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EDEXCEL INTERNATIONAL GCSE MATHS: QUESTIONS BY TOPIC

Algebraic Manipulation (A1)

International GCSE Mathematics A (4MA1) · Higher tier

133 questions · 685 marks · Mark schemes included

Past papers June 2018 - June 2025 · 6 sub-topics

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HOW TO USE THIS BOOKLET

Questions are grouped by sub-topic and run from the lowest to the highest mark tariff, then oldest paper first.
Click any row below to jump straight to that sub-topic or question.
On every question page, click ANSWER in the top-right corner to jump to its mark scheme; < QUESTION brings you back.
A gold bar in the left margin marks exactly where the question sits on the original page.
Diagrams, graphs, grids and tables are printed exactly as they appear in the original papers.
Each question is filed under its main topic; longer questions may also test skills from other topics.

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QUESTIONS

133 questions · 685 marks · 6 sub-topics

SUB-TOPIC A1a

NOTATION, SIMPLIFYING & SUBSTITUTION

Sub-topic A1a · 5 questions · 31 marks · lowest tariff first

3 Three tins, A, B and C, each contain buttons.

Tin A contains x buttons.
Tin B contains 4 times the number of buttons that tin A contains.
Tin C contains 7 fewer buttons than tin A.

The total number of buttons in the three tins is 137

Work out the number of buttons in tin C.

.....

(Total for Question 3 is 4 marks)

Answer ALL TWENTY ONE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Simplify $g^6 \times g^4$

.....

(1)

(b) Simplify $k^{10} \div k^3$

.....

(1)

(c) Simplify $(3cd^4)^2$

.....

(2)

(d) Solve the inequality $4x + 7 > 2$

.....

(2)

(Total for Question 1 is 6 marks)

Answer ALL TWENTY FOUR questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Simplify $a^7 \times a^4$

.....

(1)

(b) Simplify $w^{15} \div w^3$

.....

(1)

(c) Simplify $(8x^5y^3)^2$

.....

(2)

(d) Make t the subject of $c = t^3 - 8v$

.....

(2)

(Total for Question 1 is 6 marks)

9 (a) Write down the value of $(m + 2)^0$ where m is a positive integer.

.....

(1)

(b) Simplify $(3a^2b^4)^3$

.....

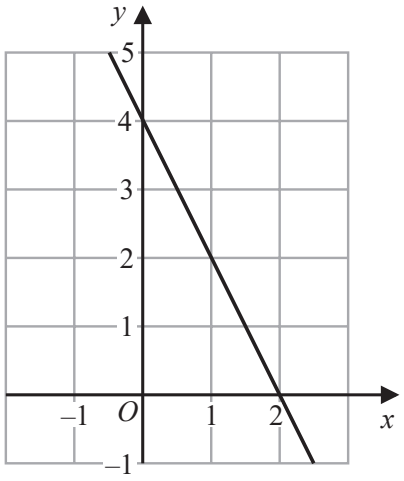
(2)

(c) Factorise fully $14x^2y^4 + 21x^3y^2$

.....

(2)

The diagram shows a straight line drawn on a grid.



(d) Write down an equation of the line.

.....

(2)

(Total for Question 9 is 7 marks)

11 (a) Simplify fully $(8e^{15})^{\frac{2}{3}}$

.....

(2)

(b) Express $\left(\frac{y}{2}\right)^{-4}$ in the form ay^n where a and n are integers.

.....

(2)

(c) Solve $\frac{4x-2}{3} - \frac{5-3x}{4} = 6$

Show clear algebraic working.

$x =$ .....

(4)

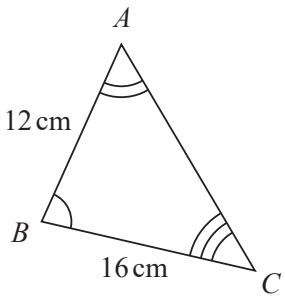
(Total for Question 11 is 8 marks)

SUB-TOPIC A1b

EXPANDING & FACTORISING

Sub-topic A1b · 44 questions · 251 marks · lowest tariff first

4 *ABC* and *DEF* are similar triangles.



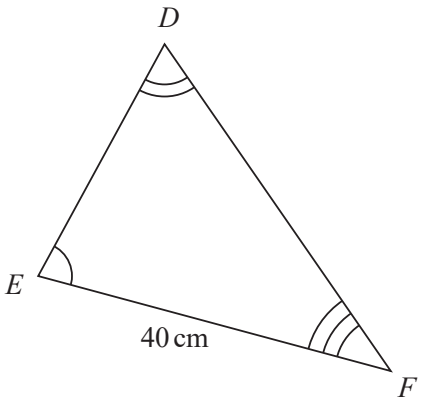


Diagram **NOT** accurately drawn

(a) Work out the length of *DE*.

..... cm

(2)

The area of triangle *DEF* is 525 cm^2

(b) Find the area of triangle *DEF* in m^2

..... m^2

(2)

(Total for Question 4 is 4 marks)

5 Factorise $x^2 - 5x - 36$

.....

(Total for Question 5 is 2 marks)

14 Expand and simplify $(4x + 1)(x - 3)(5x + 6)$

.....

(Total for Question 14 is 3 marks)

13 Expand and simplify $4x(3x + 1)(2x - 3)$
Show your working clearly.

.....

(Total for Question 13 is 3 marks)

14 Here is the number of goals that Henri's team scored one summer in each water polo match.

5 8 9 11 13 13 14 15 16 17 20

Find the interquartile range of the numbers of goals.
Show your working clearly.

.....

(Total for Question 14 is 2 marks)

Answer ALL TWENTY questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Simplify $e^8 \div e^2$

.....

(1)

(b) Expand and simplify $(x - 3)(x + 1)$

.....

(2)

(Total for Question 1 is 3 marks)

---

2 Here is a right-angled triangle.

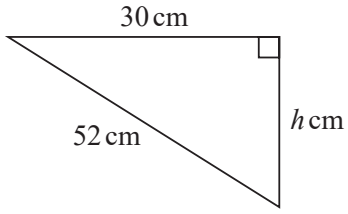


Diagram **NOT** accurately drawn

Calculate the value of h.
Give your answer correct to 3 significant figures.

h = ...

(Total for Question 2 is 3 marks)

---

12 $3^{\frac{1}{2}} \times 3^{\frac{2}{5}} = 3^m$

(a) Work out the value of m

$m =$ .....

(1)

$5^{-10} \div 5^{-4} = 5^n$

(b) Work out the value of n

$n =$ .....

(1)

(Total for Question 12 is 2 marks)

13 Expand and simplify $3x(2x - 5)^2$
Show clear algebraic working.

.....

(Total for Question 13 is 3 marks)

13 A is the point with coordinates (–5, 12)

B is the point with coordinates (19, –48)

Find an equation of the straight line that passes through the points A and B

.....

(Total for Question 13 is 3 marks)

14 Factorise fully $50g^2 - 18$

.....

(Total for Question 14 is 3 marks)

7 (a) Expand $4x(x - 5)$

.....

(1)

(b) Factorise $y^2 - 9y + 20$

.....

(2)

(Total for Question 7 is 3 marks)

8 (a) Write 5.6×10^{-3} as an ordinary number.

.....

(1)

(b) Work out $\dfrac{6 \times 10^3}{2.1 \times 10^{-4} + 9 \times 10^{-5}}$

Give your answer in standard form.

.....

(2)

(Total for Question 8 is 3 marks)

16 Expand and simplify $(2x + 3)(x - 5)(x + 4)$

.....

(Total for Question 16 is 3 marks)

17 $P = a(c + y)$

$a = 8.3$ correct to 2 significant figures
$c = 2$ correct to 1 significant figure
$y = 15$ correct to the nearest 5

Work out the upper bound for the value of P
Show your working clearly.

.....

(Total for Question 17 is 3 marks)

14 B is inversely proportional to the square of d

$B = 0.25$ when $d = 12$

Find a formula for B in terms of d

.....

(Total for Question 14 is 3 marks)

15 Write $3x(2x-1)(5x+4)$ in the form $ax^3 + bx^2 + cx$ where a, b and c are integers.

.....

(Total for Question 15 is 3 marks)

11 Khalid has a box of counters.

17 of the counters are red
28 of the counters are blue
the rest of the counters are orange

Khalid is going to take at random a counter from the box.

The probability that Khalid will take an orange counter is $\frac{4}{9}$

Work out the number of orange counters that are in the box.

.....

(Total for Question 11 is 3 marks)

12 Expand and simplify $3x(2x+5)(7x-4)$

.....

(Total for Question 12 is 3 marks)

Answer ALL TWENTY SIX questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Expand and simplify $(y + 4)(2 - y)$

.....

(2)

(b) Factorise fully $15b^5c - 35b^3c^9$

.....

(2)

(Total for Question 1 is 4 marks)

Answer ALL TWENTY SIX questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 $P = m^2 - 4c$

(a) Work out the value of P when $m = -5$ and $c = 3$

$P =$ .....

(2)

(b) Expand and simplify $(x + 5)(x - 7)$

.....

(2)

(Total for Question 1 is 4 marks)

5 (a) Factorise fully $15y^4 + 20uy^3$

.....

(2)

(b) Solve $4 - 3x = \frac{5 - 8x}{4}$

Show clear algebraic working.

$x =$ .....

(3)

(Total for Question 5 is 5 marks)

6 (a) Write 2 840 000 000 in standard form.

.....

(1)

(b) Write 2.5×10^{-4} as an ordinary number.

.....

(1)

(Total for Question 6 is 2 marks)

9 (a) Factorise fully $25a^4c^7d + 45a^9c^3h$

.....

(2)

(b) Solve $(2x + 5)^2 = (2x + 3)(2x - 1)$

$x =$ .....

(3)

(Total for Question 9 is 5 marks)

10 Jethro has sat 5 tests.
Each test was marked out of 100 and Jethro's mean mark for the 5 tests is 74

Jethro has to sit one more test that is also to be marked out of 100

Jethro wants his mean mark for all 6 tests to be at least 77

Work out the least mark that Jethro needs to get for the last test.

.....

(Total for Question 10 is 3 marks)

9 (a) Simplify $x^4 \times x^5$

.....

(1)

(b) Simplify $(4y^2)^3$

.....

(2)

(c) Factorise $n^2 - 7n + 12$

.....

(2)

(Total for Question 9 is 5 marks)

5 (a) Expand and simplify $(n - 6)(n + 4)$

.....

(2)

(b) Solve $2x - 3 = \frac{3x - 5}{4}$

Show clear algebraic working.

$x =$ .....

(3)

(Total for Question 5 is 5 marks)

8 (a) Factorise fully $18c^3d^2 - 21c^2$

.....

(2)

(b) (i) Factorise $y^2 - 3y - 18$

.....

(2)

(ii) Hence, solve $y^2 - 3y - 18 = 0$

.....

(1)

(Total for Question 8 is 5 marks)

6 (a) Expand and simplify $(m + 5)(m - 8)$

.....

(2)

(b) Solve $3n - 4 = \frac{5n + 6}{3}$

Show clear algebraic working.

$n =$ .....

(3)

(Total for Question 6 is 5 marks)

8 (a) Simplify $a^6 \times a^{10}$

.....

(1)

(b) Simplify $c^{30} \div c^{12}$

.....

(1)

(c) (i) Factorise $y^2 - 10y + 21$

.....

(2)

(ii) Hence, solve $y^2 - 10y + 21 = 0$

.....

(1)

(Total for Question 8 is 5 marks)

Answer ALL TWENTY SIX questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Factorise fully $18c - 45cd$

.....

(2)

(b) Solve $\frac{5 - 2x}{6} = 3x - 4$

Show clear algebraic working.

$x =$ .....

(3)

(Total for Question 1 is 5 marks)

13 (a) Factorise $4x^2 - 25y^2$

.....

(2)

(b) Show that $4x(x + 3)(2x - 5)$ can be written in the form $ax^3 + bx^2 + cx$ where a, b and c are integers to be found.

(3)

(Total for Question 13 is 5 marks)

3 (a) Simplify $e^9 \div e^5$

.....

(1)

(b) Simplify $(y^2)^8$

.....

(1)

(c) Expand and simplify $(x + 9)(x - 2)$

.....

(2)

(d) Factorise fully $16c^4p^2 + 20cp^3$

.....

(2)

(Total for Question 3 is 6 marks)

18 (a) Expand and simplify $(x + 2)(2x + 3)(x - 7)$
Show your working clearly.

.....

(3)

(b) Make m the subject of $p^2 = \dfrac{x + m}{2m - y}$

.....

(3)

(Total for Question 18 is 6 marks)

5 (a) Expand and simplify $3x(2x + 3) - x(3x + 5)$

.....

(2)

(b) Make t the subject of the formula $p = at - d$

.....

(2)

Given that $\frac{w^5 \times w^n}{w^3} = w^{10}$

(c) work out the value of n.

$n =$ .....

(2)

(Total for Question 5 is 6 marks)

13 (a) Expand and simplify $5x(x + 2)(3x - 4)$

.....

(3)

(b) Simplify completely $\left(\frac{16w^8}{y^{20}}\right)^{-\frac{3}{4}}$

.....

(3)

(Total for Question 13 is 6 marks)

16 (a) Expand and simplify $(3x - 1)(x + 2)(3x + 1)$

.....

(3)

(b) Simplify fully $\left(\frac{2x^5}{8xy^2}\right)^{-2}$

.....

(3)

(Total for Question 16 is 6 marks)

12 (a) Simplify $\frac{2}{y^0}$

.....

(1)

(b) Simplify fully $(16a^4)^{\frac{3}{4}}$

.....

(2)

(c) Expand and simplify $5x(3x + 4)(2x - 1)$

.....

(3)

(Total for Question 12 is 6 marks)

2 (a) Factorise fully $12pq - 18p$

.....

(2)

There are 56 metal bars in a box.
Each metal bar is gold or silver or zinc.

y metal bars are gold.
$(3y + 7)$ metal bars are silver.
$(2y - 5)$ metal bars are zinc.

(b) Work out the number of metal bars that are zinc.
Show clear algebraic working.

.....

(4)

(Total for Question 2 is 6 marks)

14 (a) Expand and simplify $(3x + 1)(2 - x)(4 + x)$

.....

(3)

(b) Simplify fully $\left(\frac{a^3b}{a^9b^5}\right)^{-\frac{1}{2}}$

.....

(3)

(Total for Question 14 is 6 marks)

3 (a) Simplify $\left(p^3\right)^5$

.....

(1)

(b) Expand and simplify $2n(4n + 3) + n(n - 4)$

.....

(2)

(c) Solve $\frac{2x + 5}{3} = 4 - x$

Show clear algebraic working.

$x =$ .....

(3)

(Total for Question 3 is 6 marks)

Answer ALL TWENTY ONE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Factorise fully $4p + 6pq$

(2)

(b) Expand and simplify $(e + 3)(e - 5)$

(2)

(c) Solve $y = \frac{2y + 1}{5}$

Show clear algebraic working.

$y =$

(3)

(Total for Question 1 is 7 marks)

14 (a) Simplify $(2e^2 f^3)^3$

.....

(2)

(b) Expand and simplify $(3x - 4y)(x + 3y)$

.....

(2)

$\dfrac{\sqrt{a} \times a}{a^{-2}}$ can be written in the form a^k

(c) Find the value of k.

$k =$ .....

(2)

(d) Simplify $\dfrac{2^n - 1}{4^n - 1}$

.....

(2)

(Total for Question 14 is 8 marks)

15 (a) Simplify $(3x^2y^5)^4$

(2)

(b) Expand and simplify $4n(n - 3)(n + 5)$

(2)

(c) Factorise $4c^2 - 9d^2$

(1)

(d) Simplify fully $\dfrac{x^2 - 7x + 12}{4x - x^2}$

(3)

(Total for Question 15 is 8 marks)

12 (a) Factorise $2x^2 - 7x + 6$

.....

(2)

(b) Solve $\frac{4m + 9}{3} = 7 - 2m$

Show clear algebraic working.

$m =$ .....

(4)

(c) Write $\frac{\sqrt[4]{y}}{y}$ in the form y^b where b is a fraction.

.....

(2)

(Total for Question 12 is 8 marks)

3 (a) Make a the subject of $d = g + 2ac$

.....

(2)

(b) Factorise fully $9ef - 12f$

.....

(2)

(c) Expand and simplify $(x + 2)(x - 5)$

.....

(2)

(d) Simplify fully $\dfrac{n^4 \times n^7}{n^5}$

.....

(2)

(Total for Question 3 is 8 marks)

7 (a) Solve $5(4 - x) = 7 - 3x$
Show clear algebraic working.

$x =$ .....

(3)

(b) Factorise fully $16m^3g^3 + 24m^2g^5$

.....

(2)

(c) (i) Factorise $y^2 - 2y - 48$

.....

(2)

(ii) Hence, solve $y^2 - 2y - 48 = 0$

.....

(1)

(Total for Question 7 is 8 marks)

Answer ALL TWENTY TWO questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 $w = 5y^2 - y^3$

(a) Work out the value of w when $y = -2$

$w =$ .....

(2)

(b) Factorise fully $8p^2 - 2p$

.....

(2)

(c) Expand $4t(3t - 2)$

.....

(2)

(d) Expand and simplify $(5x - 2)(x + 4)$

.....

(2)

(Total for Question 1 is 8 marks)

6 (a) Solve $p = \dfrac{3p - 5}{10}$

Show clear algebraic working.

$p =$ .....

(3)

(b) Simplify a^0 where $a > 0$

.....

(1)

(c) Simplify fully $\dfrac{3xy^3}{6x^2y}$

.....

(2)

(d) Factorise fully $10c^3d^2 + 15cd^4$

.....

(2)

(Total for Question 6 is 8 marks)

6 (a) Simplify $(2c^4d^7)^3$

.....

(2)

(b) Find the value of $5y^0$ where $y > 0$

.....

(1)

(c) Factorise fully $16a^2b^3 + 20a^3b$

.....

(2)

(d) (i) Factorise $x^2 + 9x - 22$

.....

(2)

(ii) Hence solve $x^2 + 9x - 22 = 0$

.....

(1)

(Total for Question 6 is 8 marks)

6 (a) Solve $\frac{2f}{3} = 4f - 17$

Show clear algebraic working.

$f =$ .....

(3)

(b) Simplify $(e + 12)^0$ where $e > 0$

.....

(1)

(c) Simplify fully $\frac{12a^4h^6}{4ah^2}$

.....

(2)

(d) Factorise fully $20x^5y + 12x^3y^4$

.....

(2)

(Total for Question 6 is 8 marks)

3 (a) Simplify $y^5 \times y^9$

.....

(1)

(b) Simplify $(2m^3)^4$

.....

(2)

(c) Solve $5(x + 3) = 3x - 4$
Show clear algebraic working.

$x =$ .....

(3)

(d) (i) Factorise $x^2 + 2x - 24$

.....

(2)

(ii) Hence, solve $x^2 + 2x - 24 = 0$

.....

(1)

(Total for Question 3 is 9 marks)

4 (a) Expand and simplify $3(c - 7) + 2(3c + 4)$

.....

(2)

(b) Expand and simplify $(x + 7)(x - 2)$

.....

(2)

(c) Factorise fully $28y^2 - 21y$

.....

(2)

(d) Solve $\frac{7x - 2}{4} = 3x + 1$

Show clear algebraic working.

$x =$.....

(3)

(Total for Question 4 is 9 marks)

6 (a) Write 7.8×10^{-4} as an ordinary number.

.....

(1)

(b) Work out $\dfrac{5.6 \times 10^4 + 7 \times 10^3}{2.8 \times 10^{-3}}$

Give your answer in standard form.

.....

(2)

(Total for Question 6 is 3 marks)

7 (a) Expand and simplify $(m - 8)(m + 5)$

.....

(2)

(b) Factorise fully $5y + 20y^2$

.....

(2)

(c) Simplify $(p^2 + 3)^0$

.....

(1)

(d) Solve $3(2x - 5) = \frac{9 - x}{2}$

Show clear algebraic working.

$x =$ .....

(4)

(Total for Question 7 is 9 marks)

7 (a) Simplify $g^9 \div g^2$

.....

(1)

(b) Expand $5k^2(k^3 + 4)$

.....

(2)

(c) (i) Factorise $x^2 - 2x - 63$

.....

(2)

(ii) Hence, solve $x^2 - 2x - 63 = 0$

.....

(1)

(d) Solve the inequality $7 - 2y < 3y - 12$

.....

(3)

(Total for Question 7 is 9 marks)

SUB-TOPIC A1c

FORMULAE & REARRANGING

Sub-topic A1c · 20 questions · 109 marks · lowest tariff first

15 Make n the subject of the formula $x = \dfrac{3p+n}{3n-4}$

.....

(Total for Question 15 is 3 marks)

7 (a) Simplify fully $\frac{20x^2y^6}{4x^2y^2}$

.....

(2)

(b) Make e the subject of the formula $h = 3e + f$

.....

(2)

(Total for Question 7 is 4 marks)

8 From point A, Stanley walks 200 m due east to point B.
From B, he then walks 160 m due south to point C.

Work out the length of AC.
Give your answer correct to 3 significant figures.

