decimal values only are given, with no working shown, require at least 1 d.p. accuracy for implied) A1)
$AQ^2 + AP^2 = PQ^2$, so $\angle PAQ$ is a right angle [A1]
requires attempt to use Pythag. for right angle at A, and A1 requires correct exact working + conclusion.

[11]