CHAPTER 1:

Ex A

1) $28x + 35$ 2) $-15x + 21$ 3) $-7a + 4$ 4) $6y + 3y^2$

5) $2x - 4$ 6) $7x - 1$ 7) $x^2 + 5x + 6$ 8) $t^2 - 7t + 10$

9) $6x^2 + xy - 12y^2$ 10) $4x^2 + 4x - 24$ 11) $4y^2 - 1$ 12) $12 + 17x - 5x^2$

Ex B

1) $x^2 - 2x + 1$ 2) $9x^2 + 30x + 25$ 3) $49x^2 - 28x + 4$ 4) $x^2 - 4$

5) $9x^2 - 1$ 6) $25y^2 - 9$

CHALLENGE QUESTIONS

Question 1

$b = -9, c = 6$

$3x(4x + 1) - 2(6x - 3)$	M1	if expanded straight away allow one sign or arithmetic error eg $12x^2 + 3x - 12x - 6$ (Must have an x^2 term, 2 'x' terms and a constant term) Condone missing brackets eg $3x \times 4x + 1 - 2 \times 6x - 3$
$12x^2 + 3x - 12x + 6$	A1	

Question 2

$a = 6, b = 2$

Question 3

$4(x + y)$

Using 'the difference of two squares':

$(1+x+y)^2 - (1-x-y)^2 = (1+x+y+1-x-y)(1+x+y-1+x+y) = 2(2x+2y) = 4(x+y).$

Question 4

$n^2 + 4n + 4$

Question 5

2: 3

$(8x - y)^2 = (6x)^2 + (x + y)^2$	M1	oe Allow $(8x - y)(8x - y)$ and $(x + y)(x + y)$ Condone $6x^2$
Expands $(8x - y)^2$ to 4 terms with 3 correct from $64x^2 - 8xy - 8xy + y^2$	M1	oe If going straight to 3 terms must be $64x^2 - 16xy + ky^2$ $(k \neq 0)$ or $ax^2 - 16xy + y^2$ $(a \neq 0)$
Expands $(x + y)^2$ to 4 terms with 3 correct from $x^2 + xy + xy + y^2$	M1	oe If going straight to 3 terms must be $x^2 + 2xy + ay^2$ $(a \neq 0)$ or $bx^2 + 2xy + y^2$ $(b \neq 0)$
$27x^2 - 18xy$ (= 0) or $27x^2 = 18xy$ or better e.g.1 $9x^2 - 6xy$ (= 0) e.g.2 $3x^2 = 2xy$	A1	$64x - 16y = 36x + x + 2y$ or equivalent linear equation e.g.1 $64x - 16y - 36x = x + 2y$ e.g.2 $64x - 16y - x - 2y = 36x$
Any correct factorisation of their $px^2 + qxy$ or correct division of their $px^2 = qxy$ by a multiple of x (p and q non zero) e.g.1 $9x(3x - 2y)$ (= 0) e.g.2 $3x(9x - 6y)$ (= 0) e.g.3 $27x = 18y$ e.g.4 $9x = 6y$	M1	Correct collection and correct simplification of terms for their linear equation in x and y e.g. $27x = 18y$ To gain this mark there must have been some expansion of brackets seen
$3x = 2y$ or $\frac{x}{y} = \frac{2}{3}$ or $\frac{y}{x} = \frac{3}{2}$ or $x = \frac{2}{3}y$ or $y = \frac{3}{2}x$ or $\frac{x}{2} = \frac{y}{3}$ or $\frac{2}{x} = \frac{3}{y}$	A1	Must see M1 M1 M1 A1 Do not allow if a contradictory statement is also seen