..... metres

(Total for Question 8 is 3 marks)

14 Here are two vectors.

$$\overrightarrow{AB} = \begin{pmatrix} 6 \\ -9 \end{pmatrix} \qquad \overrightarrow{CB} = \begin{pmatrix} 1 \\ 3 \end{pmatrix}$$

Find the magnitude of $\overrightarrow{AC}$.

.....

(Total for Question 14 is 3 marks)

15 Make x the subject of the formula $y = \sqrt{\dfrac{3x-2}{x+1}}$

.....

(Total for Question 15 is 4 marks)

16 Make x the subject of $y = \sqrt{\dfrac{x+1}{x-4}}$

.....

(Total for Question 16 is 4 marks)

15 Make x the subject of $y = \dfrac{5 - 2x}{x + 3}$

.....

(Total for Question 15 is 4 marks)

17 Given that $n > 0$

make n the subject of the formula $y = \dfrac{n^2 + d}{n^2}$

.....

(Total for Question 17 is 4 marks)

15 Make t the subject of $n^2 = \dfrac{4d + t^3}{t^3}$

.....

(Total for Question 15 is 4 marks)

16 Show that $\frac{2\sqrt{3}}{\sqrt{3}-1}$ can be written in the form $a + \sqrt{a}$ where a is an integer.

Show your working clearly.

(Total for Question 16 is 3 marks)

17 Make x the subject of $y = \sqrt[3]{\frac{6+5x}{x+4}}$

(Total for Question 17 is 4 marks)

15 Simplify fully $\left(\frac{2a^3}{10a^7c^2}\right)^{-3}$

.....

(Total for Question 15 is 3 marks)

16 Make t the subject of the formula $c = \frac{t^2+3}{7-8t^2}$

.....

(Total for Question 16 is 4 marks)

16 Show that $\frac{4}{3\sqrt{5}+7}$ can be written in the form $a-\sqrt{b}$ where a and b are integers.

Show each stage of your working.

(Total for Question 16 is 3 marks)

17 Make k the subject of $p=\frac{8k^2+5}{7-3k^2}$

.....

(Total for Question 17 is 4 marks)

6 (a) Make c the subject of $A = \frac{c}{y} - 5z$

.....

(2)

(b) Write down the value of g^0

.....

(1)

(c) Factorise $x^2 - 11x + 24$

.....

(2)

(Total for Question 6 is 5 marks)

Answer ALL TWENTY THREE questions.

Write your answers in the spaces provided.

You must write down all the stages in your working.

1 (a) Make a the subject of the formula $M = ac - bd$

.....

(2)

(b) Solve the inequality $5x - 4 < 39$

.....

(2)

(c) Factorise fully $18e^2f^3 - 12e^3f$

.....

(2)

(Total for Question 1 is 6 marks)

10 (a) Simplify fully $\left(16x^8y^6\right)^{\frac{1}{2}}$

(2)

(b) Solve $\frac{8-2x}{3}-\frac{2x-3}{2}=4$

Show clear algebraic working.

$x =$

(3)

(c) Make f the subject of $m=\sqrt{\frac{1}{3}ef}$

(2)

(Total for Question 10 is 7 marks)

14 (a) Solve $\frac{9a - 7}{5} - \frac{3a - 7}{4} = 4.55$

Show clear algebraic working.

$a =$ .....

(3)

(b) Make c the subject of the formula $p = \sqrt{\frac{ac + 8}{3 + c}}$

.....

(4)

(Total for Question 14 is 7 marks)

14 (a) Expand and simplify $(5 - x)(2x + 3)(x + 4)$
Show your working clearly.

.....

(3)

(b) Make c the subject of $g = \dfrac{c + 3}{4 + c} - 7$

.....

(4)

(Total for Question 14 is 7 marks)

17 (a) Expand and simplify $(x + 6)(3x - 2)(x + 6)$

.....

(3)

(b) Make e the subject of $w = \sqrt{\dfrac{e + g}{ef - d}}$

.....

(4)

(Total for Question 17 is 7 marks)

15 (a) Make g the subject of $e = \sqrt{\dfrac{7g + 5}{11 + 2g}}$

.....

(4)

(b) Solve the inequality $3y^2 + 4y - 32 > 0$
Show your working clearly.

.....

(3)

(Total for Question 15 is 7 marks)

12 (a) Solve $\frac{3x+2}{5} - \frac{2x+1}{3} = x$

Show clear algebraic working.

$x =$ .....

(3)

(b) Make c the subject of the formula $f = \sqrt{\frac{a+bc}{c-d}}$

.....

(4)

(Total for Question 12 is 7 marks)

17 (a) Factorise $6y^2 - y - 5$

.....

(2)

(b) Make f the subject of $w = \dfrac{2f + 3}{8 - f}$

.....

(3)

(c) Express $4x^2 - 8x + 7$ in the form $a(x + b)^2 + c$ where a, b and c are integers.

.....

(3)

(Total for Question 17 is 8 marks)

12 (a) Simplify n^0

(1)

(b) Simplify $(3x^2y^5)^3$

(2)

(c) Factorise fully $2e^2 - 18$

(2)

(d) Make r the subject of $m = \sqrt{\dfrac{6a + r}{5r}}$

(4)

(Total for Question 12 is 9 marks)

SUB-TOPIC A1d

ALGEBRAIC FRACTIONS & IDENTITIES

Sub-topic A1d · 25 questions · 112 marks · lowest tariff first

11 Express $\frac{5}{3} - \frac{x+2}{2x}$ as a single fraction in its simplest terms.

(Total for Question 11 is 3 marks)

22 Simplify fully $\dfrac{6x^3 + 13x^2 - 5x}{4x^2 - 25}$

.....

(Total for Question 22 is 3 marks)

19 $a = \dfrac{14}{3x - 7}$ $\quad x = \dfrac{7}{4y - 3}$

Express a in the form $\dfrac{py + q}{ry + s}$ where p, q, r and s are integers.

Give your answer in its simplest form.

$a =$ .....

(Total for Question 19 is 3 marks)

23 Express $\left(\frac{20}{x^2 - 36} - \frac{2}{x - 6}\right) \times \frac{1}{4 - x}$ as a single fraction in its simplest form.

.....

(Total for Question 23 is 3 marks)

11 Express $\frac{3}{4} + \frac{5-x}{6x}$ as a single fraction in its simplest terms.

.....

(Total for Question 11 is 3 marks)

20 Given that $k = x - y$ and $x = \frac{1}{4y}$

express $\frac{5k}{x+2}$ in the form $\frac{a - by^2}{c + dy}$ where a, b, c and d are integers.

.....

(Total for Question 20 is 3 marks)

11 $OABC$ is a sector of a circle, centre O

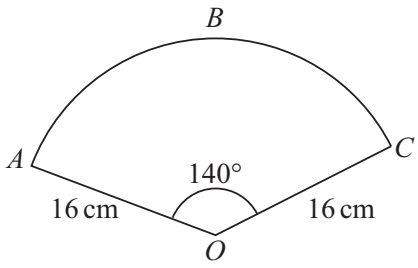


Diagram **NOT** accurately drawn

angle $AOC = 140°$
$OA = OC = 16$ cm

Calculate the area of the sector.
Give your answer correct to 3 significant figures.

..... cm^2

(Total for Question 11 is 2 marks)

12 Express $\frac{5}{4} + \frac{x-3}{6x}$ as a single fraction in its simplest form.

.....

(Total for Question 12 is 3 marks)

22 Express $\dfrac{4x^2 - 25}{5x^2 + 2x - 7} \times \left(\dfrac{2}{x - 3} - \dfrac{3}{2x - 5} \right)$ as a single fraction in its simplest form.

.....

(Total for Question 22 is 4 marks)

24 Express

$$\left(\frac{4}{2x-5}-\frac{3}{2x-3}\right)\div\frac{9x-4x^3}{6x^2-17x+5}$$

as a single fraction in its simplest form.

.....

(Total for Question 24 is 4 marks)

21 Write $\dfrac{25x^2 - 64}{5x^2 - 13x - 6} \times \dfrac{x^2 - 8x + 15}{5x + 8} - (x - 7)$

as a single fraction in its simplest form.
Show clear algebraic working.

.....

(Total for Question 21 is 4 marks)

Turn over for Question 22

21 Given that $x = \dfrac{5}{9y + 5}$ and that $y = \dfrac{5}{5a - 2}$

find an expression for x in terms of a.
Give your expression as a single fraction in its simplest form.

.....

(Total for Question 21 is 4 marks)

26 Write

$$\frac{4x^2 - 17x - 15}{2x - 1} \times \frac{2x^2 - 7x + 3}{x^2 - 25} + (29 - 4x)$$

as a single fraction in its simplest form.

.....

(Total for Question 26 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS

23 Simplify $\left(x^2 - 4\right) \div \left(\dfrac{4x^2 - 7x - 2}{x}\right) - 2x$

Give your answer in the form $\dfrac{ax^2}{bx + c}$ where a, b and c are integers.

.....

(Total for Question 23 is 4 marks)

26 Write $4 - \left[(3x - 5) \div \frac{3x^2 + x - 10}{4x - 1} \right]$ as a single fraction in its simplest form.

.....

(Total for Question 26 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS

23 Show that $\dfrac{16x^2 - 36}{x - 7} \div \dfrac{2x^2 + 7x + 6}{x^2 - 5x - 14} - (7 + 8x) = n$

where n is an integer to be found.
Show clear algebraic working.

(Total for Question 23 is 4 marks)

15 (a) Simplify fully $\left(\frac{256x^{20}}{y^8}\right)^{-\frac{1}{4}}$

.....

(2)

(b) Express $\frac{1}{9x^2 - 25} - \frac{1}{6x + 10}$ as a single fraction in its simplest form.

.....

(3)

(Total for Question 15 is 5 marks)

21 Express

$$\frac{1}{3x-2} \times \frac{9x^2-4}{3x^2-13x-10} - \frac{7}{x-1}$$

as a single fraction in its simplest form.

.....

(Total for Question 21 is 5 marks)

21 Given that $M = \dfrac{18^{4n} \times 2^{3(n^2-6n)} \times 3^{2(1-4n)}}{12^2}$

find the values of n for which $M = 2$

.....

(Total for Question 21 is 5 marks)

12 (a) Expand and simplify $n(n - 4)(3n + 5)$

.....

(2)

(b) Express

$$\frac{3}{x} + \frac{x + 2}{2x} + \frac{1}{4}$$

as a single fraction in its simplest form.

.....

(3)

(Total for Question 12 is 5 marks)

11 (a) Factorise $9x^2 - 4y^2$

.....

(2)

(b) Express $\frac{7}{8} - \frac{x+3}{4x}$ as a single fraction in its simplest form.

.....

(3)

(Total for Question 11 is 5 marks)

12 (a) Factorise fully $6y^2 - 5y - 4$

.....

(2)

(b) Express $\frac{2x+1}{4x} + \frac{7-5x}{3x}$ as a single fraction in its simplest form.

.....

(3)

(Total for Question 12 is 5 marks)

12 (a) Express $\frac{4}{x-2} - \frac{3}{x+1}$ as a single fraction.
Give your answer in its simplest form.

.....

(3)

(b) Expand and simplify $2x(x-5)(x-3)$

.....

(3)

(Total for Question 12 is 6 marks)

21 (a) Simplify fully $\dfrac{10x^2 + 23x + 12}{4x^2 - 9}$

.....

(3)

$2^{2y} \times 2^{3y+2} = \dfrac{8^{5y}}{4^n}$

(b) Find an expression for n in terms of y.
Show clear algebraic working and simplify your expression.

.....

(4)

(Total for Question 21 is 7 marks)

12 (a) Simplify $(64p^9q^{12})^{\frac{2}{3}}$

.....

(2)

(b) Write as a single fraction $\frac{2}{3x} + \frac{4}{5x} - \frac{9}{10x}$

Give your answer in its simplest form.

.....

(2)

(c) Expand and simplify $4x(x - 5)(2x + 3)$
Show your working clearly.

.....

(3)

(Total for Question 12 is 7 marks)

12 (a) Simplify $(16e^{10}f^{6})^{\frac{1}{2}}$

.....

(2)

(b) Write $\frac{2x+1}{4}+\frac{x-2}{3}$ as a single fraction in its simplest form.

.....

(3)

Given that $4^{k+3}=16\times 2^{k}$

(c) find the value of k.
Show your working clearly.

$k =$ .....

(4)

(Total for Question 12 is 9 marks)

SUB-TOPIC A1e

ALGEBRAIC PROOF & REASONING

Sub-topic A1e · 10 questions · 33 marks · lowest tariff first

17 Prove that the difference between two consecutive square numbers is always an odd number.
Show clear algebraic working.

(Total for Question 17 is 3 marks)

25 N is a multiple of 5

$A = N + 1$
$B = N - 1$

Prove, using algebra, that $A^2 - B^2$ is always a multiple of 20

(Total for Question 25 is 3 marks)

16 Use algebra to show that the recurring decimal $0.28\dot{1}\dot{3} = \frac{557}{1980}$

(Total for Question 16 is 2 marks)

17 Using algebra, prove that, given any 3 consecutive even numbers, the difference between the square of the largest number and the square of the smallest number is always 8 times the middle number.

(Total for Question 17 is 3 marks)

15 Using algebra, prove that, given any 3 consecutive whole numbers, the sum of the square of the smallest number and the square of the largest number is always 2 more than twice the square of the middle number.

(Total for Question 15 is 3 marks)

18 Prove that when the sum of the squares of any two consecutive odd numbers is divided by 8, the remainder is always 2
Show clear algebraic working.

(Total for Question 18 is 3 marks)

19 Prove algebraically that, for any three consecutive even numbers,

the sum of the squares of the smallest even number and the largest even number is 8 more than twice the square of the middle even number.

(Total for Question 19 is 3 marks)

17 Prove that, for any three numbers which are consecutive multiples of 4, the difference between the square of the largest number and the square of the smallest number is always a multiple of 64

Show clear algebraic working.

(Total for Question 17 is 3 marks)

21 (a) Show that $x(x - 1)(x + 1) = x^3 - x$

(1)

(b) Prove that the difference between a whole number and the cube of this number is always a multiple of 6

(3)

(Total for Question 21 is 4 marks)

17 The table gives information about the first six terms of a sequence of numbers.

Term number	1	2	3	4	5	6
Term of sequence	$\frac{1\times 2}{2}$	$\frac{2\times 3}{2}$	$\frac{3\times 4}{2}$	$\frac{4\times 5}{2}$	$\frac{5\times 6}{2}$	$\frac{6\times 7}{2}$

Prove algebraically that the sum of any two consecutive terms of this sequence is always a square number.

(Total for Question 17 is 4 marks)

15 Prove algebraically that the product of any two odd numbers is always an odd number.

(Total for Question 15 is 4 marks)

SUB-TOPIC A1f

FUNCTIONS (COMPOSITE & INVERSE)

Sub-topic A1f · 29 questions · 149 marks · lowest tariff first

22 The function f is such that $f(x) = x^2 - 8x + 5$ where $x \leqslant 4$

Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$

$f^{-1}(x) =$ .....

(Total for Question 22 is 3 marks)

17 $f(x) = \dfrac{x}{2x - 4}$ $g(x) = 3x + 1$

Given that $fg(k) = 2$

work out the value of k

$k =$ .....

(Total for Question 17 is 3 marks)

19 The functions f and g are such that

$$f(x) = 3x - 4 \text{ where } x > 2$$

$$g(x) = \frac{x}{2x + 1}$$

(a) State the value of x that cannot be included in any domain of g

.....

(1)

(b) Find $gf(x)$
Give your answer in its simplest form.

$gf(x) =$ .....

(2)

(Total for Question 19 is 3 marks)

20 Two functions, f and g are defined as

$$f : x \mapsto 1 + \frac{1}{x} \quad \text{for } x > 0$$

$$g : x \mapsto \frac{x+1}{2} \quad \text{for } x > 0$$

Given that $h = fg$

express the inverse function h^{-1} in the form $h^{-1} : x \mapsto \ldots$

$h^{-1} : x \mapsto$.....

(Total for Question 20 is 4 marks)

17 f is the function such that $f(x) = 4 - 3x$

(a) Work out f(5)

(1)

g is the function such that $g(x) = \dfrac{1}{1-2x}$

(b) Find the value of x that cannot be included in any domain of g

(1)

(c) Work out fg(−1.5)

(2)

(Total for Question 17 is 4 marks)

17 The function f is such that $f(x) = (x - 4)^2$ for all values of x.

(a) Find f(1)

.....

(1)

(b) State the range of the function f.

.....

(1)

The function g is such that $g(x) = \dfrac{4}{x + 3}$ $x \neq -3$

(c) Work out fg(2)

.....

(2)

(Total for Question 17 is 4 marks)

23 The functions f and g are such that

$$f(x) = x + 25 \qquad g(x) = x^2 - 12x$$

The function h is such that $h(x) = fg(x)$

The domain of h is $\{x : x \leqslant 6\}$

Express the inverse function h^{-1} in the form $h^{-1}(x) = ...$

$h^{-1}(x) =$ .....

(Total for Question 23 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS

14 The function f is defined as

$$f: x \mapsto \frac{2x}{x-6} \qquad x \neq 6$$

(a) Find f(10)

.....

(1)

(b) Express the inverse function f^{-1} in the form $f^{-1}: x \mapsto \ldots$

$f^{-1}: x \mapsto$ .....

(3)

(Total for Question 14 is 4 marks)

19 $f(x) = x^2 - 4$

$g(x) = 2x + 1$

Solve $fg(x) > 0$
Show clear algebraic working.

.....

(Total for Question 19 is 4 marks)

18 The function f is such that $f(x) = \frac{k}{x}$ where $x \neq 0$ and k is an integer.

(a) Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$

$f^{-1}(x) =$ .....

(1)

The function g is such that $g(x) = 2 - 3x^4$ where $x \neq 0$

The function h is such that $h(x) = \frac{3x}{2 - x}$ where $x \neq 2$

(b) (i) Find $g(-2)$

.....

(1)

(ii) Express the composite function hg in the form $hg(x) = ...$
Give your answer in its simplest form.

$hg(x) =$ .....

(2)

(Total for Question 18 is 4 marks)

25 The function f is such that $f(x) = 3x^2 - 12x + 7$ where $x \leqslant 2$

Express the inverse function f^{-1} in the form $f^{-1}(x) = \ldots$

$f^{-1}(x) =$ .....

(Total for Question 25 is 4 marks)

17 The functions g and h are such that

$$g(x) = \frac{11}{2x - 5}$$

$$h(x) = x^2 + 4 \qquad x \geqslant 0$$

(a) What value of x must be excluded from any domain of g?

.....

(1)

(b) Solve $gh(x) = 1$

.....

(3)

(Total for Question 17 is 4 marks)

15 The function f is defined as

$$f: x \mapsto \frac{3x + 1}{x - 2}$$

(a) State the value of x that cannot be included in any domain of the function f

.....

(1)

(b) Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$

$f^{-1}(x) =$ .....

(3)

(Total for Question 15 is 4 marks)

25 The function f is such that $f(x) = 2x^2 - 24x + 7$ where $x \geqslant 6$

Find the inverse function $f^{-1}(x)$

$f^{-1}(x) =$ .....

(Total for Question 25 is 4 marks)

TOTAL FOR PAPER IS 100 MARKS

16 $f(x) = 9 - \sqrt{x}$ where $x \geqslant 0$

$g(x) = 4x^2$

(a) Find $f(9)$

.....

(1)

(b) Solve $fg(x) < 0$

Show clear algebraic working.

.....

(3)

(Total for Question 16 is 4 marks)

19 g is the function with domain $x \geqslant -3$ such that $g(x) = x^2 + 6x$

(a) Write down the range of g^{-1}

(1)

(b) Express the inverse function g^{-1} in the form $g^{-1} : x \mapsto \ldots$

$g^{-1} : x \mapsto$

(4)

(Total for Question 19 is 5 marks)

24 The function f is such that $f(x) = 3x - 2$

(a) Find f(5)

.....

(1)

The function g is such that $g(x) = 2x^2 - 20x + 9$ where $x \geqslant 5$

(b) Express the inverse function g^{-1} in the form $g^{-1}(x) = ...$

$g^{-1}(x) =$ .....

(4)

(Total for Question 24 is 5 marks)

TOTAL FOR PAPER IS 100 MARKS

21 The functions f and g are such that

$$f(x) = x^2 - 2x \qquad g(x) = x + 3$$

The function h is such that $h(x) = fg(x)$ for $x \geqslant -2$

Express the inverse function $h^{-1}(x)$ in the form $h^{-1}(x) = \ldots$

$h^{-1}(x) =$ .....

(Total for Question 21 is 5 marks)

25 The function g is defined as

$$g: x \mapsto 5 + 6x - x^2 \quad \text{with domain } \{x : x \geqslant 3\}$$

(a) Express the inverse function g^{-1} in the form $g^{-1}: x \mapsto \ldots$

$g^{-1}: x \mapsto$ .....

(4)

(b) State the domain of g^{-1}

.....

(1)

(Total for Question 25 is 5 marks)

23 The function f is defined as $f(x) = \dfrac{\sqrt{x^2 + k^2}}{x}$ for $x > 0$ and where k is a positive number.

(a) Find the value of p for which $f^{-1}(p) = k$

$p =$

(3)

The function g is defined as $g(x) = x^2$ for $x > 0$

(b) Given that $gf(a) = k$ for $k > 1$
find an expression for a in terms of k.

$a =$

(3)

(Total for Question 23 is 6 marks)

TOTAL FOR PAPER IS 100 MARKS

24 The functions f and g are defined as

$$f(x) = 5x^2 - 10x + 7 \qquad \text{where } x \geqslant 1$$

$$g(x) = 7x - 6$$

(a) Find fg(2)

.....

(2)

(b) Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$

$f^{-1}(x) =$ .....

(4)

(Total for Question 24 is 6 marks)

15 The functions f and g are such that

$$f(x) = 2x - 3$$

$$g(x) = \frac{x}{3x + 1}$$

(a) State the value of x that cannot be included in any domain of g

.....

(1)

(b) Find $gf(x)$
Simplify your answer.

$gf(x) =$ .....

(2)

(c) Express the inverse function g^{-1} in the form $g^{-1}(x) = ...$

$g^{-1}(x) =$ .....

(3)

(Total for Question 15 is 6 marks)

16 The function f is such that

$$f(x) = \frac{2}{3x - 5} \quad \text{where } x \neq \frac{5}{3}$$

(a) Find $f\left(\frac{1}{3}\right)$

.....

(1)

(b) Find $f^{-1}(x)$

$f^{-1}(x) =$ .....

(2)

The function g is such that

$$g(x) = 5x^2 - 20x + 23$$

(c) Express $g(x)$ in the form $a(x - b)^2 + c$

.....

(3)

(Total for Question 16 is 6 marks)

14 The function f is such that

$$f(x) = \frac{3x - 5}{4}$$

(a) Find f(–7)

.....

(1)

(b) Express the inverse function f^{-1} in the form $f^{-1}(x) = ...$

$f^{-1}(x) =$ .....

(2)

The function g is such that

$$g(x) = \sqrt{19 - x}$$

(c) Find fg(3)

.....

(2)

(d) Which values of x cannot be included in any domain of g?

.....

(2)

(Total for Question 14 is 7 marks)

21 The function f is such that $f(x) = 5 + 6x - x^2$ for $x \leqslant 3$

(a) Express $5 + 6x - x^2$ in the form $p - (x - q)^2$ where p and q are constants.

.....

(2)

(b) Using your answer to part (a), find the range of values of x for which $f^{-1}(x)$ is positive.

.....

(5)

(Total for Question 21 is 7 marks)

TOTAL FOR PAPER IS 100 MARKS

19 The functions f and g are such that

$$f: x \mapsto 5x + 7$$

$$g: x \mapsto \frac{5}{2x - 9}$$

(a) State which value of x cannot be included in any domain of g

.....

(1)

(b) Find fg(4)

.....

(2)

The function h is such that

$$h: x \mapsto 3x^2 - 12x + 8 \quad \text{where } x > 2$$

(c) Express the inverse function h^{-1} in the form $h^{-1}: x \mapsto ...$

$h^{-1}: x \mapsto$ .....

(4)

(Total for Question 19 is 7 marks)

18 The functions f and g are defined as

$$f(x) = \frac{x}{4x - 3} \quad \text{and} \quad g(x) = x - 5$$

(a) State which value of x must be excluded from any domain of the function f.

.....

(1)

(b) Find $fg(x)$.
Simplify your answer.

$fg(x) =$ .....

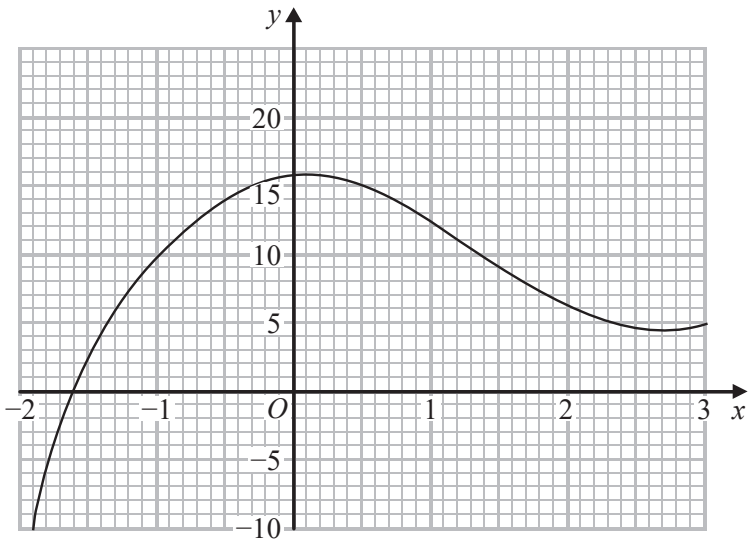
(2)

(c) Express the inverse function f^{-1} in the form $f^{-1}(x) = \ldots$

$f^{-1}(x) =$ .....

(3)

Part of the curve with equation $y = h(x)$ is shown on the grid.



(d) Find an estimate for the gradient of the curve at the point where $x = -0.5$
Show your working clearly.

.....

(3)

(Total for Question 18 is 9 marks)

16 The functions f and g are defined as

$$f: x \mapsto 5x - 7$$

$$g: x \mapsto \frac{5x}{x + 4}$$

(a) Write down the value of x that must be excluded from any domain of g

.....

(1)

(b) Find gf(2.6)

.....

(2)

(c) Solve $fg(x) = 2$

$x =$ .....

(3)

(d) Express the inverse function g^{-1} in the form $g^{-1}: x \mapsto ...$

$g^{-1}: x \mapsto$ .....

(3)

(Total for Question 16 is 9 marks)

17 The functions f and g are defined as

$f(x) = x^2 + 6$
$g(x) = x - 10$

(a) Find fg(3)

.....

(2)

(b) Solve the equation $fg(x) = f(x)$
Show clear algebraic working.

.....

(3)

The function h is defined as

$$h(x) = \frac{2x - 4}{x}$$

(c) State the value of x that cannot be included in the domain of h

.....

(1)

(d) Express the inverse function h^{-1} in the form $h^{-1}(x) = \ldots$

$h^{-1}(x) =$ .....

(3)

(Total for Question 17 is 9 marks)

MARK SCHEMES

official mark schemes, in the same order as the questions

International GCSE Maths A January 2020 – Paper 2HR Mark scheme

Apart from Questions 1b, 7, 16c, 19a, 21b, 24 and 25 where the mark scheme states otherwise, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.

Question	Working	Answer	Mark	Notes
1 (a)		5^{19}	1	B1
(b)			2	M1 A factor tree / division ladder of 3 or more factors (≠1), multiplying to 800, which must include 2 and 5. Condone 1 error when product ≠ 800
		$2\times2\times2\times2\times5\times5$		A1 dep on M1 oe eg $2^5 \times 5^2$
				Total 3 marks

2	$10 \times 5 + 30 \times 11 + 50 \times 8 + 70 \times 19 + 90 \times 9$ $(50 + 330 + 400 + 1330 + 810)$		3	M2 Correct products using midpoints (allowing one error) with intention to add. M1 for products using frequency and a consistent value within the range (allowing one error) with intention to add. or correct products using midpoints without addition (allow 1 error)
		2920		A1 N.B. 2920 ÷ 52 (=56.2..) scores M2A0
				Total 3 marks

3	$4x$ or $x - 7$		4	M1 Correct expression for B or C
	$x + 4x + x - 7 = 137$ oe			M1 Correct equation
	$x = 144 \div 6$ (=24) or $6x = 144$ or $6x - 144 = 0$			M1 Gathering up the x's and numbers Dep on previous M1
		17		A1
				Total 4 marks

International GCSE Maths

Apart from question 11c, 12, 13, 16, 19, 20 (where the mark scheme states otherwise) the correct answer, unless clearly obtained from an incorrect method, should be taken to imply a correct method.

Q		Working	Answer	Mark	Notes
1	a		g^{10}	1	B1
	b		k^7	1	B1
	c		$9c^2d^8$	2	B2 B1 for 2 out of 3 terms correct in a product
	d	$4x > 2 - 7$ oe			M1 accept as an equation or with wrong inequality sign.
			$x > -1.25$	2	A1 oe allow $(-1.25, (+)\infty)$ Note: award M1A0 for an answer on the answer line of −1.25 with no sign or the incorrect sign eg $x = -1.25$, $x < -1.25$
					Total 6 marks

2	a		$50 < L \leq 60$	1	B1	oe eg 50 - 60
	b	$25 \times 6 + 35 \times 26 + 45 \times 31 + 55 \times 40 + 65 \times 17$ $(150 + 910 + 1395 + 2200 + 1105)(= 5760)$			M2	For correct products using midpoints (allow one error) with intention to add. M1 for products using frequency and a consistent value within the range (allow one error) with intention to add or correct products using midpoints (allow one error) without addition
		"5760" ÷ "120"			M1	dep on M1
			48	4	A1	
						Total 5 marks

International GCSE Maths					
Apart from questions 18, 19, 22 and 24, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.					
Q		**Working**	**Answer**	**Mark**	**Notes**
1	(a)		a^{11}	1	B1
	(b)		w^{12}	1	B1
	(c)		$64x^{10}y^{6}$	2	B2 if not B2 then award B1 for 2 correct parts as part of a product eg $kx^{10}y^{6}$ where $k \neq 64$ **or** $64x^{k}y^{6}$ where $k \neq 10$ **or** $64x^{10}y^{k}$ where $k \neq 6$
	(d)	$c + 8v = t^3$		2	M1
			$t = \sqrt[3]{c+8v}$		A1 oe SCB1 for an answer of $t = \frac{c+8v}{3}$ oe
					Total 6 marks

2	196 ÷ (9 – 5) (= 49) oe		3	M1
	3 × "49"			M1
		147		A1 SCB1 for an answer from 34.5 – 34.6 **or** an answer of 42
				Total 3 marks

Question		Working	Answer	Mark	Notes
9	(a)		1	1	B1
	(b)		$27a^6b^{12}$	2	B2 (B1 for 2 of 3 parts in a product)
	(c)		$7x^2y^2(2y^2+3x)$	2	B2 B1 for a correct factorisation with at least 2 factors outside (eg $7x$, x^2, xy, etc) eg $7x(2xy^4+3x^2y^2)$ eg $x^2y^2(14y^2+21x)$ or for the correct common factor with just one mistake inside the bracket eg $7x^2y^2(2y+3x)$ which is missing the squared on the y term
	(d)	$y = mx + 4$ where $m \neq 0$ oe (eg $y = 2x + 4$) **or** $y = -2x + c$ or $y + 2x = c$ oe **or** $-2x + 4$ or $f(x) = -2x + 4$ oe		2	M1
		Correct answer scores full marks (unless from obvious incorrect working)	$y = -2x + 4$		A1 oe eg $y + 2x = 4$
					Total 7 marks

11	a		$4e^{10}$	2	B2	(B1 for $4e^{k}$ **or** ke^{10})
	b	A correct first step eg $\frac{y^{-4}}{2^{-4}}$ **or** $\left(\frac{y^4}{16}\right)^{-1}$ **or** $\frac{y^{-4}}{0.0625}$ **or** $\left(\frac{2}{y}\right)^4$ **or** $\frac{16}{y^4}$ **or** $\left(\frac{1}{y/2}\right)^4$ **or** $\frac{1}{\left(y/2\right)^4}$			M1	or for $16y^{p}$ where $p \neq -4$
			$16y^{-4}$	2	A1	
	c	eg $12\times\frac{4x-2}{3}-12\times\frac{5-3x}{4}=12\times6$ **or** eg $4(4x-2)-3(5-3x)=12\times6$ **or** eg $\frac{4(4x-2)}{12}-\frac{3(5-3x)}{12}(=6)$ **or** eg $\frac{4(4x-2)-3(5-3x)}{12}(=6)$ oe			M1	for clear intention to multiply **all** terms by 12 or a multiple of 12 **or** to express LHS as two fractions over 12 or a multiple of 12 or as a single fraction with a denominator of 12 or a multiple of 12 (if expanded numerator, allow one sign error)
		eg $16x-8-15+9x=6\times12$			M1	expanding brackets and multiplying both sides by denominator with no more than one sign error
		eg $16x + 9x = 72 + 8 + 15$			M1	for correct rearrangement of a correct equation with terms in x isolated
			3.8	4	A1	oe, award full marks for a correct answer if at least M1 scored
						Total 8 marks

Question		Working	Answer	Mark	Notes	
3	(a)		–5, 5, 5, –5	2	B2	All 4 correct values If not B2 then B1 for 2 or 3 correct values
	(b)		Fully correct curve	2	M1 A1	Plotting at least 6 points correctly from their table dep on B1 in part(a) Do not accept horizontal line at top of curve or straight line segments
						Total 4 marks

4	(a)	40 ÷ 16 × 12 oe	30	2	M1 A1	$40 \times \frac{12}{16}$ oe
	(b)	$525 \div 100^2$	0.0525 oe	2	M1 A1	$\frac{525}{100^2}$ Accept 5.25×10^{-2}
						Total 4 marks

5			$(x + 4)(x - 9)$	2	M1 A1	For $(x + a)(x + b)$ where $ab = -36$ and a and b are integers Ignore extension to roots $x = -4$ & 9
						Total 2 marks

6		P(mint =) 1 – (0.35 + 0.32 + 0.12) {= 0.21} P(strawberry or mint =) 0.32 + "0.21"	0.53 oe	3	M1 M1 A1	Or a correct equation summing to 1 Dep Allow 0.53/1
						Total 3 marks

7		55 ÷ (6 + 3 + 2) {= 5} (6 x "5") – (2 x "5")	20	3	M1 M1 A1	Or $\frac{6}{11}$ x 55 (= 30) or $\frac{2}{11}$ x 55 (= 10) Or M2 for Won = 30 and Lost = 10 (can be seen in a ratio 30 : 15: 10)
						Total 3 marks

14	$(4x+1)(x-3)=4x^2-12x+x-3(=4x^2-11x-3)$ $(4x+1)(5x+6)=20x^2+24x+5x+6(=20x^2+29x+6)$ $(x-3)(5x+6)=5x^2+6x-15x-18(=5x^2-9x-18)$		3	M1 for multiplying 2 brackets with at least 3 out of 4 terms correct
	$(5x+6)(4x^2-11x-3)=20x^3-55x^2-15x+24x^2-66x-18$ $(x-3)(20x^2+29x+6)=20x^3+29x^2+6x-60x^2-87x-18$ $(4x+1)(5x^2-9x-18)=20x^3-36x^2-72x+5x^2-9x-18$			M1 (dep) for multiplying the product of the first 2 brackets (ft from the 1st stage) by the 3rd bracket, and getting at least 3 out of 6 or 4 out of 8 terms correct
		$20x^3-31x^2-81x-18$		A1
	Alternative			
	$20x^3+24x^2-60x^2+5x^2-15x+6x-72x-18$			B2 for at least 6 out of 8 terms correct (B1 for 4 or 5 out of 8 correct terms)
		$20x^3-31x^2-81x-18$		A1
				Total 3 marks

15		*BDF* = 70°	4	B1 may be marked on diagram
		Alternate segment theorem		B1 reason, the angle between a tangent and a chord is equal to the angle subtended in the alternate segment
		EFB = 180 – (70 + 40) = 70 opposite angles in a cyclic quadrilateral		B1 Angle *EFB* with reason, opposite angles in a cyclic quadrilateral sum to 180°
		CBF = *EFB* alternate angles therefore *EF* is parallel to *ABC*		B1 conclusion, alternate angles are equal
				Total 4 marks

13		$4x(3x + 1) = 12x^2 + 4x$ **or** $4x(2x - 3) = 8x^2 - 12x$ **or** $(3x + 1)(2x - 3) = 6x^2 - 9x + 2x - 3$ $(= 6x^2 - 7x - 3)$		3	M1	for expanding two of the three factors, allow one error
		$(12x^2 + 4x)(2x - 3) = 24x^3 - 36x^2 + 8x^2 - 12x$ oe $(8x^2 - 12x)(3x + 1) = 24x^3 + 8x^2 - 36x^2 - 12x$ oe $4x(6x^2 - 7x - 3) =$ eg $24x^3 - 28x^2$.... oe			M1	(dep)ft for expanding by the third factor, allow one error (some may do the expansion in one stage and will get to $24x^3 - 36x^2 + 8x^2 - 12x$ without firstly expanding two factors)
		Working required	$24x^3 - 28x^2 - 12x$		A1	dep on M1 isw correct factorisation eg $4(6x^3 - 7x^2 - 3x)$ $x(24x^2 - 28x - 12)$ $4x(6x^2 - 7x - 3)$ do not isw incorrect simplification eg $24x^3 - 28x^2 - 12x = 6x^3 - 7x^2 - 3x$ gets M2A0
						Total 3 marks

International GCSE Maths

Apart from Questions 6, 7, 13, and 18 (where the mark scheme states otherwise), the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.

Q		Working	Answer	Mark	Notes
1	(a)		e^6	1	B1 cao
	(b)	$x^2 - 3x + x - 3$		2	M1 for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs **or** for $x^2 - 2x \ldots$ **or** for $\ldots -2x - 3$
		Correct answer scores full marks (unless from obvious incorrect working)	$x^2 - 2x - 3$		A1
					Total 3 marks

2	$30^2 + h^2 = 52^2$ oe or $900 + h^2 = 2704$ $(h^2 =) 52^2 - 30^2 (= 1804)$ or $(h^2 =) 2704 - 900 (= 1804)$		3	M1 for applying Pythagoras theorem correctly
	$(h =) \sqrt{52^2 - 30^2}$ $(= \sqrt{1804})$ (= 42.47352..) or $(h =) \sqrt{2704 - 900}$ $(= \sqrt{1804})$ (= 42.47352..)			M1 for square rooting
	Correct answer scores full marks (unless from obvious incorrect working)	42.5		A1 awrt 42.5 or allow $2\sqrt{451}$
				Total 3 marks

13	$3x(2x-5)=6x^2-15x$ **or** $(2x-5)^2=4x^2-10x-10x+25$ **or** $(2x-5)^2=4x^2-20x+25$		3	M1 for multiplying $3x$ by $(2x-5)$ with **both** terms correct or for multiplying $(2x-5)$ by $(2x-5)$ with 3 out of 4 terms correct or for multiplying $(2x-5)$ by $(2x-5)$ and getting $4x^2-20x\ldots$ **or** $\ldots-20x+25$ (not for $4x^2+25$)
	$(6x^2-15x)(2x-5)=12x^3-30x^2-30x^2+75x$ oe **or** $(6x^2-15x)(2x-5)=12x^3-60x^2+75x$ oe **or** $3x(4x^2-10x-10x+25)=12x^3-30x^2-30x^2+75x$ oe **or** $3x(4x^2-20x+25)=12x^3-60x^2+75x$			M1ft (dep) for multiplying the product of $3x$ and $(2x-5)$ by $(2x-5)$ with 3 out of 4 terms correct or for multiplying the product of $3x$ and $(2x-5)$ by $(2x-5)$ and getting $12x^3-60x^2\ldots$ **or** $\ldots-60x^2+75x$ for multiplying the product of $(2x-5)$ and $(2x-5)$ by $3x$ with 3 out of 4 terms correct or for multiplying the product of $(2x-5)$ and $(2x-5)$ by $3x$ with 2 out of 3 terms correct or Expansion in one stage will lead to $12x^3-30x^2-30x^2+75x$ without firstly expanding two factors – award M2 for 3 out of 4 terms correct M1 for 2 out of 4 terms correct
	Working required	$12x^3-60x^2+75x$		A1 dep on M1
				Total 3 marks

13	eg (gradient =) $\frac{12--48}{-5-19}\left(=-2.5\right)$ oe		3	M1 for a method to find the gradient
	eg $12 = \text{“}-2.5\text{”} \times -5 + c$ oe $y - 12 = \text{“}-2.5\text{”}(x - -5)$ oe			M1 ft their gradient
	Correct answer scores full marks (unless from obvious incorrect working)	$y = -2.5x - 0.5$		A1 oe eg $y - 12 = -2.5(x + 5)$ **or** $2y + 5x + 1 = 0$
				Total 3 marks

14		$2(5g + 3)(5g - 3)$	3	B3 for $2(5g + 3)(5g - 3)$ B2 for $2(5g \pm 3)(5g \pm 3)$ oe eg $2(5g - 3)^2$ B1 for $2(25g^2 - 9)$ **or** $(10g + 6)(5g - 3)$ **or** $(5g + 3)(10g - 6)$ **or** $(5g + 3)(5g - 3)$
				Total 3 marks

5	eg 0.74 × 300 (= 222) **or** 1 − 0.74 (= 0.26) seen **or** $\frac{78}{300}$		2	M1	for a method to work out an estimate for the number of games Evie will win **or** the probability that Evie will lose **or** an answer of $\frac{78}{300}$
	Correct answer scores full marks (unless from obvious incorrect working)	78		A1	cao
					Total 2 marks

6	(a)		m^7	1	B1	
	(b)		8	1	B1	Allow k^8
	(c)		$9x^{12}y^{16}$	2	B2	B1 for a product in the form ax^py^q where 2 from a , p or q are correct eg $3x^{12}y^{16}$ (Allow $9x^{12}$ or $9y^{16}$ or $x^{12}y^{16}$ so as long as not added to any other terms)
						Total 4 marks