Question 6

$x = 2$

CHAPTER 2

Ex A

1) 7 2) 3 3) 1½ 4) 2 5) -3/5 6) -7/3

Ex B

1) 2.4 2) 5 3) 1 4) ½

Ex C

1) 7 2) 15 3) 24/7 4) 35/3 5) 3 6) 2 7) 9/5 8) 5

Ex D

1) 34, 36, 38 2) 9.875, 29.625 3) 24, 48

Challenge Questions

Question 1

78 km

78	4	**M1** for $26x + 100 - 20x = 118$ **M1** for *their* $6x$ = *their* 18 **M1** for $x = \frac{\text{their } 18}{\text{their } 6}$ **soi**	 Simplifying their equation to $ax = b$ Simplifying their $ax = b$ to $x = \frac{b}{a}$

Question 2

19 cards

$x + 2x + 2x + 6 = 101$ $5x + 6 = 101$ $5x = 95$	19	4	M1 for $2x$ or $2x + 6$ seen (any letter) M1 (dep) for forming equation x + '$2x$' + '$2x$ + 6' = 101 M1 for intention to isolate x term(s) in their equation if of the form $ax + b$=101 A1 cao dep on at least M1 awarded OR M1 for a correct trial with $x \geq 1$ to evaluate x, $2x$ and $2x + 6$ (algebraic expressions may not be seen) M1 for 3 values that sum to 101 M1 for intention to add $19 + 2\times19 + 2\times19 + 6$ (=101) A1 for 19 cao dep on at least M1 awarded

Question 3

$$x = 7$$

Question 4

$$x = -30$$

Question 5

2600 cm^2

2600	4	M1 for $40(3x - 10) = 30(x + 15) + 1400$ M1 for reducing to the form $90x = b$ or better e.g $x = 25$ M1 for $40 \times (3\times'25' - 10)$
		A1 cao

Question 6

60 apples

Let the number of apples Andrew had be $6n$. When Boris divided the same number of apples into five piles, each pile contained two more apples than each of Andrew's piles. Therefore $6n = 5(n+2)$ and hence $6n = 5n + 10$. This has solution $n = 10$. Therefore the number of apples Andrew had was $6 \times 10 = 60$.

CHAPTER 3

1) $x = 1, y = 3$ 2) $x = -3, y = 1$ 3) $x = 0, y = -2$ 4) $x = 3, y = 1$

5) $a = 7,\ b = -2$ 6) $p = 11/3,\ q = 4/3$

CHALLENGE QUESTIONS:

Question 1

77 cherries

Suppose that Karen has x cherries. Then Lionel has $\frac{1}{3}x$ cherries and Michael has $\frac{1}{2}x$ cherries. Michael has seven more cherries than Lionel and so $\frac{1}{2}x - \frac{1}{3}x = 7$. Therefore $(\frac{1}{2} - \frac{1}{3})x = 7$, that is, $(\frac{3-2}{6})x = 7$, and hence $\frac{1}{6}x = 7$. Therefore $x = 42$. It follows that Karen has 42 cherries, Lionel has 14 cherries and Michael has 21 cherries. So they have $42 + 14 + 21 = 77$ cherries between them.

Question 2

2010

Let the two numbers be a and b, where $a > b$. Then we have $a + b = 97$ and $a - b = 37$. Hence $2a = 134$ and therefore $a = 67$ and $b = 30$. The product of 67 and 30 is 2010.

Question 3

length = 15 cm and width = 9 cm

15 9	**6**	**B5** for [x=] 4.5 or $4\frac{1}{2}$ and [y =] -0.5 or $-\frac{1}{2}$ even given as answers OR **B2** for $5x - y - 8 = 3x + 5y + 4$ or $3x + y - 4 = 2x - 6y - 3$ and **M1dep** for rearranging either equation correctly so that the x's, y's and numbers are combined in <u>one</u> of the equations and **M1dep** for multiplying one equation to equate coefficients of one variable and **M1dep** for the correct method to eliminate a variable If **0** scored **SC1** for equating two adjacent sides e.g. $5x - y - 8 = 2x - 6y - 3$	accept 15 or 9 either way round for **6** marks The next **M1**s are dep on **B2** gained. For **M1** need an equation with one x term, one y term and one number term and allow one numerical error e.g. $2x - 6y = 12$ oe or $x + 7y = 1$ oe . allow one numerical error e.g. $2x - 6y = 12$ and $2x + 14y = 2$ allow one numerical error e.g. $20y = -10$