7	(a)		$4x^2 - 20x$	1	B1	or $-20x + 4x^2$
	(b)	$(y \pm 5)(y \pm 4)$ or $(5 \pm y)(4 \pm y)$ or $y(y-4)-5(y-4)$ or $y(y-5)-4(y-5)$		2	M1	for $(y \pm 5)(y \pm 4)$ **or** $(5 \pm y)(4 \pm y)$ **or** for $(y + a)(y + b)$ where $ab = 20$ or $a + b = -9$
		Correct answer scores full marks (unless from obvious incorrect working)	$(y - 5)(y - 4)$		A1	oe Allow any letter for y Accept $(5 - y)(4 - y)$
						Total 3 marks

Question	Working	Answer	Mark	Notes
16	$(2x+3)(x-5)=2x^2-10x+3x-15(=2x^2-7x-15)$ or $(2x+3)(x+4)=2x^2+8x+3x+12(=2x^2+11x+12)$ or $(x-5)(x+4)=x^2+4x-5x-20(=x^2-x-20)$ oe		3	M1 For a correct method to expand two brackets with at least 3 terms correct out of 4 terms (or 2 terms correct out of 3 terms) Do not award this mark for eg $2x^2-10x+3x-15+x^2+4x-5x-20$ or eg $2x^2-10x+3x-15+x+4$
	$(2x^2-7x-15)(x+4)=2x^3+8x^2-7x^2-28x-15x-60$ or $(2x^2+11x+12)(x-5)=2x^3-10x^2+11x^2-55x+12x-60$ or $(x^2-x-20)(2x+3)=2x^3+3x^2-2x^2-3x-40x-60$ oe			M1ft Ft dep on M1 and a quadratic for a correct method to multiply by the 3rd bracket – allow one further error
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$2x^3+x^2-43x-60$		A1 If no working shown then award B2 for 3 out of a maximum of 4 terms correct
	ALTERNATIVE			
	$2x^3+8x^2-10x^2-40x+3x^2+12x-15x-60$		3	M2 For a complete expansion with 8 terms present of which 4 are correct (M1 for 4 correct terms from any number of terms)
		$2x^3+x^2-43x-60$		A1
				Total 3 marks

15	$3x(2x-1)=6x^2-3x$ or $3x(5x+4)=15x^2+12x$ or $(2x-1)(5x+4)=10x^2+8x-5x-4$ $(10x^2+3x-4)$		3	M1	An expansion with only one error. Do not award this mark for $6x^2-3x+15x^2+12x$	M2 for 3 (out of a maximum of 4) of $30x^3+24x^2-15x^2-12x$
	$(6x^2-3x)(5x+4)=30x^3+24x^2-15x^2-12x$ $(15x^2+12x)(2x-1)=30x^3-15x^2+24x^2-12x$ $3x(10x^2+8x-5x-4)=30x^3+24x^2-15x^2-12x$ $3x(10x^2+3x-4)=30x^3+9x^2-12x$			M1	ft dep on M1 allow one further error	(M1 for 2 correct out of a maximum of 4)
	Correct answer scores full marks (unless from obvious incorrect working)	$30x^3+9x^2-12x$		A1	cao (terms may be in any order but must be simplified) dep on M1 accept $a = 30$, $b = 9$, $c = -12$ ISW correct factorisation eg $3(10x^3+3x^2-4x)$ Do not ISW incorrect simplification	
						Total 3 marks

Q	Working	Answer	Mark	Notes		
12	$3x(2x+5)=6x^2+15x$ or $3x(7x-4)=21x^2-12x$ or $(2x+5)(7x-4)=14x^2-8x+35x-20$ $(14x^2+27x-20)$		3	M1	An expansion with only one error. Do not award this mark for $6x^2 + 15x + 21x^2 - 12x$ or $(6x^2 + 15x)(21x^2 - 12x)$	M2 for 3 (out of a maximum of 4) of $42x^3+105x^2-24x^2-60x$
	$(6x^2+15x)(7x-4)=42x^3-24x^2+105x^2-60x$ $(21x^2-12x)(2x+5)=42x^3+105x^2-24x^2-60x$ $3x(14x^2-8x+35x-20)=42x^3-24x^2+105x^2-60x$ $3x(14x^2+27x-20)=42x^3+81x^2-60x$			M1	ft dep on M1 allow one further error	(M1 for 2 correct out of a maximum of 4)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$42x^3+81x^2-60x$		A1	cao (terms may be in any order but must be simplified) dep on M1 ISW correct factorisation eg $3(14x^3+27x^2-20x)$ Do not ISW incorrect simplification eg $14x^3+27x^2-20x$	
						Total 3 marks

International GCSE Maths					
Apart from questions 2, 7, 10, 11, 17, 18, 21b and 26 the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method					
Q		**Working**	**Answer**	**Mark**	**Notes**
1	(a)	$2y-4y+8-y^2$		2	M1 for 3 correct terms **or** for 4 correct terms ignoring signs **or** $...-2y-y^2$ **or** $8-2y-...$
			$8-2y-y^2$		A1 Any order but simplified
	(b)		$5b^3c(3b^2-7c^8)$	2	B2 fully correct **or** B1 for a correct partial factorisation with at least two terms outside the bracket eg $5b^3(3b^2c-7c^9)$ or $5c\,(3b^5-7b^3c^8)$ etc **or** the fully correct factor outside the bracket with a two term expression in terms of b and c inside the bracket eg $5b^3c(15b^2-c^8)$
					Total 4 marks

International GCSE Maths					
Apart from questions 16, 21, 23, 24 and 25 (where the mark scheme states otherwise) the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method					
Q		**Working**	**Answer**	**Mark**	**Notes**
1	(a)	$25 \pm \ldots\ldots$ **or** $\ldots\ldots - 12$ **or** $(-5)^2 - 4 \times 3$ or $(-5)^2 - 4(3)$ or $-5 \times -5 - 4 \times 3$ or $-5 \times -5 - 4(3)$		2	M1 for either 25 or –12 in the correct place **or** the correct substitution shown with brackets around –5
		Correct answer scores full marks (unless from obvious incorrect working)	13		A1 (M0A0 for −37 without any working)
	(b)	$x^2 + 5x - 7x - 35$		2	M1 for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs **or** for $x^2 - 2x \ldots$ **or** for $\ldots -2x - 35$
		Correct answer scores full marks (unless from obvious incorrect working)	$x^2 - 2x - 35$		A1 oe Ignore solutions/roots if correct expansion seen
					Total 4 marks

5	(a)		$5y^3(3y + 4u)$	2	B2	for $5y^3(3y + 4u)$
					(B1	for $5y(3y^3 + 4uy^2)$ **or** $5y^2(3y^2 + 4uy)$ **or** $y^2(15y^2 + 20uy)$ **or** $y^3(15y + 20u)$ **or** $5y^3(\ldots)$ where there is only one mistake in the brackets)
	(b)	$4\times(4-3x)=5-8x$ oe **or** $16-12x=5-8x$ oe **or** $4-3x=\frac{5}{4}-2x$ oe		3	M1	for removal of fraction in a correct equation
		e.g. $16-5=12x-8x$ **or** $11=4x$ oe **or** $4-\frac{5}{4}=3x-2x$			M1	for terms in x on one side **and** numbers on the other side in an equation, allow correct rearrangement of their equation in the form $ax + b = cx + d$
			2.75		A1	(dep on M1) oe e.g. $2\frac{3}{4}$ or $\frac{11}{4}$
						Total 5 marks

6	(a)		2.84×10^9	1	B1
	(b)		0.000 25	1	B1
					Total 2 marks

9	(a)		$5a^4c^3(5c^4d + 9a^5h)$	2	B2	If not B2 then award B1 for any **correct** factorisation with at least 2 of: the 5, a term in a, a term in c, outside the bracket eg $5ac(5a^3c^6d + 9a^8c^2h)$ **or** $a^2c(25a^2c^6d + 45a^7c^2h)$ (NB: not just a^4 etc as we want to know students have considered more than just one letter or the number) **or** the correct common factor **and** a 2 term expression inside the bracket eg $5a^4c^3(5c^4 + 9a^5)$ (this is missing d in first term and h in the second but the common factor is correct)
	(b)	$4x^2 + 10x + 10x + 25 = 4x^2 - 2x + 6x - 3$ $4x^2 + 20x + 25 = 4x^2 + 4x - 3$		3	M1	Correct expansion of $(2x + 5)^2$ **or** $(2x + 3)(2x - 1)$ **or** expansion of **both** sets of brackets with at least 3 of 4 terms correct in both (NB: if written as a 3 term quadratic (and not seen as 4 terms) then the middle term must be correct as it is equivalent to 2 correct terms) (eg (RHS) $4x^2 + 4x + 3$ has 1 error, $2x^2 + 4x - 3$ has 1 error, $4x^2 + 10x - 3$ has 2 errors)
		$10x + 10x - 6x + 2x = -3 - 25$ **or** $3 + 25 = -16x$ **or** $16x = -28$ oe			M1	ft if previous mark awarded. For terms in x on one side and number terms on the other side in a correct ft equation dependent on a linear equation
		Working not required, so correct answer scores full marks (unless from obvious incorrect working eg -1.75 oe from $2x^2 + 20x + 25 = 2x^2 + 4x - 3$ scores M2A0)	-1.75		A1	**or** $-1\frac{3}{4}$ **or** $-\frac{7}{4}$ **or** $-\frac{28}{16}$ **or** $-1\frac{12}{16}$ oe
						Total 5 marks

7	$220 \div 80$ (= 2.75 or $\frac{11}{4}$) oe			M1 for a method to find the time from B to C
	$72 \times \frac{50}{60}$ (= 60) oe			M1 for a method to find the distance from C to D Allow 0.83(333…) to 2 dp truncated or rounded
	$\frac{245+220+"60"}{2.5+"2.75"+\frac{50}{60}} \left(= \frac{525}{73\frac{1}{12}}\right)$ oe			M1 for a complete method to find the average speed for entire journey 0.83(333…) to 2 dp truncated or rounded 6.0(8333…) to 2 sf truncated or rounded
		86.3		A1 for 86.3 – 86.4
				Total 4 marks

8	(a)		50 000	1	B1
	(b)		6×10^{-5}	1	B1
	(c)	$2.5 \times 10^{512-700}$ **or** 2.5×10^{n} **or** 0.25×10^{-187} **or** $p \times 10^{-188}$ where $1 \leq p < 10$		2	M1
			2.5×10^{-188}		A1
					Total 4 marks

9	(a)		x^9	1	B1 cao
	(b)		$64y^6$	2	B2 for $64y^6$ (B1 for ky^6 where $k \neq 64$ **or** $64y^m$ where $m \neq 6$)
	(c)	$(n \pm 3)(n \pm 4)$		2	M1 for $(n \pm 3)(n \pm 4)$ or $(n + a)(n + b)$ where $ab = 12$ or $a + b = -7$ Condone use of a different letter to n
			$(n - 3)(n - 4)$		A1
					Total 5 marks

4	$7x + 3x + 8x = 360$ oe		4	M1	M2 for $7x = 140$
	$(x =)\ 360 \div 18\ (= 20)$			M1	(140 can be on diagram)
	$360 \div (180 - 7 \times$ "20") oe or $360 \div (180 -$ "140") $\frac{(n-2)\times 180}{n} = 7 \times$ "20" oe or $360 \div 40$			M1 for $360 \div$ exterior angle	
		9		A1	
				Total 4 marks	

5	(a)	$n^2 - 6n + 4n - 24$		2	M1 for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs **or** for $n^2 - 2n \ldots$ **or** for $\ldots - 2n - 24$
			$n^2 - 2n - 24$		A1 oe
	(b)	$8x - 12$ **or** $\frac{3}{4}x - \frac{5}{4}$ oe or $0.75x - 1.25$ oe		3	M1 for correct multiplication by 4 **or** separate fractions on the RHS
		$8x - 3x = -5 + 12$ oe or $5x = 7$ oe **or** $2x - \frac{3}{4}x = -\frac{5}{4} + 3$ or $2x - 0.75x = -1.25 - 3$ oe			M1 ft (dep on 4 terms) for terms in x on one side of equation and number terms on the other
			$\frac{7}{5}$		A1 oe dep on M1 1.4 or $1\frac{2}{5}$ oe
					Total 5 marks

8	(a)		$3c^2(6cd^2-7)$	2	B2	fully correct **or** B1 for a correct partial factorisation with at least two terms outside the bracket ie $3c(6c^2d^2-7c)$ or $c^2(18cd^2-21)$ **or** the fully correct factor outside the bracket with two terms inside the bracket and at most one mistake $3c^2(.....)$
	(b) (i)	eg $(y\pm6)(y\pm3)$ or $y(y+3)-6(y+3)$ or $y(y-6)+3(y-6)$		2	M1	or $(y+a)(y+b)$ where $ab=-18$ **or** $a+b=-3$ or factorisation which expands to give 2 out of 3 correct terms
		[allow use of x rather than y]	$(y-6)(y+3)$		A1	
	(ii)		6, −3	1	B1	ft must come from their factors in (b)(i)
						Total 5 marks

8(b) As we have always done, (ii) must ft from (i)
If they do nothing in (i) and then factorise and give the solutions in (ii) can we give marks retrospectively – yes, as long as nothing in (i) – this could gain M1A1B1 (correct factorisation and correct solutions) or M1A0B1 (factorisation worthy of the method mark, but not correct and ft solutions from incorrect factorisation) or M0A0B1 (incorrect factorisation that is worthy of no marks and then answers which ft from their incorrect factorisation)
What do we do if they give the incorrect factorisation in (i) and then start again in (ii), showing the correct factors and give the correct answers from their factorisation in (ii) as answers? Award M0A0 in (i) and then B1 in (ii)
What do we do if nothing is done in (i) and then we see they have used the quadratic formula and got the answers from this in (ii)? No marks at all M0A0B0
What do we do if the student has got the correct factorisation in (i) and the correct answers in (ii) but also has the quadratic formula shown in (ii)? We award M1A1B1 – assuming that the quadratic formula is a check
What if they factorise and solve in part (i) with nothing in (ii)
M1A1B1 if fully correct or M1A0B1(allowable factorisation) or M0A0B1 (ft from incorrect factorisation that is not allowable)
What if they factorise in (i) and give the correct answers for (ii) in (i) and then a different answer for the solution in (ii)

6	(a)	$m^2 - 8m + 5m - 40$		2	M1 for any 3 correct terms from 4 terms **or** for 4 out of 4 correct terms ignoring signs **or** for $m^2 - 3m \ldots$ **or** for $\ldots - 3m - 40$
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$m^2 - 3m - 40$		A1
	(b)	$9n - 12 = 5n + 6$ oe **or** $3n - 4 = \frac{5}{3}n + \frac{6}{3}$ oe		3	M1 for removal of fraction **and** multiplying out LHS **or** separating fraction (RHS) in an equation
		$9n - 5n = 12 + 6$ oe or $4n = 18$ or $-12 - 6 = 5n - 9n$ oe or $-4n = -18$ oe or $n = \frac{-18}{-4}$ **or** $3n - \frac{5}{3}n = \frac{6}{3} + 4$ oe			M1 ft (dep on 4 terms) correctly rearranging their 4 term equation for terms in n on one side of equation and number terms on the other
		Working required	$\frac{9}{2}$		A1 dep on M2 oe eg $\frac{18}{4}$ or 4.5 or $4\frac{1}{2}$
					Total 5 marks

8	(a)		a^{16}	1	B1	
	(b)		c^{18}	1	B1	
	(c)(i)			2	M1	for $(y \pm 3)(y \pm 7)$ **or** for $(y \pm a)(y \pm b)$ with $ab = 21$ or $a + b = -10$
		Correct answer scores full marks (unless from obvious incorrect working)	$(y-3)(y-7)$		A1	for correct factors
	(ii)		3, 7	1	B1	ft dep on factorising in the form $(y \pm p)(y \pm q)$
						Total 5 marks

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Values in quotation marks must come from a correct method previously seen unless clearly stated otherwise.					
Q		**Working**	**Answer**	**Mark**	**Notes**
1	(a)		$9c(2 - 5d)$	2	B2 for $9c(2 - 5d)$ or $-9c(5d - 2)$ (B1 for $9(2c - 5cd)$ or $c(18 - 45d)$ or $3c(6 - 15d)$ or $3(6c - 15cd)$ **or** $9c(p + qd)$ where p and q are non-zero integers **or** $(2 - 5d)$ as a factor)
	(b)	eg $5 - 2x = 18x - 24$ **or** $\frac{5}{6} - \frac{2}{6}x = 3x - 4$		3	M1 for removal of the fraction **and** correctly multiplying out RHS by 6 in an equation **or** separating fractions on the LHS in an equation
		$5 + 24 = 18x + 2x$ oe **or** $29 = 20x$ oe **or** $\frac{5}{6} + 4 = \frac{2}{6}x + 3x$ oe			M1ft dep on 4 terms for correctly rearranging their 4 term equation for terms in x on one side of the equation and number terms on the other
		Working required	1.45		A1 dep on M1 oe eg $\frac{29}{20}$ or $1\frac{9}{20}$
					Total 5 marks

13	(a)	$(2x \pm 5y)(2x \pm 5y)$ **or** $(2x)^2 - (5y)^2$		2	M1		
		Correct answer only scores full marks (unless from obviously incorrect working)	$(2x + 5y)(2x - 5y)$		A1		
	(b)	$4x(x + 3) = 4x^2 + 12x$ **or** $4x(2x - 5) = 8x^2 - 20x$ **or** $(x + 3)(2x - 5) = 2x^2 - 5x + 6x - 15$ $(= 2x^2 + x - 15)$		3	M1	An expansion with only one error Do **not** award this mark for $4x^2 + 12x + 8x^2 - 20x$	M2 for 3 terms (out of a maximum of 4 terms) from: $8x^3 - 20x^2 + 24x^2 - 60x$ If not M2, then M1 for 2 correct out of a maximum of 4
		$(4x^2 + 12x)(2x - 5) = 8x^3 - 20x^2 + 24x^2 - 60x$ **or** $(8x^2 - 20x)(x + 3) = 8x^3 + 24x^2 - 20x^2 - 60x$ **or** $4x(2x^2 - 5x + 6x - 15) = 8x^3 - 20x^2 + 24x^2 - 60x$ **or** $4x(2x^2 + x - 15) = 8x^3 + 4x^2 - 60x$			M1	ft dep on M1 allow one further error	
		Working required	$8x^3 + 4x^2 - 60x$		A1	cao dep on M1 Terms may be in any order but must be simplified ISW **correct** factorisation $8x^3 + 4x^2 - 60x$ must be seen previously to award 3 marks eg $4(2x^3 + x^2 - 15x)$ $x(8x^2 + 4x - 60)$ Do not ISW incorrect simplification or further incorrect work following $8x^3 + 4x^2 - 60x$ eg $8x^3 + 4x^2 - 60x = 2x^3 + x^2 - 15x$ gets M2A0	
							Total 5 marks

3	(a)		e^4	1	B1	
	(b)		y^{16}	1	B1	
	(c)	$x^2 + 9x - 2x - 18$		2	M1	for 3 correct terms **or** 4 correct terms ignoring signs **or** $x^2 + 7x + c$ **or** .... $+ 7x - 18$
			$x^2 + 7x - 18$		A1	
	(d)		$4cp^2(4c^3 + 5p)$	2	B2	if not B2 then award B1 for any correct factorisation with at least 2 factors outside the bracket eg $4cp(4c^3p + 5p^2)$, $cp^2(16c^3 + 20p)$, $2p(8pc^4 + 10cp^2)$ etc **or** the correct common factor **and** a 2 term expression with just one error
						Total 6 marks

4	(a)		9, 3, (−1), −3, (−3), −1, (3)	2	B2	If not B2 then award B1 for at least 2 correct values
	(b)			2	M1	dep on B1 ft from (a) for at least 5 points plotted correctly
			correct graph		A1	for the correct graph (clear intention to go through all the points and which must be curved at the bottom)
						Total 4 marks

18 (a)	$(x + 2)(2x + 3) = 2x^2 + 3x + 4x + 6$ $(2x + 3)(x – 7) = 2x^2 – 14x + 3x – 21$ $(x + 2)(x – 7) = x^2 – 7x + 2x – 14$		3	M1	For multiplying a pair of brackets and getting 3 out of 4 terms correct.
	$(2x^2+7x+6)(x–7) = 2x^3–14x^2+7x^2–49x+6x–42$ $(2x^2–11x–21)(x+2) = 2x^3+4x^2–11x^2–22x–21x–42$ $(x^2–5x–14)(2x+3) = 2x^3+3x^2–10x^2–15x–28x–42$			M1dep	For multiplying the product of the first 2 brackets (ft from the 1st stage) by the 3rd bracket, and getting at least 3 out of 6 or 4 out of 8 terms correct
		$2x^3 – 7x^2 – 43x – 42$		A1	Fully correct. isw extra work as long as correct e.g. $x(2x^2 – 7x – 43) – 42$
	Alternative (all in one method)				
	$(x + 2)(2x + 3)(x – 7) =$ $2x^3 – 14x^2 + 3x^2 – 21x + 4x^2 – 28x + 6x – 42$			M2 (M1)	For at least 6 out of 8 correct terms for 4 or 5 out of 8 correct terms
		$2x^3 – 7x^2 – 43x – 42$		A1	
(b)	$p^2(2m – y) = x + m$ $2p^2m – p^2y = x + m$		3	M1	Multiplying by denominator **and** expanding bracket
	e.g. $2p^2m – m = x + p^2y$ $m(2p^2 – 1) = x + p^2y$			M1	Collect terms in m **and** factorise in a correct equation
		$m = \frac{x + p^2y}{2p^2 – 1}$		A1	oe eg $m = \frac{–x – p^2y}{1 – 2p^2}$ must have $m =$

5	(a)	$6x^2 + 9x - 3x^2 - 5x$		2	M1	expansion with at least 3 correct terms (must see for example, $6x^2$ and not just $3x \times 2x$)(can assume that no sign in front of a number is a + if terms written in a list or table)
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$3x^2 + 4x$		A1	**or** $4x + 3x^2$ **or** $x(3x + 4)$ **or** $x(4 + 3x)$
	(b)	eg $p + d = at$ **or** $-at = -d - p$ **or** $\frac{p}{a} = \frac{at}{a} - \frac{d}{a}$ oe		2	M1	Correct first stage in rearrangement
		Working not required, so correct answer scores full marks	$t = \frac{p+d}{a}$		A1	oe eg $t = \frac{p}{a} + \frac{d}{a}$ **or** $t = \frac{-d-p}{-a}$ Must have "$t =$" either in working or on answer line
	(c)	$w^2 \times w^n = w^{10}$ **or** $w^5 \times w^n = w^{13}$ **or** $w^5 \times w^{n-3} = w^{10}$ **or** $\frac{w^{5+n}}{w^3} = w^{10}$ oe **or** $5 + n - 3 = 10$ **or** $2 + n = 10$ **or** $5 + n = 13$		2	M1	A correct first stage simplifying at least one index in a correct equation **or** a clearly correct subsequent stage showing correct use of a rule of indices eg $w^5 \times w^n = w^{30}$ **and** $w^n = w^{30-5}$ **or** a correct equation using indices only
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	8		A1	accept w^8 (trial and error gains full marks if correct and no marks if incorrect unless a rule of indices is clearly shown)
						Total 6 marks

13 (a)	$5x(x+2) = 5x^2 + 10x$ **or** $(x+2)(3x-4) = 3x^2 - 4x + 6x - 8 (= 3x^2 + 2x - 8)$ **or** $5x(3x-4) = 15x^2 - 20x$		3	M1	for a correct intention to multiply all 3 factors by starting to multiply 2 factors only, allow one error
	eg $[(5x^2 + 10x)(3x-4) =] 15x^3 - 20x^2 + 30x^2 - 40x$ **or** $[5x(3x^2 + 2x - 8) =] 15x^3 + 10x^2 - 40x$ **or** $[(x+2)(15x^2 - 20x) =] 15x^3 - 20x^2 + 30x^2 - 40x$			M1	(dep)ft for expanding by the third factor, allow one error (some may do the expansion in one stage and will get to $15x^3 - 20x^2 + 30x^2 - 40x$ without firstly expanding two factors, allow two errors)
		$15x^3 + 10x^2 - 40x$		A1	isw correct factorisation eg $5(3x^3 + 2x^2 - 8x)$ do not isw incorrect factorisation eg $15x^3 + 10x^2 - 40x = 3x^3 + 2x^2 - 8x$

(b)	$\left(\frac{2w^2}{y^5}\right)^{-3}$ or $\left(\frac{y^{20}}{16w^8}\right)^{\frac{3}{4}}$ or $\left(\frac{4096w^{24}}{y^{60}}\right)^{-\frac{1}{4}}$		3	M1 for one of fourth rooting or reciprocating or cubing
	$\left(\frac{8w^6}{y^{15}}\right)^{-1}$ or $\frac{2^{-3}w^{-6}}{y^{-15}}$ or $\frac{1}{8}\frac{w^{-6}}{y^{-15}}$ or $\left(\frac{y^5}{2w^2}\right)^3$ or $\left(\frac{y^{60}}{4096w^{24}}\right)^{\frac{1}{4}}$ or $\frac{0.125y^{15}}{w^6}$ or $\frac{0.125w^{-6}}{y^{-15}}$ or $\frac{0.125}{y^{-15}w^6}$ oe			M1 for two of fourth rooting or reciprocating or cubing
		$\frac{y^{15}}{8w^6}$		A1 allow $\frac{y^{15}}{8w^6}$ or $\frac{y^{15}w^{-6}}{8}$ or $0.125y^{15}w^{-6}$ or $\frac{1}{8}y^{15}w^{-6}$ or $\frac{w^{-6}}{8y^{-15}}$ or $\frac{1}{8y^{-15}w^6}$
	ALTERNATIVE			
			3	M2 for 2 correct terms (M1 for 1 correct term)
		$\frac{y^{15}}{8w^6}$		A1 allow $\frac{y^{15}}{8w^6}$ or $\frac{y^{15}w^{-6}}{8}$ or $0.125y^{15}w^{-6}$ or $\frac{1}{8}y^{15}w^{-6}$ or $\frac{w^{-6}}{8y^{-15}}$ or $\frac{1}{8y^{-15}w^6}$
				Total 6 marks

16	(a)	$(3x-1)(x+2)=3x^2+6x-x-2(=3x^2+5x-2)$ **or** $(3x-1)(3x+1)=9x^2+3x-3x-1(=9x^2-1)$ **or** $(x+2)(3x+1)=3x^2+x+6x+2(=3x^2+7x+2)$		3	M1	for a correct intention to multiply all 3 factors by multiplying 2 factors only, allow one error
		$[(3x^2+5x-2)(3x+1)=]\ 9x^3+15x^2-6x+3x^2+5x-2$ **or** $[(9x^2-1)(x+2)=]\ 9x^3+18x^2-x-2$ **or** $[(3x^2+7x+2)(3x-1)=]\ 9x^3+21x^2+6x-3x^2-7x-2$			M1	(dep)ft for expanding by the third factor, allow one error
			$9x^3+18x^2-x-2$		A1	
		ALTERNATIVE				
		$9x^3+3x^2+18x^2+6x-3x^2-x-6x-2$		3	M2	for a complete expansion with 8 terms present, at least 4 of which must be correct
			$9x^3+18x^2-x-2$		A1	
	(b)	$\left(\frac{8xy^2}{2x^5}\right)^2$ **or** $\left(\frac{x^4}{4y^2}\right)^{-2}$ **or** $\left(\frac{4x^{10}}{64x^2y^4}\right)^{-1}$		3	M1	for one of reciprocating or simplifying or squaring
		$\left(\frac{4y^2}{x^4}\right)^2$ **or** $\left(\frac{x^8}{16y^4}\right)^{-1}$ **or** $\frac{64x^2y^4}{4x^{10}}$ **or** $\frac{\frac{1}{4}x^{-10}}{\frac{1}{64}x^{-2}y^{-4}}$			M1	for two of reciprocating or simplifying or squaring
			$\frac{16y^4}{x^8}$		A1	accept $16y^4x^{-8}$ or $\frac{16}{y^{-4}x^8}$ or $\frac{16x^{-8}}{y^{-4}}$ oe
		ALTERNATIVE				
				3	M2	for 2 correct terms (M1 for 1 correct term)
			$\frac{16y^4}{x^8}$		A1	accept $16y^4x^{-8}$ or $\frac{16}{y^{-4}x^8}$ or $\frac{16x^{-8}}{y^{-4}}$ oe
						Total 6 marks

12	(a)		2	1	B1
	(b)		$8a^3$	2	B2 for $8a^3$ If not B2 then B1 for $8a^k$ where $k \neq 3$ or ka^3 where $k \neq 8$
	(c)	$5x(3x + 4) = 15x^2 + 20x$ **or** $5x(2x - 1) = 10x^2 - 5x$ **or** $(3x + 4)(2x - 1) = 6x^2 - 3x + 8x - 4$ $(= 6x^2 + 5x - 4)$		3	M1 for a correct intention to multiply all 3 factors by multiplying 2 factors only, allow one error
		$(15x^2 + 20x)(2x - 1) = 30x^3 - 15x^2 + 40x^2 - 20x$ oe $(10x^2 - 5x)(3x + 4) = 30x^3 + 40x^2 - 15x^2 - 20x$ oe $5x(6x^2 + 5x - 4) = 30x^3 + 25x^2 - 20x$ oe			M1 (dep)ft for expanding by the third factor, allow one error (some may do the expansion in one stage and will get to $30x^3 - 15x^2 + 40x^2 - 20x$ without firstly expanding two factors – this gains M2, allow one error)
		Correct answer scores full marks (unless from obvious incorrect working)	$30x^3 + 25x^2 - 20x$		A1 isw correct factorisation ($30x^3 + 25x^2 - 20x$ must be seen previously to award 3 marks) eg $5(6x^3 + 5x^2 - 4x)$ $x(30x^2 + 25x - 20)$ $5x(6x^2 + 5x - 4)$ do not isw incorrect simplification eg $30x^3 + 25x^2 - 20x = 6x^3 + 5x^2 - 4x$ gets M2A0
					Total 6 marks

International GCSE Maths					
Apart from questions 2b, 10, 13b, 19 where the mark scheme states otherwise the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method					
Q		**Working**	**Answer**	**Mark**	**Notes**
1	(a)		5 7 9 11 13 15	1	B1 all numbers must be present with no repeats. Numbers can be in any order
	(b)		5 15	1	B1
	(c)		6 8 12 14 16	1	B1
					Total 3 marks

2	(a)		$6p(2q-3)$	2	B2 If not B2 then award B1 for any **correct** partial factorisation with 2 factors taken out ($2p$ or $3p$ or 6 (2×3)) outside of the bracket $2p(6q-9)$ or $3p(4q-6)$ or $6(2pq-3p)$ or allow $6p$ and one error inside the bracket eg $6p(2q-a)$ or $6p(b-3)$ oe eg $6p(2q+3)$		
	(b)	$y+(3y+7)+(2y-5)$ (= $6y+2$) oe or $56-7+5$ (= 54)		4	M1	M2 for $y+(3y+7)+(2y-5)=56$ oe or $6y=54$ oe	M3 for $(56-7+5)\div6$ (= 9) or $54\div6$ (= 9)
		$y+(3y+7)+(2y-5)=56$ or "$6y+2$" = 56 oe eg $6y=54$			M1		
		$(y=)\frac{56-2}{6}(=9)$ oe			M1 for a correct method to find the value of y or the correct value of y		
			13		A1 (or for 9 (gold), 34 (silver) and 13 (zinc) seen) dep on sight of ($y=$) 9 SCB2 for 16.6 (17 if rounded 16.6 seen) (if no other marks awarded) SCB1 for $5y+2=56$ oe (if no other marks awarded)		
					Total 6 marks		

14 (a)	$(3x + 1)(2 – x) = 6x – 3x^2 + 2 – x$ $(= –3x^2 + 5x + 2)$ **or** $(2 – x)(4 + x) = 8 + 2x – 4x – x^2$ $(= –x^2 – 2x + 8)$ **or** $(3x + 1)(4 + x) = 12x + 3x^2 + 4 + x$ $(= 3x^2 + 13x + 4)$		3	M1	for a correct method to expand two brackets with at least 3 terms correct out of 4 terms (or 2 terms correct out of 3 terms). Do not award this mark for eg $6x – 3x^2 + 2 – x + 8 + 2x – 4x – x^2$ or $6x – 3x^2 + 2 – x + 4 + x$
	$(–3x^2 + 5x + 2)(4 + x) = –12x^2 – 3x^3 + 20x + 5x^2 + 8 + 2x$ **or** $(–x^2 – 2x + 8)(3x + 1) = –3x^3 – x^2 – 6x^2 – 2x + 24x + 8$ **or** $(3x^2 + 13x + 4)(2 – x) = 6x^2 – 3x^3 + 26x – 13x^2 + 8 – 4x$			M1	ft dep on M1 **and** a quadratic for a correct method to multiply by the 3rd bracket – allow one further error
	Correct answer scores full marks (unless from obvious incorrect working)	$–3x^3 – 7x^2 + 22x + 8$		A1	oe but must be simplified eg $22x – 3x^3 – 7x^2 + 8$ if no working shown then award B2 for 3 out of a maximum of 4 terms correct
	ALTERNATIVE				
ALT (a)	$24x + 6x^2 – 12x^2 – 3x^3 + 8 + 2x – 4x – x^2$ oe		3	M2 (M1	for a complete expansion with 8 terms present of which at least 4 are correct for at least 4 correct terms from any number of terms)
		$–3x^3 – 7x^2 + 22x + 8$		A1	oe but must be simplified eg $22x – 3x^3 – 7x^2 + 8$ if no working shown then award B2 for 3 out of a maximum of 4 terms correct

(b)	$\left(\frac{1}{a^6b^4}\right)^{-\frac{1}{2}}$ **or** $\left(a^{-6}b^{-4}\right)^{-\frac{1}{2}}$ **or** $\left(\frac{a^{1.5}b^{0.5}}{a^{4.5}b^{2.5}}\right)^{-1}$ **or** $\left(\frac{a^9b^5}{a^3b}\right)^{\frac{1}{2}}$ **or** $\left(\frac{a^{-3}b^{-1}}{a^{-9}b^{-5}}\right)^{\frac{1}{2}}$ oe		3	M1	for simplifying the a and the b term in the fraction **or** for applying the power ½ to at least 3 out of 4 of a^3, b, a^9, b^5 **or** for applying the negative power to at least 3 out of 4 of a^3, b, a^9, b^5
	$\left(\frac{1}{a^3b^2}\right)^{-1}$ **or** $\left(a^{-3}b^{-2}\right)^{-1}$ **or** $\frac{a^{4.5}b^{2.5}}{a^{1.5}b^{0.5}}$ **or** $\left(a^6b^4\right)^{\frac{1}{2}}$ **or** $\left(\frac{a^{-1.5}b^{-0.5}}{a^{-4.5}b^{-2.5}}\right)$ oe			M1	for two of simplifying the a and the b term in the fraction **or** for applying the power ½ to at least 3 out of 4 of a^3, b, a^9, b^5 **or** for applying the negative power to at least 3 out of 4 of a^3, b, a^9, b^5
	Correct answer scores full marks (unless from obvious incorrect working)	a^3b^2		A1	accept $\frac{1}{a^{-3}b^{-2}}$
					Total 6 marks

3	(a)		p^{15}	1	B1 cao
	(b)	$8n^2+6n+n^2-4n$		2	M1 for expanding with at least 3 correct terms (must see for example, $8n^2$ and not just $2n \times 4n$)(can assume that no sign in front of a number is a + if terms written in a list or table)
			$9n^2+2n$		A1 oe $2n+9n^2$ or $n(9n+2)$ or $n(2+9n)$
	(c)	eg $2x+5=12-3x$ or $\frac{2}{3}x+\frac{5}{3}=4-x$ oe		3	M1 for removal of fraction **and** multiplying out RHS correctly by 3 **or** separating fraction (LHS) in an equation
		eg $2x+3x=12-5$ or $5x=7$ or $5-12=-3x-2x$ or $-7=-5x$ or $\frac{2}{3}x+x=4-\frac{5}{3}$ oe or $\frac{5}{3}x=\frac{7}{3}$ oe			M1 ft (dep on 4 terms) correctly rearranging their 4 term equation for terms in x on one side of equation and number terms on the other
		Working required	$\frac{7}{5}$		A1 oe eg 1.4 or $1\frac{2}{5}$ dep on M2
					Total 6 marks

Apart from Questions 1(c), 5, 6(c), 20 and 21 (where the mark scheme states otherwise), the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.

Question		Working	Answer	Mark	Notes
1	(a)		$2p(2+3q)$	2	B2 If not B2 then award B1 for $2(2p+3pq)$ **or** $p(4+6q)$ **or** $2p$(a two term expression) **or** $x(2+3q)$ where $x \neq 2p$
	(b)	$e^2+3e-5e-15$			M1 for 3 correct terms **or** for 4 correct terms ignoring signs **or** e^2-2e+k for non-zero k **or** $\ldots-2e-15$
			$e^2-2e-15$	2	A1
	(c)	$5y=2y+1$ **or** $y=\frac{2y}{5}+\frac{1}{5}$			M1 for a correct first step
		E.g. $5y-2y=1$ **or** $3y=1$ **or** $3y-1=0$ **or** $\frac{3y}{5}=\frac{1}{5}$			M1 for collecting terms in y in a correct equation
			$\frac{1}{3}$ oe	3	A1 dep on at least M1 for $\frac{1}{3}$ oe **e**.g. $0.\dot{3}$, 0.3333…

13	$\frac{1}{3}+\frac{1}{5}$ (= $\frac{8}{15}$) or 0.53... or 53.3.....% or 53%	900	4	M1
	1− "$\frac{8}{15}$" (= $\frac{7}{15}$) or 0.46..... or 0.47 or 46.6...% or 47%			M1
	420 ÷ "$\frac{7}{15}$" (= 900) oe			M1
				A1
				Total 4 marks

14	(a)		$8e^6f^9$	2	B2 B1 for 2 correct terms in a product of 3 terms
	(b)	$3x^2+9xy-4yx-12y^2$	$3x^2+5xy-12y^2$	2	M1 M1 for 3 correct terms out of 4 **or** for 4 correct terms ignoring signs **or** for $3x^2+5xy+c$ for any non zero value of c **or** for $d+5xy-12y^2$ for any non zero value of d
					A1
	(c)	$a^{\frac{1}{2}}\times a=a^{\frac{3}{2}}$ or $\frac{a}{a^{-2}}=a^3$ or $\frac{a^{\frac{1}{2}}}{a^{-2}}=a^{\frac{5}{2}}$	$\frac{7}{2}$	2	M1 for one correct step
					A1 oe
	(d)	$\frac{2^n-1}{(2^n-1)(2^n+1)}$	$\frac{1}{2^n+1}$	2	M1 for $(2^n-1)(2^n+1)$
					A1
					Total 8 marks

Question		Working	Answer	Mark	Notes	
15	(a)		$81x^8y^{20}$	2	B2	(B1 two terms correct in a product of 3 terms)
	(b)	$4n(n^2+2n-15)$ **or** $(4n^2-12n)(n+5)$ **or** $(4n^2+20n)(n-3)$	$4n^3+8n^2-60n$	2	M1	For a correct partial expansion (may be unsimplified e.g $4n(n^2+5n-3n-15)$)
					A1	
	(c)		$(2c-3d)(2c+3d)$	1	B1	
	(d)	$\frac{(4-x)(3-x)}{x(4-x)}$ or $\frac{(x-4)(x-3)}{x(4-x)}$	$\frac{3-x}{x}$	3	M1	for either numerator or denominator factorised correctly
					M1	for both numerator and denominator factorised correctly
					A1	oe

12	(a)		$(2x - 3)(x - 2)$	2	B2	or $(3 - 2x)(2 - x)$ (B1 for $(2x + a)(x + b)$ where $ab = 6$ or $2b + a = -7$ eg $(2x + 3)(x + 2)$, $(2x - 5)(x - 1)$), etc or for
	(b)	$4m + 9 = 3(7 - 2m)$		4	M1	for removing fraction
		$4m + 9 = 21 - 6m$			M1	for correct expansion of bracket in a correct equation
		$4m + 6m = 21 - 9$ **or** $10m = 12$ **or** $-21 + 9 = -6m - 4m$ **or** $-10m = -12$			M1	for a correct equation with m terms isolated on one side ft their equation if first M1 awarded
			$\frac{12}{10}$ oe		A1	dep on at least M2 [SC: B2 for an answer of $m = 2$ with working shown (from $4m + 9 = 21 - 2m$ oe) **or** $m = -0.2$oe with working shown (from $4m + 9 = 7 - 6m$ oe)]
		Alternative				
		$\frac{4}{3}m + 3 = 7 - 2m$		4	M1	Division of each term on LHS by 3
		$\frac{4}{3}m + 2m = 7 - 3$ oe			M1	for a correct equation with m terms isolated on one side ft their equation if first M1 awarded

		$10m = 3 \times 4$ oe			M1	For removing fraction in a fully correct equation
			$\frac{12}{10}$ oe		A1	dep on at least M2
12 contd	(c)	$\frac{y^{\frac{1}{4}}}{y}$ **or** $\sqrt[4]{y} = y^{\frac{1}{4}}$ **or** $y^{\frac{1}{4}-1}$		2	M1	or b = $-\frac{3}{4}$
			$y^{-\frac{3}{4}}$		A1	
						Total 8 marks

3	a	e.g. $d - g = 2ac$ $\frac{d}{2c} = \frac{g}{2c} + a$			M1	for a correct first step e.g. subtract g from both sides **OR** divide all terms by 2 **OR** divide all terms by c **OR** divide all terms by $2c$
			$a = \frac{d-g}{2c}$	2	A1	oe
	b		$3f(3e - 4)$	2	B2	(B1 for $3(3ef - 4f)$ or $f(9e - 12)$ or $3f(ke - 4)$ or $3f(3e - m)$ where $k \neq 0$ and $m \neq 0$)
	c	$x^2 - 5x + 2x - 10$			M1	for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs **or** $x^2 - 3x\ldots$ **or** for $\ldots -3x - 10$
			$x^2 - 3x - 10$	2	A1	
	d	$\frac{n^{11}}{n^5}$ **OR** $n^{-1} \times n^7$ **OR** $n^4 \times n^2$ **OR** $n^4 \times n^7 \times n^{-5}$ **OR** $n^{"11"} \div n^5 = n^{("11"-5)}$			M1	for simplifying two terms
			n^6	2	A1	
						Total 8 marks