Question 4

15 frogs

Let the number of Brachycephalus frogs and common frogs in the bucket be b and c respectively. Note that each Brachycephalus frog has 6 toes and 4 fingers, while a common frog has 10 toes and 8 fingers.
Therefore, $6b + 10c = 122$ (1); $4b + 8c = 92$ (2). Subtracting (2) from (1) gives $2b + 2c = 30$, so $b + c = 15$.

Question 5

$L = 7$

Adding the top row and the middle column gives,
$2J + K + 2K + J = 5 + 7 = 12$. Hence $3J + 3K = 12$. So $J + K = 4$.
The first column shows that $J + K + L = 11$.
Hence, $J + K + L - (J + K) = 11 - 4 = 7$. Therefore $L = 7$.
(*It is then possible to deduce that $J = 1$ and $K = 3$ and check that each total is correct.*)

J	K	J	5
K	K	L	13
L	J	L	15
11	7	15	

CHAPTER 4

Ex A

1) $x(3 + y)$ 2) $2x(2x – y)$ 3) $pq(q – p)$ 4) $3q(p – 3q)$ 5) $2x^2(x - 3)$

6) $4a^3b^2(2a^2 – 3b^2)$ 7) $(y – 1)(5y + 3)$

Ex B

1) $(x – 3)(x + 2)$ 2) $(x + 8)(x – 2)$ 3) $(2x + 1)(x + 2)$ 4) $x(2x – 3)$

5) $(3x -1)(x + 2)$ 6) $(2y + 3)(y + 7)$ 7) $(7y – 3)(y – 1)$

8) $5(2x – 3)(x + 2)$ 9) $(2x + 5)(2x – 5)$ 10) $(x – 3)(x – y)$

11) $4(x – 2)(x – 1)$ 12) $(4m – 9n)(4m + 9n)$ 13) $y(2y – 3a)(2y + 3a)$

14) $2(4x – 1)(x + 2)$

Challenge questions

Question 1

$3(x-2)(a+4c)$

Question 2

$\frac{a+c+3}{2b}$

Question 3

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

Question 4

29×23

29 and 23 identified	B2	B1	$(n+9)(n+3)$ or 667 or 29 or 23

Question 5

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

Question 6

$a = 3, b = 2, c = -5$

(b)		$\frac{3x}{2x-5}$	M1	factorise $2x^2+x-15$ [$=(2x-5)(x+3)$] or $3x^2+9x$ [$=3x(x+3)$]
			M1	$\frac{1}{(2x-5)(x+3)} \times \frac{3x(x+3)}{1}$
			A1	cao

Question 7

$12(x^2+1)$

$12(x^2 + 1)$	M1	for using 'a' = $x^2 + 4$ and 'b' = $x^2 - 2$ **OR** multiplying out both brackets, at least one fully correct
	M1	(dep) for a correct expression for ('a' + 'b')('a' – 'b') with no additional brackets, simplified or unsimplified eg $(x^2 + 4 + x^2 - 2)(x^2 + 4 - x^2 + 2)$ **or** $(2x^2 + 2) \times 6$ **OR** ft for a correct expression without brackets, simplified or unsimplified eg $x^4 + 8x^2 + 16 - x^4 + 4x^2 - 4$
	A1	for $12(x^2 + 1)$ **or** $12x^2 + 12$ oe

Question 8

18 year-old

CHAPTER 5

Ex A

1) $x = \frac{y+1}{7}$ 2) $x = 4y - 5$ 3) $x = 3(4y + 2)$ 4) $x = \frac{9y + 20}{12}$

Ex B

1) $t = \frac{32rP}{w}$ 2) $t = \pm\sqrt{\frac{32rP}{w}}$ 3) $t = \pm\sqrt{\frac{3V}{\pi h}}$ 4) $t = \frac{P^2 g}{2}$ 5) $t = v - \frac{Pag}{w}$ 6) $t = \pm\sqrt{\frac{r-a}{b}}$

Ex C

1) $x = \frac{c-3}{a-b}$ 2) $x = \frac{3a+2k}{k-3}$ 3) $x = \frac{2y+3}{5y-2}$ 4) $x = \frac{ab}{b-a}$

CHALLENGE QUESTIONS

Question 1

$h = \sqrt{\frac{S^2 - 4\pi^2 d^4}{4\pi^2 d^2}}$

$\frac{S}{2\pi d} = \sqrt{h^2 + d^2}$

$\left(\frac{S}{2\pi d}\right)^2 = h^2 + d^2$

$h = \sqrt{\frac{S^2 - 4\pi^2 d}{4\pi^2 d^2}}$	3	M1 for correctly isolating $\sqrt{h^2 + d^2}$ or $h^2 + d^2$ or $h + d$ or kh^2 or kh M1(indep) squaring both sides A1 $h = \sqrt{\frac{S^2 - 4\pi^2 d^4}{4\pi^2 d^2}}$, $h = \frac{\sqrt{S^2 - 4\pi^2 d^4}}{2\pi d}$ $h = \sqrt{\left(\frac{S}{2\pi d}\right)^2 - d^2}$

Question 2

$y = \frac{x^4}{16a^3} - \frac{x^2}{2a}$

$\sqrt{t} = \frac{x}{2a}$ or $x^2 = (2a\sqrt{t})^2$ or $x^4 = (2a\sqrt{t})^4$ oe	$y = \frac{x^4}{16a^3} - \frac{x^2}{2a}$	4	M1 Correct rearrangement for $\sqrt{t}$ or correct expression for x^2 or x^4
$t = \left(\frac{x}{2a}\right)^2$ oe or $t^2 = \frac{x^4}{16a^4}$ oe			M1 Correct expressions for t or t^2 or for at^2 or $2at$ in terms of x and a
$y = a\left[\left(\frac{x}{2a}\right)^2\right]^2 - 2a\left(\frac{x}{2a}\right)^2$ oe			M1 For correct substitution of t and t^2 into expression for y
			A1 Fully correct answer in required form

Question 3

$q = \frac{p-1}{1-2p}$

Question 4

$x = \frac{\sqrt{y}-1}{\sqrt{y}}$

Question 5

$x = y + 1$

Question 6

$y = \frac{3x(x+4)}{3x+4}$

$\frac{y(x+4)}{x(x+4)} + \frac{2xy}{x(x+4)} = 3$ **or** $\frac{y(x+4)}{x(x+4)} + \frac{2xy}{x(x+4)} = \frac{3x(x+4)}{x(x+4)}$		5	M1	LHS may be two separate fractions or one single fraction (brackets may or may not be removed on RHS and denominator)
$y(x + 4) + 2xy = 3x(x + 4)$ **or** $\frac{xy+4y}{x(x+4)} + \frac{2xy}{x(x+4)} = 3$ **or** $\frac{xy+4y}{x(x+4)} + \frac{2xy}{x(x+4)} = \frac{3x(x+4)}{x(x+4)}$			M1	LHS may be two separate fractions or one single fraction; if one fraction, numerator on LHS may or may not be simplified **(implies previous M1)** (brackets may or may not be removed on RHS and denominator)
$xy + 4y + 2xy = 3x^2 + 12x$ **or** $xy + 4y \_ 2xy = 3x(x+4)$ **or** $3xy + 4y = 3x^2 + 12x$ **or** $3xy + 4y = 3x(x+4)$			M1	(brackets may or may not be removed on RHS) **(implies previous two M1s)**
$y(3x+4) = 3x(x+4)$ **or** $y(3x+4) = 3x^2 + 12x$			M1	LHS factorised correctly - expression in bracket on LHS may or may not be simplified
	$\frac{3x(x+4)}{3x+4}$		A1	$\frac{3x(x+4)}{3x+4}$ or $\frac{3x^2+12x}{3x+4}$ a fully correct method must be seen in order to award full marks