4	ai		b, l, u, e, g, r, y	1	B1	No incorrect or repeats
	aii		w, h, i, t	1	B1	No incorrect or repeats
	b		No with reason	1	B1	eg 'e is in all three sets' **OR** 'all three sets share a member' **OR** $B \cap G \cap W = (\{\})e(\{\})$
						Total 3 marks

7	(a)	$20 - 5x$ $(= 7 - 3x)$		3	M1	for expansion of bracket
		E.g. $20 - 7 = -3x + 5x$ or $-5x + 3x = 7 - 20$			M1	ft from a 4-term equation for a correct process of isolating terms in x on one side of the equation and numbers on the other side
			6.5 oe		A1	dep on M1 awarded and from correct working
	(b)			2	M1	for any **correct** partial factorisation with at least 2 factors, one of which must be a letter **or** the correct common factor with no more than 1 error inside the bracket
			$8m^2g^3(2m + 3g^2)$		A1	
	(c)(i)	$(y \pm 6)(y \pm 8)$		2	M1	
			$(y - 8)(y + 6)$		A1	
	(c)(ii)		8, −6	1	B1	**must** ft from their factors in (c)(i)
						Total 8 marks

International GCSE Maths					
Apart from Q9, 10, 12, 17b, 18, 19a & 21 (where the mark scheme states otherwise) the correct answer, unless obtained from an incorrect method, should be taken to imply a correct method.					
Q	**Working**	**Answer**	**Mark**	**Notes**	
1 (a)	$5 \times (-2)^2 - (-2)^3$ (= 20 – –8)		2	M1	for correct expression or at least one of 20 or 5×4 or – – 8 or (+) 8
		28		A1	
(b)		$2p(4p - 1)$	2	B2	B1 for $p(8p - 2)$ or $2(4p^2 - p)$ or $2p(4p - 1)$ with two terms inside the bracket with one term correct.
(c)		$12t^2 - 8t$	2	B2	B1 for $12t^2$ or $-8t$
(d)	$5x^2 + 20x - 2x - 8$		2	M1	for 4 correct terms (ignoring signs) or 3 correct terms with correct signs. or $5x^2 + 18x + ...$ or … + $18x - 8$
		$5x^2 + 18x - 8$		A1	
				Total 8 marks	

2	$0.5 \times \pi \times 6^2$ (= 56.54…) **or** 12×6 (= 72) **or** $\pi \times 6^2$ oe		3	M1	
	"72" – "56.54…"			M1	dep M1 for a complete method
		15.5		A1	15.4 to 15.5
				Total 3 marks	

6	(a)	eg $10p = 3p - 5$ **or** $p = \frac{3p}{10} - \frac{5}{10}$ oe eg $p = 0.3p - 0.5$		3	M1	for a correct first step – multiplying both sides by 10 correctly or writing the RHS as 2 terms each over 10 or each term as a decimal [must be in a correct equation]
		eg $10p - 3p = -5$ **or** $7p = -5$ **or** $p - \frac{3p}{10} = -\frac{5}{10}$ **or** $0.7p = -0.5$			M1ft	(ft a 3 term equation) for collecting terms in p on one side and number the other
			$-\frac{5}{7}$		A1	(dep on at least M1) for $-\frac{5}{7}$ oe, accept −0.71(4...) allow –0.7 if you have seen $-\frac{5}{7}$ or $-5 \div 7$
	(b)		1	1	B1	
	(c)		$\frac{y^2}{2x}$	2	B2	for $\frac{y^2}{2x}$ oe eg $\frac{0.5y^2}{x}$, $0.5y^2x^{-1}$, $\frac{y^2x^{-1}}{2}$, $\frac{1}{2xy^{-2}}$ oe If not B2, award B1 for 2 of number, x, y correct eg $\frac{ky^2}{x}$ where $k \neq \frac{1}{2}$ **or** $\frac{y^2}{2x^m}$ where $m \neq 1$ **or** $0.5y^2$ **or** $\frac{y^p}{2x}$ where $p \neq 2$) **oe** [one term can be missing with 2 correct for B1]

(d)		$5cd^2(2c^2+3d^2)$	2	B2	for $5cd^2(2c^2+3d^2)$ B1 for a correct partial factorisation eg $5(2c^3d^2+3cd^4)$ or $cd^2(10c^2+15d^2)$ **or** $5d^2(2c^3+3cd^2)$ **or** $5c(2c^2d^2+3d^4)$ $5cd(2c^2d+3d^3)$ etc **or** $5cd^2$(a 2 term expression with just one error)
					Total 8 marks

7	$(4^n=)(2^2)^n$ **or** $(4^n=)2^{2n}$ oe eg $2^k\div 2^{2n}=2^x$ **or** $2^k=4^{\frac{1}{2}k}$ **and** $2^x=4^{\frac{1}{2}x}$ oe eg $\frac{4^{\frac{1}{2}k}}{4^n}=4^{\frac{1}{2}x}$		2	M1	for writing 4^n as $\left(2^2\right)^n$ or 2^{2n} or for writing each term in terms of 4 ie $2^k=4^{\frac{1}{2}k}$ **and** $2^x=4^{\frac{1}{2}x}$ If these things are seen in working, award this mark even if followed by incorrect working – if not a choice of methods
		$k-2n$		A1	allow 2^{k-2n}
					Total 2 marks

6	(a)		$8c^{12}d^{21}$	2	B2	(B1 for 2 correct terms as part of a product)
	(b)		5	1	B1	
	(c)		$4a^2b(4b^2 + 5a)$	2	B2	B1 for any correct partial factorisation with at least 2 factors, **or** the correct common factor with no more than 1 error inside the bracket
	(d)(i)	$(x \pm 11)(x \pm 2)$		2	M1	for $(x \pm 11)(x \pm 2)$ **or** for $(x + a)(x + b)$ with $ab = -22$ or $a + b = 9$
		Correct answer scores full marks (unless from obvious incorrect working)	$(x + 11)(x - 2)$		A1	for correct factors
	(ii)		$-11, 2$	1	B1ft	ft dep on factorising in the form $(x + p)(x + q)$
						Total 8 marks

7		$x \leq 1$	4	B1	accept $x < 1$
		$y \geq -2$		B1	accept $y > -2$
	$y = 2x + c$ or $y = mx + 4$			M1	allow = or < or ≤ or > or ≥
	Correct answer scores full marks (unless from obvious incorrect working)	$y \leq 2x + 4$		A1	oe, allow $y < 2x + 4$ oe SCB2 for the correct inequalities with all inequality signs the wrong way round
					Total 4 marks

4	(a)(i)		1, 2, 3, 5, 6, 7	1	B1	in any order with no repeats
	(a)(ii)		4, 5, 7, 8, 9, 10	1	B1	in any order with no repeats
	(b)	eg 1. 2 (**or** 3 **or** 2 and 3) is in both sets oe 2. *A* and *B* have 2 (**or** 3 **or** 2 and 3) oe 3. 2 (**or** 3 **or** 2 and 3) is common oe 4. 2 (**or** 3 **or** 2 and 3) is in the intersection oe 5. $A \cap B = \{2,3\}$ oe or $A \cap B = \{2\}$ oe or $A \cap B = \{3\}$ oe 6. They share 2 (**or** 3 **or** 2 and 3)oe 7. As 2 and/or 3 are factors of 6 and also prime numbers oe Allow sector for set This is not an exhaustive list	2 (**or** 3 **or** 2 and 3) is a member of *A* and *B*	1	B1	for identifying the element 2 **or** 3 **or** 2 and 3 with a correct explanation to show they know the meaning of intersection and empty set If students mention a number that is common, it must be correct
	(c)		1, 5, 6, 7	2	B2 (B1	for 1, 5, 6, 7 for three correct values with no more than one incorrect or for four correct values with no more than one incorrect)
						Total 5 marks

Question		Working	Answer	Mark	Notes
3	a		y^{14}	1	B1
	b		$16m^{12}$	2	B2 if not B2 then B1 for am^{12} **or** $16m^{b}$ **or** $2^{4}m^{12}$ $b \neq 0, 12$ $a \neq 1, 16$
	c	$5x + 15 = 3x - 4$ **or** $x + 3 = \frac{3x}{5} - \frac{4}{5}$ e.g. $5x - 3x = -4 - 15$	$-\frac{19}{2}$ oe	3	M1 for removing bracket in a correct equation or dividing all terms by 5 in a correct equation M1 ft from $ax + b = cx + d$ for correctly isolating terms in x on one side of equation and constant terms on the other side A1 dep on at least M1
	d (i)		$(x - 4)(x + 6)$	2	M1 for $(x + a)(x + b)$ where either $ab = -24$ **or** $a + b = +2$ e.g $(x - 6)(x + 4)$ A1
	(ii)		4, − 6	1	B1 cao **or** ft from any $(x + p)(x + q)$
4	a (i)		1, 2, 3, 4, 6, 12	1	B1 cao
	(ii)		1, 3, 5, 7, 9, 10, 11	1	B1 cao
	b		Yes with reason	1	B1 e.g. no numbers in both A and C **or** A and C do not intersect **or** A and C do not overlap **or** A and C are mutually exclusive
	c		$\frac{10}{12}$ oe	2	M1 for $12 - 2$ (=10) **or** $\frac{a}{12}$ with $a < 12$ **or** 10 and 12 used with incorrect notation E.g. 10 : 12 A1 for $\frac{10}{12}$ oe **or** 0.83(3…) **or** 83(.3..)%

Question	Working	Answer	Mark	Notes
3	eg (6.3 × 1000) ÷ 210 (= 30)		4	M1 for a method to find the number of candles, could work in grams or kg
	$\frac{2}{5}\times"30"\times 13\,(=156)$			M1 for a method to find money made from the $13 candles
	$\left(1-\frac{2}{5}\right)\times"30"\times 0.8\times 13\,(=187.20)$			M1 for a method to find money made from the reduced candles
		343.2(0)		A1
				Total 4 marks

4	(a)	$3c - 21 + 6c + 8$	$9c - 13$	2	M1 For 3 or 4 terms correct A1
	(b)	$x^2 - 2x + 7x - 14$	$x^2 + 5x - 14$	2	M1 For 3 correct terms or for 4 correct terms ignoring signs or for $x^2 + 5x + k$ for any non-zero value of k or for .... + 5x − 14 A1
	(c)		$7y(4y - 3)$	2	B2 B1 for $y(28y - 21)$ or $7(4y^2 - 3y)$ or $7y(4y + k)$ or $7y(ay - 3)$
	(d)	eg $7x - 2 = 4(3x + 1)$ oe		3	M1 correct first step
		$7x - 12x = 4 + 2$ oe or $-2 - 4 = 12x - 7x$ oe			M1 for rearranging the x terms on one side and the numerical terms on the other. ft rearranging their expansion $ax + b = cx + d$ eg $7x - 2 = 12x + 4$
			$-\frac{6}{5}$		A1 oe, dep on M1
					Total 9 marks

7	(a)	$m^2 - 8m + 5m - 40$		2	M1 for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs for $m^2 - 3m \ldots$ **or** for $\ldots - 3m - 40$
			$m^2 - 3m - 40$		A1
	(b)		$5y(1 + 4y)$	2	B2 If not B2 then award B1 for $5(y + 4y^2)$ **or** $y(5 + 20y)$ **or** $5y(a + 4y)$ where a is an integer and $a \neq 0$ **or** $5y(1 + by)$ where b is an integer and $b \neq 0$
	(c)		1	1	B1
	(d)	E.g. $6x - 15$ or $12x - 30$ oe		4	M1 for expansion of a correct bracket
		$2 \times 3(2x - 5) = 9 - x$ oe **or** $2(\text{'}6x - 15\text{'}) = 9 - x$ oe **or** $3(2x - 5) = \frac{9}{2} - \frac{x}{2}$ oe			M1 for removal of fraction or separating fraction (RHS) in an equation
		$12x + x = 9 + 30$ oe **or** $6x + \frac{x}{2} = \frac{9}{2} + 15$ oe			M1 ft (dep on 4 terms) for terms in x on one side of equation; number terms on the other
			3		A1 dep on at least M2 awarded
					Total 9 marks

7	(a)		g^7	1	B1	
	(b)		$5k^5+20k^2$	2	B2	for $5k^5+20k^2$
					(B1	for $5k^5$ or $20k^2$)
	(c) (i)	$(x \pm 7)(x \pm 9)$		2	M1	for $(x \pm 7)(x \pm 9)$ **or** for $(x + a)(x + b)$ where $ab = -63$ **or** $a + b = -2$ where a and b are integers
		Correct answer scores full marks (unless from obvious incorrect working)	$(x + 7)(x – 9)$		A1	for correct factors
	(ii)		–7, 9	1	B1	must ft from (c)(i) dep on factorising in the form $(x+p)(x+q)$ where p and q are integers
	(d)	$-2y-3y<-12-7$ **or** $7+12<3y+2y$ **or** $7 < 5y – 12$ **or** $7 – 5y < -12$ **or** $-2y < 3y – 19$ **or** $19 – 2y < 3y$		3	M1	for rearrangement with y terms on one side and numerical terms on the other in a correct inequality **or** the correct simplification of y terms or numbers on one side in a correct inequality sign can be = or the incorrect inequality sign
		$-5y<-19$ **or** $19<5y$ **or** $-y<\frac{-19}{5}$ **or** $y<\frac{19}{5}$ **or** $y=\frac{19}{5}$ oe			M1	for the correct simplification of y terms on one side and numbers on the other side in a correct inequality **or** a correct inequality with the wrong sign sign can be = or the incorrect inequality sign
		Correct answer scores full marks (unless from obvious incorrect working)	$y>\frac{19}{5}$		A1	oe eg $y > 3.8$ or $3.8 < y$ Must be given as the correct inequality on the answer line
						Total 9 marks

15	$3nx-4x=3p+n$		3	M1 for removing the denominator and expanding in a correct equation
	$3nx-n=3p+4x$ or $-4x-3p=n-3nx$			M1ft for gathering terms in n on one side and other terms the other side in an equation ft their equation dep on 2 terms in n and 2 other terms
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$n=\frac{3p+4x}{3x-1}$		A1 oe $n=\frac{-3p-4x}{1-3x}$ oe (must see "$n=$"… on answer line or in working)
				Total 3 marks

16	$\left(\frac{dy}{dx}=\right)3\times4x^2-8\ (=12x^2-8)$		4	B2 for $3\times4x^2-8$ or $12x^2-8$ (with no other terms) (B1 for one term, ie $3\times4x^2$ or $12x^2$ or -8)
	$"12x^2-8"=\frac{1}{3}$			M1 for equating their initial derivative with the given gradient. Derivative must be a **quadratic** (dep on B1)
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\pm\frac{5}{6}$		A1oe Ignore y values Allow $\pm0.83(333\ldots)$ or $\pm\sqrt{\frac{25}{36}}$ oe
				Total 4 marks

Question		Working	Answer	Mark	Notes
7	(a)		$5y^4$	2	B2 B1 for fully simplifying terms in x or terms in y
	(b)	$h - f = 3e$ or $\frac{h}{3} = e + \frac{f}{3}$ or $\frac{h-f}{3}$	$e = \frac{h-f}{3}$	2	M1
					A1 oe, accept $e = \frac{f-h}{-3}$
					Total 4 marks

8	$160^2 + 200^2$ (=65600)		3	M1
	$\sqrt{160^2 + 200^2}$			M1
		256		A1 accept 256 – 256.2
				Total 3 marks

9	Interior angle of pentagon (180 × 3) ÷ 5 (= 108) oe		4	M1 or exterior angle of pentagon = $\frac{360}{5}$ (= 72)
	Interior angle of octagon (180 × 6) ÷ 8 (= 135) oe			M1 or exterior angle of octagon = $\frac{360}{8}$ (= 45)
	(*CBF* =) 360 – ("108" + "135") (= 117)			M1 (*CBF* =) "72" + "45" (= 117)
		31.5		A1
				Total 4 marks

14					M2 for $\sqrt{5^2+(-12)^2}$ **or** $\sqrt{(-5)^2+12^2}$ **or** $\sqrt{5^2+12^2}$ If not M2 then M1 for $\begin{pmatrix}6\\-9\end{pmatrix}-\begin{pmatrix}1\\3\end{pmatrix}$ or $\begin{pmatrix}6\\-9\end{pmatrix}+\begin{pmatrix}-1\\-3\end{pmatrix}\left(=\begin{pmatrix}5\\-12\end{pmatrix}\right)$ **or** or $\begin{pmatrix}1\\3\end{pmatrix}-\begin{pmatrix}6\\-9\end{pmatrix}$ or $\begin{pmatrix}1\\3\end{pmatrix}+\begin{pmatrix}-6\\9\end{pmatrix}\left(=\begin{pmatrix}-5\\12\end{pmatrix}\right)$
			13	3	A1
					Total 3 marks

15		$y^2=\frac{3x-2}{x+1}$			M1 squaring both sides to get a correct equation
		$xy^2 + y^2 = 3x - 2$ oe			M1 for multiplying by the denominator **and** expanding the bracket
		$y^2 + 2 = x(3 - y^2)$ oe			M1 for isolating terms in x **and** factorising the correct expression of the equation
			$x=\frac{2+y^2}{3-y^2}$	4	A1 accept $x=\frac{-2-y^2}{y^2-3}$ oe
					Total 4 marks

16	$y^2 = \frac{x+1}{x-4}$		4	M1	for squaring
	$y^2(x-4) = x+1$ or $y^2x - 4y^2 = x+1$			M1	for removing the fraction
	$y^2x - x = 4y^2 + 1$ or $-4y^2 - 1 = x - y^2x$ **or** $x(y^2 - 1) = 4y^2 + 1$ or $-4y^2 - 1 = x(1 - y^2)$			M1	for expanding the bracket **and** rearranging for x so that the terms in x are on one side of the correct equation
		$x = \frac{4y^2+1}{y^2-1}$		A1	for $x = \frac{4y^2+1}{y^2-1}$ or $x = \frac{-4y^2-1}{1-y^2}$ (need to see x = somewhere)
					Total 4 marks

17	e.g. $n^2 - (n-1)^2$ or $(n+1)^2 - n^2$		3	M1	for setting up a correct algebraic expression (any letter can be used)
	e.g. $n^2 - n^2 + 2n - 1$ or $n^2 + 2n + 1 - n^2$			M1	Correct expansion of brackets and correct signs or a correct result
		e.g. $2n - 1$ is always odd		A1	dep on M2 for eg $2n - 1$ or $2n + 1$ or $-(2n + 1)$ oe **and** a suitable conclusion SCB1 for eg $(2n)^2 - (2n-1)^2$ or $(2n+1)^2 - (2n)^2$ oe
					Total 3 marks

15	$xy + 3y = 5 - 2x$ oe			M1	multiplying both sides by $(x + 3)$ and expanding the brackets correctly
	e.g. $xy + 2x = 5 - 3y$			M1	ft dep on 2 terms on left and $(5 - 2x)$ on right, for collecting all x terms on one side and non-x terms on the other side
	eg $x(y + 2) = 5 - 3y$			M1	ft, dep on 2 terms in x, for factorising for x
		$x = \frac{5-3y}{2+y}$	4	A1	oe allow $\frac{5-3y}{2+y}$ as answer so long as previously seen $x = \frac{5-3y}{2+y}$
					Total 4 marks

16	(a) (i)		40	2	B1	cao (may be written on the diagram)
	(ii)		Angles in same segment (are equal)		B1	**or** angles at the circumference from the same arc of the circle **or** angles on the same arc of the circle **Alternatively**: (two applications of) Opposite angles of a cyclic quadrilateral sum to 180°
	(b)		140	1	B1	cao (may be written on the diagram)
						Total 3 marks

17	$yn^2 = n^2 + d$ **or** $y = 1 + \frac{d}{n^2}$		4	M1	
	$yn^2 - n^2 = d$ **or** $-d = n^2 - yn^2$ **or** $y - 1 = \frac{d}{n^2}$			M1	
	$n^2(y-1) = d$ **or** $-d = (1-y)n^2$			M1	for factorising n^2 from a suitable expression. or $n^2 = \frac{d}{y-1}$
		$n = \sqrt{\frac{d}{y-1}}$		A1	Accept $n = \sqrt{\frac{-d}{1-y}}$ Penalise $\pm\sqrt{}$
					Total 4 marks

15	$n^2t^3 = 4d + t^3$	$n^2 = \frac{4d}{t^3} + 1$		4	M1 for multiplying by the denominator **or** for dividing the RHS by t^3
	$t^3\left(n^2 - 1\right) = 4d$ oe	$n^2 - 1 = \frac{4d}{t^3}$			M1 for isolating terms in t^3 **and** factorising the correct expression of the equation **or** for isolating the $\frac{4d}{t^3}$ term
	$t^3 = \frac{4d}{\left(n^2 - 1\right)}$ oe	$t^3 = \frac{4d}{\left(n^2 - 1\right)}$			M1 for making t^3 the subject
			$t = \sqrt[3]{\frac{4d}{\left(n^2 - 1\right)}}$		A1 oe eg. $t = \sqrt[3]{\frac{-4d}{\left(1 - n^2\right)}}$ or $t = \left(\frac{4d}{\left(n^2 - 1\right)}\right)^{\frac{1}{3}}$ SC B2 for $t = \sqrt[3]{\frac{4d}{\left(n^2 + 1\right)}}$
					Total 4 marks