CHAPTER 6

1) a) -1, -2 b) -1, 4 c) -5, 3

2) a) 0, -3 b) 0, 4 c) 2, -2

3) a) -1/2, 4/3 b) 0.5, 2.5

4) a) -5.30, -1.70 b) 1.07, -0.699 c) -1.20, 1.45 d) no solutions
e) no solutions f) no solutions

CHALLENGE QUESTIONS

Question 1

my number is 13

2m Gives the number as 13 and shows a complete correct method for solving algebraically
eg

- $(x-25)^2 = x^2 - 25$
  $x^2 - 50x + 625 = x^2 - 25$
  $50x = 650$
  $x = 13$

or

1m Shows a correct expression without brackets that is equivalent to $(\text{unknown} - 25)^2$
eg

- $x^2 - 50x + 625$
- $n^2 - 25n - 25n + 625$
- $a \times a - 50 \times a + 25 \times 25$

or

Shows a correct equation
eg

- $(x-25)^2 = x^2 - 25$

Question 2

$x = 6$

Question 3

9

Let the two positive integers be m and n. Then $mn = 2(m+n) = 6(m-n)$.
So $2m + 2n = 6m - 6n$, that is $8n = 4m$. Therefore $m = 2n$. Substituting for m gives: $(2n)n = 2(2n + n)$. So $2n^2 = 6n$, that is $2n(n - 3) = 0$.
Therefore $n = 0$ or 3. However, n is positive so the only solution is $n = 3$.
Therefore $m = 2 \times 3 = 6$ and $m + n = 6 + 3 = 9$.

Question 4

7

The triangle is isosceles when one of the following three equations is true:

$$n^2 + n = 2n + 12; \quad (1)$$
$$n^2 + n = 3n + 3; \quad (2)$$
$$2n + 12 = 3n + 3. \quad (3)$$

When equation (1) is true, we have $n^2 - n - 12 = 0$, so that $(n-4)(n+3) = 0$.
Hence either $n = 4$ or $n = -3$. However, when $n = -3$ then $3n + 3 < 0$, so that no triangle can be formed. There is, though, an isosceles triangle when $n = 4$, as the sides of the triangle are then

Question 5

$x =$ 22.2 cm and $V =$ 14.8 litres

Question 6

$2x^2 + 7x + 4 = 0$

$2x^2 + 7x + 4 = 0$	3	M1 for finding a correct coefficient M1 for a method to find a and c or b and c A1 $2x^2 + 7x + 4 = 0$ or $a = 2$, $b = 7$, $c = 4$

Question 7

$x = 2.37$ or $x = 0.63$

$\frac{x-1}{(x-2)(x-1)} - \frac{x-2}{(x-2)(x-1)}$ or $x - 1 - (x - 2)$ or $2(x - 2)(x - 1)$ or $x^2 - 2x - x + 2$	M1	oe
their $[x - 1 - (x - 2)] = 2(x - 1)(x - 2)$ or $x - 1 - x + 2$ or $2(x^2 - 2x - x + 2)$	M1dep	oe
$2x^2 - 6x + 3 (= 0)$	A1	oe Must be three terms
$\frac{--6 \pm \sqrt{(-6)^2 - (4 \times 2 \times 3)}}{2 \times 2}$ or $\frac{6 \pm \sqrt{12}}{4}$	M1	oe Allow one error, ft *their* quadratic
$\frac{--6 \pm \sqrt{(-6)^2 - (4 \times 2 \times 3)}}{2 \times 2}$ or $\frac{6 \pm \sqrt{12}}{4}$	A1ft	ft *their* quadratic, fully correct oe 2.366(…) and 0.633(…)
2.37 and 0.63	A1ft	SC2 for one correct answer to 2 dp SC1 for one correct answer to 3 dp or more

Question 8

$r = 12$

$\frac{5\pi r}{2}(3r + 4) = 1200\pi$	M1	oe Allow $1200\pi \rightarrow 1200$
Correct equation or 3 term expression with no unexpanded brackets e.g.1 $3r^2 + 4r - 480 (= 0)$ e.g.2 $15r^2 + 20r = 2400$ e.g.3 $\frac{15\pi}{2}r^2 + 10\pi r = 1200\pi$	A1	oe
Attempt to factorise their 3 term quadratic e.g. for $3r^2 + 4r - 480$ $(3r + a)(r + b)$ where $ab = \pm 480$ or $3b + a = \pm 4$ or Attempt to substitute in the formula for their 3 term quadratic (allow one sign error) e.g. for $3r^2 + 4r - 480$ $\frac{-4 \pm \sqrt{4^2 - 4 \times 3 \times -480}}{2 \times 3}$ or $\frac{4 \pm \sqrt{4^2 - 4 \times 3 \times -480}}{2 \times 3}$ (1 sign error)	M1dep	oe Attempt to complete the square for their 3 term quadratic e.g. for $3r^2 + 4r - 480$ (3) $[(r + \frac{2}{3})^2 \ldots\ldots]$

Correctly factorises their 3 term quadratic e.g. for $3r^2 + 4r - 480$ (= 0) $(3r + 40)(r - 12)$ (= 0) or Correct substitution in formula for their 3 term quadratic e.g. for $3r^2 + 4r - 480$ (= 0) $\frac{-4 \pm \sqrt{4^2 - 4 \times 3 \times -480}}{2 \times 3}$	A1ft	ft M1 A0 M1dep oe Correct completion of square for their 3 term quadratic e.g. for $3r^2 + 4r - 480$ (3) $[(r + \frac{2}{3})^2 - (\frac{2}{3})^2 - 160]$ oe
12	A1	Do not award if negative solution also included

CHAPTER 7

Ex A

1) $5b^6$ 2) $6c^7$ 3) b^3c^4 4) $-12n^8$ 5) $4n^5$ 6) d^2 7) a^6 8) $-d^{12}$

Ex B

1) 2 2) 3 3) 1/3 4) 1/25 5) 1 6) 1/7 7) 9 8) 9/4 9) ¼ 10) 0.2

11) 4/9 12) 64 13) $6a^3$ 14) x 15) xy^2

CHALLENGE QUESTIONS

Question 1

4^5

Question 2

$x = \frac{1}{2}$ or $x = -\frac{3}{2}$

Question 3

9

Note that $8^m = (2^3)^m = 2^{3m} = (2^m)^3$ and $27 = 3^3$; so $2^m = 3$. Therefore $4^m = 2^m \times 2^m = 9$.

Question 4

625

625	2	M1 for 3^{4n} or 5^4 or $(3^{-n})^{-4}$ or 0.2^{-4} A1 625

Question 5

$\frac{x}{y} = 144$

$\sqrt{x} = 6$ or $x = 6^2$ or $x = 36$	M1	
$\frac{1}{y^3} = 64$ or $y^3 = \frac{1}{64}$	M1	
$y = \frac{1}{4}$	A1	
144	A1ft	ft Their $x \div$ their y if $y \neq$ integer

Question 6

$n = \frac{11}{8}$

$b\sqrt{b}$ is $b \times b^{\frac{1}{2}}$, add the powers for $b^{\frac{3}{2}}$

$$\sqrt[8]{b} = b^{\frac{1}{8}}$$

Then take away powers as you are dividing

Question 7

$x = 1$ and $x = -5$

Question 8

$27x^{19}y^{-1}$