17	$y^3 = \frac{6+5x}{x+4}$		4	M1 for removing cube root
	$xy^3 + 4y^3 = 6 + 5x$ oe **or** $x - \frac{5x}{y^3} = \frac{6}{y^3} - 4$			M1 for multiplying by denominator and expanding in a **correct** equation **or** for gathering x terms on one side and the other terms on the other side in a **correct** equation in fractional form
	$xy^3 - 5x = 6 - 4y^3$			M1 for gathering terms in x on one side and other terms the other side in a **correct** equation **or** for removing all fractions
	Correct answer scores full marks (unless from obvious incorrect working)	$x = \frac{6-4y^3}{y^3-5}$		A1 or $x = \frac{4y^3-6}{5-y^3}$ SCB2 for $x = \frac{6-4y^{\frac{1}{3}}}{y^{\frac{1}{3}}-5}$ or $x = \frac{4y^{\frac{1}{3}}-6}{5-y^{\frac{1}{3}}}$ $y^{\frac{1}{3}}$ can also be y^2
				Total 4 marks

16*	$7c-8ct^2=t^2+3$ oe		4	M1	for multiplying both sides by denominator **and** expanding the brackets
	$7c-3=t^2+8ct^2$ oe or $-8ct^2-t^2=3-7c$ oe			M1	ft dep on 2 terms in t^2 and 2 other terms for collecting t^2 terms on one side and other terms on the other side
	$7c-3=t^2(1+8c)$ oe or $t^2(-8c-1)=3-7c$ oe			M1	ft dep on previous M1 for factorising for t^2
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$t=(\pm)\sqrt{\frac{7c-3}{1+8c}}$		A1	oe eg $t=(\pm)\sqrt{\frac{3-7c}{-8c-1}}$ or $t=(\pm)\left(\frac{7c-3}{1+8c}\right)^{\frac{1}{2}}$ or $t=(\pm)\left(\frac{7c-3}{1+8c}\right)^{0.5}$ NB To award A1 we must see $t=(\pm)\sqrt{\frac{7c-3}{1+8c}}$ in working if $(\pm)\sqrt{\frac{7c-3}{1+8c}}$ alone is given as an answer
					Total 4 marks

17		$7p - 3k^2p = 8k^2 + 5$		4	M1	for correctly multiplying both sides by the denominator **and** expanding the brackets
		$7p - 5 = 8k^2 + 3k^2p$ **or** $-3k^2p - 8k^2 = 5 - 7p$			M1ft	dep on 2 terms in k^2 and 2 other terms for correctly collecting their k^2 terms on one side and their other terms on the other side Note: eg $8k^2 + 3k^2$ does **not** count as 2 terms in k^2
		eg $7p - 5 = k^2(8 + 3p)$ **or** $k^2(-3p - 8) = 5 - 7p$			M1ft	dep on previous M1 for correctly factorising for k^2 or $-k^2$ in their equation
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$k = (\pm)\sqrt{\frac{7p - 5}{8 + 3p}}$		A1	oe eg $k = (\pm)\sqrt{\frac{5 - 7p}{-3p - 8}}$ **or** $k = (\pm)\left(\frac{7p - 5}{8 + 3p}\right)^{\frac{1}{2}}$ **or** $k = (\pm)\left(\frac{7p - 5}{8 + 3p}\right)^{0.5}$ (condone omission of ±) NB: to award A1 we must see $k = (\pm)\sqrt{\frac{7p - 5}{8 + 3p}}$ in working if $(\pm)\sqrt{\frac{7p - 5}{8 + 3p}}$ alone is given as an answer
						Total 4 marks

4	3.4 or $\frac{17}{5}$ or $3\frac{2}{5}$ or $3\frac{24}{60}$ or 204 oe		3	B1	
	433.5 ÷ 3.4 or 433.5 ÷ $\frac{17}{5}$ or 433.5 ÷ $3\frac{2}{5}$ or $\frac{433.5}{'204'} \times 60$ oe			M1	for use of speed = distance ÷ time Allow 433.5 ÷ 3.24 (= 133.796…) for this mark only
		127.5		A1	oe allow 128
					Total 3 marks

5	a	(x =) 270 ÷ (12 × 5) (= 4.5) oe		3	M1	
		π × '4.5'^{2} × 2 × '4.5' (= 182.25π oe)			M1	ft dep on M1
			573		A1	accept 572 − 573
	b		1 000 000	1	B1	or (1 ×) 10^6 or (one or 1) million oe
						Total 4 marks

6	a	e.g. $A + 5z = \frac{c}{y}$ oe **or** $Ay = c - 5yz$ oe		2	M1	for a correct first step e.g. add 5z to both sides **or** multiply all terms by y
			$c = y(A + 5z)$		A1	oe
	b		1	1	B1	
	c	$(x \pm 3)(x \pm 8)$		2	M1	or for $(x \pm a)(x \pm b)$ where $ab = 24$ or $a + b = -11$
			$(x - 3)(x - 8)$		A1	
						Total 5 marks

International GCSE Maths A June 2018 – Paper 2H Mark scheme					
Apart from Questions 4, 9, 15, 16, 21(a) 21(b) and 22, where the mark scheme states otherwise, the correct answer, unless clearly obtained by an incorrect method, should be taken to imply a correct method.					
Question	**Working**	**Answer**	**Mark**	**Notes**	
1 (a)	$ac=M+bd$ **or** $-ac=-M-bd$ **or** $\frac{M}{c}=a-\frac{bd}{c}$		2	M1	For a correct first stage
		$a=\frac{M+bd}{c}$		A1	oe, eg $a=\frac{M}{c}+\frac{bd}{c}$, $a=\frac{-M-bd}{-c}$ [must have been seen with a = to award accuracy mark]
(b)	$5x<39+4$ oe		2	M1	Accept as equation or with the wrong inequality sign. Also award M1 for an answer of 8.6 or 8.6 with an = sign or the incorrect inequality sign.
		$x<8\frac{3}{5}$		A1	Accept $x<\frac{43}{5}$ **or** $x<8.6$ **or** $[-\infty, 8.6)$
(c)	eg $6e^2(3f^3-2ef)$, eg $2f(9e^2f^2-6e^3)$ eg $ef(18ef^2-12e^2)$		2	M1	Any correct partially factorised expression with at least 2 terms in the common factor **or** for the correct common factor and a 2 term expression inside the brackets with just one error
		$6e^2f(3f^2-2e)$		A1	
					Total 6 marks

Question		Working	Answer	Mark	Notes	
10	(a)		$4x^4y^3$	2	B2	B1 for 2 correct terms of 3 in a product
	(b)	e.g. $2(8-2x)-3(2x-3)=4\times 6$ or $\frac{2(8-2x)}{6}-\frac{3(2x-3)}{6}=4$ or $\frac{16-4x}{6}-\frac{6x-9}{6}=4$ or $\frac{2(8-2x)-3(2x-3)}{6}=4$ or $\frac{-10x+25}{6}=4$ oe	0.1	3	M1 M1	For method to deal with fractions eg. finds a common denominator (6 or a multiple of 6) or multiplies by common multiple in a correct equation. Condone one error in expansion For method to expand brackets and multiplies by common denominator in a correct equation. Condone one error in expansion
		e.g. $16-4x-6x+9=24$ or $-10x+25=24$ oe			A1	oe dep on M1
	(c)	$m^2=\frac{1}{3}ef$	$f=\frac{3m^2}{e}$	2	M1 A1	for squaring the m oe must have $f=$

14	(a)	eg $20\times\frac{9a-7}{5}-20\times\frac{3a-7}{4}=20\times4.55\,(=91)$ or eg $4(9a-7)-5(3a-7)=20\times4.55$ or eg $\frac{4(9a-7)}{20}-\frac{5(3a-7)}{20}\,(=4.55)$ or eg $\frac{4(9a-7)-5(3a-7)}{20}\,(=4.55)$		3	M1	For clear intention to multiply all terms by 20 (or 4 × 5) or a multiple of 20 oe or to express LHS as two fractions over 20 (or 4 × 5) or a multiple of 20 oe or as a single fraction with a denominator of 20 (or 4 × 5) or a multiple of 20 oe if expanded numerator, allow one error
		eg $36a - 28 - 15a + 35 = 20 \times 4.55$ or $21a = 84$ oe			M1	Expanding brackets and multiplying by denominator with no more than one sign error
			4		A1	dep on M1
	(b)	$p^2=\frac{ac+8}{3+c}$		4	M1	for removing square root
		$3p^2+cp^2=ac+8$			M1	for multiplying by denominator and expanding in a correct equation
		$cp^2-ac=8-3p^2$ **or** $3p^2-8=ac-cp^2$			M1ft	for gathering terms in c on one side and other terms the other side ft their equation dep on 2 terms in c and two other terms
			$c=\frac{8-3p^2}{p^2-a}$		A1	or $c=\frac{3p^2-8}{a-p^2}$
						Total 7 marks

14 (a)	$(5 - x)(2x + 3) = 10x + 15 - 2x^2 - 3x$ $(= -2x^2+7x+15)$ or $(5 - x)(x + 4) = 5x + 20 - x^2 - 4x$ $(= -x^2 + x + 20)$ or $(2x + 3)(x + 4) = 2x^2 + 8x + 3x + 12$ $(=2x^2+11x+12)$		3	M1	multiplying 2 factors only but do not award if they multiply eg $(5 - x)(2x + 3)$ **and** $(5 - x)(x + 4)$ as their method allow one error
	$(-2x^2+7x+15)(x+4) = -2x^3 - 8x^2 + 7x^2 + 28x + 15x + 60$ or $(-x^2+x+20)(2x+3) = -2x^3 - 3x^2 + 2x^2 + 3x + 40x + 60$ or $(2x^2+11x+12)(5-x) = 10x^2 - 2x^3 + 55x - 11x^2 + 60 - 12x$			M1	(dep)ft for expanding by the third factor, allow one further error
		$-2x^3 - x^2 + 43x + 60$		A1	Dep on M1
	ALTERNATIVE				
	$10x^2 + 15x + 40x + 60 - 2x^3 - 3x^2 - 8x^2 - 12x$		3	M2	for a complete expansion with 8 terms present, at least 4 of which must be correct (M1 for 4 correct terms from any number of terms)
		$-2x^3 - x^2 + 43x + 60$		A1	

(b)	$g+7=\frac{c+3}{4+c}$ or $g(4+c)=c+3-7(4+c)$ or $g=\frac{c+3}{4+c}-\frac{7(4+c)}{4+c}\left(=\frac{c+3-28-7c)}{4+c}\right)$		4	M1	Adding 7 to both sides as a first step or removing fraction correctly
	eg $4g + gc + 28 + 7c = c + 3$ or $4g + gc = c + 3 – 28 – 7c$ oe			M1	removing fraction and expanding all brackets in an equation with no more than one error
	eg $gc + 7c – c = 3 – 28 – 4g$ or $28 – 3 + 4g = c – 7c – gc$			M1ft	ft dep on previous M1 - terms in c on one side and other terms on the other side in an equation
		$c=\frac{-(4g+25)}{g+6}$		A1	oe eg $c=\frac{25+4g}{-6-g}$ or $c=\frac{3-28-4g}{g+7-1}$ oe [if c = is missing allow full marks if seen in working otherwise 3 marks] (SCB2 for an answer of $c=\frac{-4-4g}{g-1}$ oe or $c=\frac{31-4g}{g-8}$ oe SCB1 in working for $4g + cg = c + 3 – 7$ oe or $4g+cg-28-7c=c+3$ oe
					Total 7 marks

17 (a)	eg $3x^2-2x+18x-12$ $(=3x^2+16x-12)$ **or** $x^2+6x+6x+36$ $(=x^2+12x+36)$ (allow in a table with no sign indicating +)		3	M1	for a correct method to expand two brackets with at least 3 terms correct out of 4 terms seen (or 2 terms correct out of 3 terms seen)
	eg $3x^3+36x^2+108x-2x^2-24x-72$ or $3x^3+18x^2+18x^2+108x-2x^2-12x-12x-72$ **or** $3x^3+16x^2-12x+18x^2+96x-72$ or $3x^3-2x^2+18x^2-12x+18x^2-12x+108x-72$			M1ft	ft dep on M1 and a quadratic for a correct method to multiply by the 3rd bracket allow one further error
	Correct answer scores full marks (unless from obvious incorrect working)	$3x^3+34x^2+84x-72$		A1	If no working shown then award B2 for 3 out of a maximum of 4 terms correct
	ALTERNATIVE				
	$3x^3-2x^2+18x^2-12x+18x^2-12x+108x-72$		3	M2	For a complete expansion with 8 terms present of which 4 are correct (M1 for 4 correct terms from any number of terms)
		$3x^3+34x^2+84x-72$		A1	
	See next page for 17(b)				

17 (b)	$w^2 = \frac{e+g}{ef-d}$		4	M1 for removing square root
	$w^2ef - w^2d = e+g$ oe			M1 for multiplying by denominator and expanding in a correct equation
	$w^2ef - e = g + w^2d$ oe			M1ft ft their equation dep on 2 terms in e and two other terms for gathering terms in e on one side and other terms the other side
	Correct answer scores full marks (unless from obvious incorrect working)	$e = \frac{g+w^2d}{w^2f-1}$		A1 oe eg $e = \frac{-g-w^2d}{1-w^2f}$, $e = -\frac{g+w^2d}{1-w^2f}$ oe must see e = on answer line or in working.
				Total 7 marks

18		**C**	3	B1 check diagrams
		F		B1 check diagrams
		A		B1 check diagrams
				Total 3 marks

15 (a)	$e^2 = \frac{7g+5}{11+2g}$		4	M1	for removing square root
	$11e^2 + 2e^2g = 7g + 5$			M1	For multiplying by denominator and expanding in a correct equation
	eg $2e^2g - 7g = 5 - 11e^2$ or $11e^2 - 5 = 7g - 2e^2g$ oe			M1	For gathering terms in g on one side and other terms the other side in a correct equation.
	Correct answer scores full marks (unless from obvious incorrect working)	$g = \frac{5-11e^2}{2e^2-7}$		A1	or $g = \frac{11e^2-5}{7-2e^2}$ oe eg $g = \frac{\frac{5}{e^2}-11}{2-\frac{7}{e^2}}$ or $g = \left(\frac{5-11e^2}{e^2-3.5}\right) \div 2$ etc
(b)	$(3y-8)(y+4)$		3	M1	For correct factorisation or correct use of quadratic formula $\frac{-4 \pm \sqrt{4^2-4\times3\times-32}}{2\times3}$ or as far as $\frac{-4 \pm \sqrt{400}}{6}$ $\left(y-\frac{8}{3}\right)(y+4)$ is not valid factorisation, unless preceded by division of quadratic by 3, so no marks
	$y = \frac{8}{3}, y = -4$			A1	dep on M1 for correct critical values (allow 2.6 or better or 2.7)
	working required	$y < -4,\ y > \frac{8}{3}$		A1	oe dep on M1 (allow use of x rather than y) or $(-\infty, -4), \left(\frac{8}{3}, (+)\infty\right)$ or $(-\infty, -4) \cup \left(\frac{8}{3}, (+)\infty\right)$ oe
					Total 7 marks

12 (a)	eg $\frac{3(3x+2)-5(2x+1)}{15}(=x)$ oe eg $\frac{1-x}{15}(=x)$ or $\frac{3(3x+2)}{15}-\frac{5(2x+1)}{15}(=x)$ or $3(3x+2)-5(2x+1)=x\times5\times3$ oe or $\frac{3}{5}x+\frac{2}{5}-\frac{2}{3}x-\frac{1}{3}(=x)$		3	M1	Writing fractions over a common denominator or removing denominator or writing each term separately – if student has expanded/multiplied at this stage, then allow one of the 4 terms on the LHS incorrect. If the student has removed the denominator at this stage then a correct method must be shown or implied
	eg $9x+6-10x-5=15x$ oe **or** $1-x=15x$ oe eg $9x+6=15x+10x+5$ **or** $\frac{-x+1}{15}=\frac{15x}{15}$ **or** $-\frac{16}{15}x=-\frac{1}{15}$			M1	An equation with no brackets or fractions **or** an equation with a common denominator for all terms with numerators simplified (allow one error for the 4 terms on the LHS only (they may have moved these to the RHS) across the 2 M marks and ft for simplifying)
	Working required	$\frac{1}{16}$		A1	oe 0.0625 (allow 0.062 or 0.063) dep on M1

(b)	$f^2 = \frac{a+bc}{c-d}$		4	M1	for squaring both sides in a correct equation
	eg $cf^2 - df^2 = a + bc$			M1	for multiplying by the denominator and expanding in a correct equation
	eg $cf^2 - bc = a + df^2$			M1	for isolating terms in c on one side and other terms the other in a correct equation
	Correct answer scores full marks (unless from obvious incorrect working)	$c = \frac{a+df^2}{f^2-b}$		A1	oe eg $c = \frac{-a-df^2}{b-f^2}$
					Total 7 marks

17	(a)	$6y(y-1)+5(y-1)$ or $y(6y+5)-1(6y+5)$		2	M1 for $(6y \pm 5)(y \pm 1)$ or $(6y \pm 1)(y \pm 5)$ or $(ay+5)(by-1)$ where $ab = 6$ or $5b-a=-1$ or $(6y+p)(y+q)$ where $pq=-5$ or $6q+p=-1$ Condone use of a different letter to y
		Correct answer scores full marks (unless from obvious incorrect working)	$(6y+5)(y-1)$		A1 oe
	(b)	$8w-fw=2f+3$ oe		3	M1 for multiplying by denominator and expanding in a correct equation
		$8w-3=2f+fw$ oe or $-2f-fw=3-8w$ oe			M1 for gathering terms in f on one side and other terms the other side in a correct equation ft their equation dep on 2 terms in f and two other terms
		Correct answer scores full marks (unless from obvious incorrect working)	$f=\frac{8w-3}{2+w}$		A1 oe accept $f=\frac{3-8w}{-2-w}$ oe
	(c)	$4(x^2-2x)+7$ or $4\left(x^2-2x+\frac{7}{4}\right)$ oe		3	M1
		$4\left[(x-1)^2-1^2\right]+7$ oe or $4\left[(x-1)^2-1^2+\frac{7}{4}\right]$ oe			M1 for a complete method
		Correct answer scores full marks (unless from obvious incorrect working)	$4(x-1)^2+3$		A1 allow $a = 4$, $b = -1$ and $c = 3$
					Total 8 marks

17 ALT	(c)	$ax^2+2bax+b^2a+c$		3	M1 for correctly expanding $a(x+b)^2+c$ to give $ax^2+2bax+b^2a+c$
		$2ba=-8$ and $b^2a+c=7$			M1 for a complete method (equating coefficients)
		Correct answer scores full marks (unless from obvious incorrect working)	$4(x-1)^2+3$		A1 allow $a = 4$, $b = -1$ and $c = 3$

Question		Working	Answer	Mark	Notes
12	(a)		1	1	B1
	(b)		$27x^6y^{15}$	2	B2 If not B2 then B1 for any two correct terms in a product
	(c)	$2(e^2 - 9)$ **or** $(2e - 6)(e + 3)$ **or** $(e - 3)(2e + 6)$			M1
			$2(e - 3)(e + 3)$	2	A1
	(d)	$m^2 = \frac{6a + r}{5r}$			M1
		$m^2 \times 5r = 6a + r$			M1
		$5rm^2 - r = 6a$			M1
			$r = \frac{6a}{5m^2 - 1}$	4	A1 or for $r = \frac{-6a}{1 - 5m^2}$ oe NB: to award A1 we must see $r = \frac{6a}{5m^2 - 1}$ in working if $\frac{6a}{5m^2 - 1}$ alone is given as answer

Question	Working	Answer		Mark	Notes
11	E.g. $\frac{10x}{6x} - \frac{3(x+2)}{6x}$ or $\frac{10x-3(x+2)}{6x}$			M1	for two correct fractions with common denominator **or** a single correct fraction
	$\frac{10x-3x-6}{6x}$ **or** $\frac{7}{6x} - \frac{1}{x}$			M1	for a correct single fraction with brackets expanded
		$\frac{7x-6}{6x}$	3	A1	for $\frac{7x-6}{6x}$ as the final answer SC: If no marks awarded then award B1 for an answer of $\frac{7x+6}{6x}$

22		$x(2x + 5)(3x - 1)$ or $(2x + 5)(3x^2 - x)$ or $(2x + 5)(2x - 5)$ oe			M1 for a correct factorisation of the numerator into 2 or 3 factors where one of the factors must be $(2x + 5)$ **or** denominator into 2 brackets where one of the factors must be $(2x + 5)$
		$x(2x + 5)(3x - 1)$ or $(2x + 5)(3x^2 - x)$ **and** $(2x + 5)(2x - 5)$ oe			M1 for a correct factorisation of the numerator into 2 or 3 factors where one of the factors must be $(2x + 5)$ **and** denominator into 2 brackets where one of the factors must be $(2x + 5)$
			$\frac{x(3x-1)}{2x-5}$	3	A1 accept $\frac{3x^2-x}{2x-5}$ oe Do not ISW
					Total 3 marks

19	$(a=)\dfrac{14}{3\times\dfrac{7}{4y-3}-7}$		3	M1 For a correct substitution
	$(a=)\dfrac{14(4y-3)}{21-7(4y-3)}$ oe eg $\dfrac{56y-42}{21-28y+21}$			M1 or for a correct but unsimplified answer in the form $\frac{m}{n}$ ie the denominator should be simplified to remove the fraction
		$\dfrac{4y-3}{3-2y}$		A1 oe but must be simplified
				Total 3 marks

19 alt	$x=\dfrac{14+7a}{3a}$ **and** $\dfrac{14+7a}{3a}=\dfrac{7}{4y-3}$		3	M1 For rearranging 'x' to be in terms of a and equating two expressions for a
	$a(42-28y)=56y-42$ oe eg $(a=)\dfrac{56y-42}{21-28y+21}$			M1 or for a correct but unsimplified answer in the form $\frac{m}{n}$
		$\dfrac{4y-3}{3-2y}$		A1 oe but must be simplified
				Total 3 marks

23	eg $\frac{20}{x^2-36}-\frac{2(x+6)}{x^2-36}$ oe **or** $\frac{20}{(x-6)(x+6)}-\frac{2(x+6)}{(x-6)(x+6)}$ oe **or** $\frac{20(x-6)}{(x^2-36)(x-6)}-\frac{2(x+6)(x-6)}{(x^2-36)(x-6)}$ or $\frac{20-2(x+6)}{(x^2-36)(4-x)}$ oe		3	M1 for writing the first two fractions with a common denominator (may be a single denominator) or multiplying both fractions by $\frac{1}{4-x}$ and writing over a common denominator
	eg $\frac{8-2x}{x^2-36}\times\frac{1}{4-x}$ **or** $\frac{8-2x}{(x-6)(x+6)}\times\frac{1}{4-x}$ **or** $\frac{20x-2x^2-48}{(x^2-36)(x-6)}\times\frac{1}{4-x}$ oe $\frac{8-2x}{(x^2-36)(4-x)}$ oe			M1 for simplifying first 2 fractions to a single fraction and expanding and simplifying numerator – must be correct, and showing intention to multiply by $\frac{1}{4-x}$ or expanding the numerator of the full solution and writing as a single fraction
		$\frac{2}{x^2-36}$		A1 oe eg $\frac{2}{(x-6)(x+6)}$
				Total 3 marks

11	$\frac{9x}{12x}+\frac{2(5-x)}{12x}$ oe or $\frac{3(6x)}{24x}+\frac{4(5-x)}{24x}$ oe or $\frac{3(6x)}{4(6x)}+\frac{4(5-x)}{4(6x)}$ oe or $\frac{18x}{24x}+\frac{20-4x}{24x}$ oe or $\frac{3\times3x+2(5-x)}{12x}$ oe		3	M1 for two correct fractions with common denominator with the intention to add **or** a single correct fraction
	$\frac{9x+10-2x}{12x}$ oe or $\frac{18x+20-4x}{24x}$ oe or $\frac{14x+20}{24x}$ oe or			M1 for a correct numerator over a single denominator with brackets expanded and correct signs Allow $\frac{7x}{12x}+\frac{10}{12x}$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\frac{7x+10}{12x}$		A1 oe $\frac{10+7x}{12x}$
				Total 3 marks

20	$\dfrac{5\left(\frac{1}{4y}-y\right)}{\frac{1}{4y}+2}=\left(\dfrac{\frac{5}{4y}-5y}{\frac{1}{4y}+2}\right)$ oe or $\dfrac{4y(5x-5y)}{8y+1}$ oe		3	M1	For a correct substitution with only values of y or an expression containing xy (not just x) or a correct denominator of $1 + 8y$
	$\dfrac{\frac{5}{4y}\times 4y-5y\times 4y}{\frac{1}{4y}\times 4y+2\times 4y}$ or $\dfrac{\frac{5-20y^2}{4y}}{\frac{1+8y}{4y}}$ oe or $\dfrac{4y(5x-5y)}{8y+1}=\dfrac{20xy-20y^2}{8y+1}$			M1	multiplying every term by $4y$ or a multiple of $4y$ or writing numerator and denominator over 4y or a multiple of $4y$ or correctly expanded with an xy term (xy could be replaced with 0.25 oe) or 3 of a, b, c or d correct if written in the form $\dfrac{a-by^2}{c+dy}$ where a, b, c and d are integers
	Correct answer scores full marks (unless from obvious incorrect working)	$\dfrac{5-20y^2}{1+8y}$		A1	oe eg $\dfrac{-5+20y^2}{-1-8y}$ or $\dfrac{20-80y^2}{4+32y}$
					Total 3 marks

12	eg $\frac{5(6x)}{24x}+\frac{4(x-3)}{24x}$ oe **or** $\frac{5(6x)}{4(6x)}+\frac{4(x-3)}{4(6x)}$ oe **or** $\frac{30x}{24x}+\frac{4(x-3)}{24x}$ oe **or** $\frac{30x+4(x-3)}{24x}$ oe **or** $\frac{15x}{12x}+\frac{2(x-3)}{12x}$ oe **or** $\frac{15x+2(x-3)}{12x}$ oe		3	M1 for two correct fractions with common denominator **or** a single correct fraction
	eg $\frac{30x+4x-12}{24x}$ oe **or** $\frac{30x}{24x}+\frac{4x-12}{24x}$ oe **or** $\frac{30x}{24x}+\frac{4x}{24x}-\frac{12}{24x}$ oe **or** $\frac{34x}{24x}-\frac{12}{24x}$ oe **or** $\frac{34x-12}{24x}$ oe **or** $\frac{15x+2x-6}{12x}$ oe			M1 for correct fraction(s) with bracket(s) expanded correctly
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{17x-6}{12x}$		A1 oe but must be simplified eg $\frac{-6+17x}{12x}$ do not ISW incorrect simplification eg $\frac{17x-6}{12x}=\frac{11}{12}$ is M2A0
				Total 3 marks

Question	Working	Answer	Mark	Notes
21 (a)		(−2, −2), (1, 6), (4, −2) Plotted and joined	2	B2 Fully correct graph- professional judgment required. (B1 for (1, 6) plotted **OR** (−2, −2) and (4, −2) plotted)
(b)		(2, −1), (−1, 3) (−4, −1) Plotted and joined	2	B2 Fully correct graph – professional judgment required. (B1 for 2 of the 3 points plotted) SC B1 for a correct reflection in the *x*-axis
				Total 4 marks

22	$\frac{(2x+5)(2x-5)}{(5x+7)(x-1)} \times \frac{2(2x-5)-3(x-3)}{(x-3)(2x-5)}$ $\frac{(2x+5)(2x-5)}{(5x+7)(x-1)} \times \frac{x-1}{(x-3)(2x-5)}$ $\frac{2x+5}{(5x+7)(x-3)}$	$\frac{2x+5}{(5x+7)(x-3)}$	4	M1 For $4x^2 - 25 = (2x + 5)(2x - 5)$ or $5x^2 + 2x - 7 = (5x + 7)(x - 1)$ M1 $\frac{2}{x-3} - \frac{3}{2x-5} = \frac{2(2x-5)-3(x-3)}{(x-3)(2x-5)}$ oe M1 $\frac{(2x+5)(2x-5)}{(5x+7)(x-1)} \times \frac{x-1}{(x-3)(2x-5)}$ oe may be partially simplified A1 Denominator may be expanded eg $\frac{2x+5}{5x^2-8x-21}$ isw for incorrect denominator expansion
				Total 4 marks

24	$\frac{4(2x-3)-3(2x-5)}{(2x-5)(2x-3)}$ or $\frac{8x-12-6x+15}{(2x-5)(2x-3)}$ oe		4	M1	Writing 1st fraction as a fraction over a common denominator (can be 2 separate fractions)
	$x(3-2x)(3+2x)$ or $(3x-1)(2x-5)$			M1	Complete factorisation of numerator or denominator of 2nd fraction
	$\frac{2x+3}{(2x-5)(2x-3)} \times \frac{(3x-1)(2x-5)}{x(3-2x)(3+2x)}$			M1	may be partially simplified
		$\frac{3x-1}{x(2x-3)(3-2x)}$		A1	e.g. $\frac{3x-1}{x(2x-3)(3-2x)}$ or $\frac{1-3x}{x(2x-3)^2}$ or $\frac{3x-1}{x(12x-9-4x^2)}$ or $\frac{3x-1}{(12x^2-9x-4x^3)}$ oe isw for incorrect denominator expansion
					Total 4 marks

						Total 4 marks

21		$\frac{(5x-8)(5x+8)}{(5x+2)(x-3)} \times \frac{(x-5)(x-3)}{5x+8}$ or eg $\frac{(5x-8)(x-5)}{(5x+2)}(-(x-7))$		4	M2	For factorising at least 2 of the quadratics correctly – could be implied by 2 factors cancelled correctly (M1 For factorising at least 1 of the 3 quadratics correctly)
		$\frac{(5x-8)(x-5)-(x-7)(5x+2)}{5x+2}$ oe or $\frac{5x^2-25x-8x+40-(5x^2-35x+2x-14)}{5x+2}$ oe or $\frac{(25x^2-64)(x^2-8x+15)-(x-7)(5x^2-13x-6)(5x+8)}{(5x^2-13x-6)(5x+8)}$ oe or $\frac{(5x-8)(x^2-8x+15)-(x-7)(5x+2)(x-3)}{(5x+2)(x-3)}$ oe or $\frac{(25x^2-64)(x-5)-(x-7)(5x+2)(5x+8)}{(5x+2)(5x+8)}$ oe			M1	(indep (ft if M2 awarded)) For writing the fractions over a common denominator with or without brackets removed – need not be in simplest form Could be written as 2 separate fractions over a common denominator
			$\frac{54}{5x+2}$		A1	dep on M3
						Total 4 marks

21		$[x=]\ \dfrac{5}{9\left(\dfrac{5}{5a-2}\right)+5}$ oe **or** $y=\dfrac{5}{9x}-\dfrac{5}{9}$ oe		4	M1	A correct substitution for y **or** writing y in terms of x
		$[x=]\ \dfrac{5(5a-2)}{45+5(5a-2)}$ oe **or** $(5-5x)(5a-2)=45x$ oe **or** $9x=\dfrac{5(45a-18)}{35+25a}$ oe			M1	Multiplying each term in the numerator and denominator by $(5a-2)$ to eliminate the fraction in the denominator **or** equating y's and getting rid of fractions as far as shown on left **or** single fraction in terms of a
		$[x=]\ \dfrac{25a-10}{35+25a}$ oe **or** $[x=]\ \dfrac{5(5a-2)}{5(7+5a)}$			M1	A correct fraction not in simplest form with all brackets expanded **or** numerator and denominator factorised with the same common factor taken out
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$x=\dfrac{5a-2}{7+5a}$		A1	Correctly simplified $x=$ needed for the answer, or $x=$ previously seen in working with correct simplified expression Do not isw if students have tried to do some incorrect cancelling eg $x=\dfrac{5a-2}{7+5a}=\dfrac{-2}{7}$ gets M3A0
						Total 4 marks

26	eg $\frac{(4x+3)(x-5)}{2x-1}\times\frac{(2x-1)(x-3)}{(x+5)(x-5)}$ **or** eg $\frac{(4x+3)(x-3)}{x+5}(+(29-4x))$		4	M2	for factorising at least 2 of the quadratics correctly – could be implied by 2 factors cancelled correctly (M1 for factorising at least 1 of the 3 quadratics correctly)
	eg $\frac{(4x+3)(x-3)+(29-4x)(x+5)}{x+5}$ oe **or** eg $\frac{4x^2-9x-9+145+9x-4x^2}{x+5}$ oe			M1	for writing the correct fractions over a common denominator of $(x + 5)$ with or without brackets removed – need not be in simplest form. Could be written as 2 separate fractions.
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{136}{x+5}$		A1	
					Total 4 marks

23	$(x+2)(x-2)$ oe or $(4x+1)(x-2)$ oe		4	M1	for complete factorisation of x^2-4 **or** $4x^2-7x-2$ Each factor must be in the form $(ax \pm b)$ where a and b are integers
	$(x+2)(x-2)\times\frac{x}{(4x+1)(x-2)}$ or $\frac{x(x+2)(x-2)}{(4x+1)(x-2)}$ or $\frac{x(x+2)}{(4x+1)}$			M1	for complete factorisation of $4x^2-7x-2$ **and** x^2-4 and inverting and intention to multiply
	$\frac{x(x+2)-2x(4x+1)}{(4x+1)}$ or $\frac{x^2+2x-8x^2-2x}{(4x+1)}$ or $\frac{x(x+2)}{(4x+1)}-\frac{2x(4x+1)}{(4x+1)}$ or $\frac{x^2+2x}{(4x+1)}-\frac{8x^2+2x}{(4x+1)}$			M1	for a correct single fraction following correct cancellation or for two correct fractions with common denominator following correct cancellation
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{-7x^2}{4x+1}$		A1	oe but must be in form $\frac{ax^2}{bx+c}$ where a, b and c are integers.
					Total 4 marks

23 ALT	$\frac{-7x^3+14x^2}{4x^2-7x-2}$ oe		4	M1	for a correct single fraction
	$\frac{-7x^2(x-2)}{(4x+1)(x-2)}$ oe			M1	for complete factorisation of $-7x^3+14x^2$ **or** $4x^2-7x-2$ Each factor must be in the form $(ax \pm b)$
	$\frac{-7x^2(x-2)}{(4x+1)(x-2)}$ oe			M1	for complete factorisation of $-7x^3+14x^2$ **and** $4x^2-7x-2$ Each factor must be in the form $(ax \pm b)$
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{-7x^2}{4x+1}$		A1	oe but must be in form $\frac{ax^2}{bx+c}$ where a, b and c are integers.
					Total 4 marks

26	$(3x-5)(x+2)$	$\frac{4(3x^2+x-10)-(3x-5)(4x-1)}{3x^2+x-10}$ oe or $\frac{27x-45}{3x^2+x-10}$		4	M1 for correctly factorising $3x^2+x-10$ to give $(3x-5)(x+2)$ (may be seen later on in working) **OR** combining 2 fractions into a correct single fraction
	$\frac{4x-1}{x+2}$ implies first M1	$\frac{4(3x^2+x-10)-(3x-5)(4x-1)}{(3x-5)(x+2)}$ or $\frac{27x-45}{(3x-5)(x+2)}$			M1 for inverting and cancelling giving a correct fraction **OR** for a correct single fraction where the denominator is factorised
	$\frac{4(x+2)-(4x-1)}{x+2}$ or $\frac{4x+8-4x+1}{x+2}$ or $\frac{4(x+2)}{x+2}-\frac{4x-1}{x+2}$ or $\frac{4x+8}{x+2}-\frac{4x-1}{x+2}$	$\frac{9(3x-5)}{(3x-5)(x+2)}$			M1 for a correct single fraction or two correct fractions with a common denominator **OR** for a correct fully factorised single fraction
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)		$\frac{9}{x+2}$		A1
					Total 4 marks

23	$16x^2-36=(4x-6)(4x+6)$ [$=4(2x+3)(2x-3)$] oe or $16x^2-36=(8x-12)(2x+3)$ [$=4(2x+3)(2x-3)$] oe		4	M1indep	
	$2x^2+7x+6=(2x+3)(x+2)$ **and** $x^2-5x-14=(x-7)(x+2)$ [We will make an exception of $2x^2+7x+6=(4x+6)(0.5x+1)$ as this then cancels with $(4x + 6)$]			M1indep	[NB: the two fractions when divided and cancelled give an answer of $4(2x – 3)$ or $2(4x – 6)$ or $8x – 12$ (any one of these gain 2 marks)] M2 for any fraction with completely simplified non-linear numerator and non-linear denominator that will cancel to –19
	$4(2x-3)-(7+8x)(=n)$ [allow invisible brackets ie $8x – 12 – 7 + 8x$] or an expression that clearly shows the numerator is – 19 times the denominator eg $\frac{-38x-57}{2x+3}(=n)$			M1	a linear expression that should give the correct value for n (this mark implies previous M marks as not all factorising is necessary)
	Working required	–19		A1	dep on M2
					Total 4 marks

Question		Working	Answer	Mark	Notes
15	a	E.g. $\left(\frac{y^8}{256x^{20}}\right)^{\frac{1}{4}}$ **or** $\left(\frac{4x^5}{y^2}\right)^{-1}$ **or** $\frac{x^{-5}}{4y^{-2}}$ **or** $\frac{\frac{1}{4}x^{-5}}{y^{-2}}$ **or** $k\frac{y^a}{x^b}$ **or** $\frac{ky^a}{x^b}$ with 2 of $k = \frac{1}{4}$ oe , $a = 2$, $b = 5$ **or** $\frac{y^a}{mx^b}$ with 2 of $m = 4$, $a = 2$, $b = 5$	$\frac{y^2}{4x^5}$	2	M1 for a correct first step leading to a correct partially simplified expression A1 for $\frac{y^2}{4x^5}$ **or** $\frac{\frac{1}{4}y^2}{x^5}$ **or** $0.25\frac{y^2}{x^5}$ **or** $0.25y^2x^{-5}$
	b	$\frac{1}{(3x-5)(3x+5)} - \frac{1}{2(3x+5)}$ E.g. $\frac{2}{2(3x-5)(3x+5)} - \frac{1(3x-5)}{2(3x-5)(3x+5)}$ **or** $\frac{6x+10}{(9x^2-25)(6x+10)} - \frac{9x^2-25}{(9x^2-25)(6x+10)}$	$\frac{7-3x}{2(3x-5)(3x+5)}$	3	M1 indep for $(3x + 5)(3x – 5)$ M1 for two correct fractions with a common denominator if there is any expansion at this stage then it must be correct A1 accept equivalents eg. $\frac{7-3x}{18x^2-50}$
		Alternative scheme $\frac{6x+10}{(9x^2-25)(6x+10)} - \frac{9x^2-25}{(9x^2-25)(6x+10)}$	$\frac{7-3x}{2(3x-5)(3x+5)}$	3	M1 for two correct fractions with a common denominator

	$\frac{(7-3x)(3x+5)}{(9x^2-25)(6x+10)}$			M1 Numerator expanded and then factorised correctly A1 accept equivalents

21	$\left(\frac{9x^2-4}{3x^2-13x-10}=\right)\ \frac{(3x+2)(3x-2)}{(3x+2)(x-5)}$			M1	for either $(3x+2)(3x-2)$ **or** $(3x+2)(x-5)$	M2 for $\frac{9x^2-4}{(9x^2-4)(x-5)}=\frac{1}{(x-5)}$
	$\left(\frac{9x^2-4}{3x^2-13x-10}=\right)\ \frac{(3x+2)(3x-2)}{(3x+2)(x-5)}$			M1	for $(3x+2)(3x-2)$ **and** $(3x+2)(x-5)$	
	E.g. of denominators $(3x-2)(3x^2-13x-10)(x-1)$ **or** $(3x-2)(3x+2)(x-5)(x-1)$ **or** $9x^4-54x^3+41x^2+24x-20$ **or** $(3x+2)(x-5)(x-1)$ **or** $3x^3-16x^2+3x+10$ **or** $(3x-2)(x-5)(x-1)$ **or** $3x^3-20x^2+27x-10$ **or** $(x-5)(x-1)$ **or** x^2-6x+5			M1	(indep) ft their fractions for use of a correct common denominator for 2 fractions with **algebraic** denominators NB: fractions need not be simplified	
	$\frac{x-1-7(x-5)}{(x-5)(x-1)}$ **or** $\frac{x-1-7x+35}{(x-5)(x-1)}$ **or** $\frac{x-1-7(x-5)}{x^2-6x+5}$ **or** $\frac{x-1-7x+35}{x^2-6x+5}$ oe			M1	for a **correct** fraction with a **correct quadratic** denominator – may or may not be expanded which leads to a correct answer	
		$\frac{2(17-3x)}{(x-5)(x-1)}$	5	A1	accept $\frac{34-6x}{(x-5)(x-1)}$ oe; if denominator is expanded then it must be correct	
						Total 5 marks

21	$12^2 = 2^4 \times 3^2$ **or** $2 \times 12^2 = 2^5 \times 3^2$ oe **or** $\frac{2\times12^2}{3^2}(=32) = 2^5$		5	M1	
	$18^{4n} = (2 \times 3^2)^{4n}$ **or** $2^{4n} \times 3^{2\times4n}$			M1	
	$3n^2 - 14n - 5\ (= 0)$			A1	
	e.g. $(3n + 1)(n - 5)(= 0)$ $n = \frac{14 \pm \sqrt{(-14)^2 - (4\times3\times-5)}}{2\times3}$			M1	for solving their 3 term quadratic equation using any correct method - if factorising, allow brackets which expanded give 2 out of 3 terms correct (if using formula or completing the square allow one sign error and some simplification – allow as far as e.g. $\frac{14 \pm \sqrt{196+60}}{6}$ oe)
		$-\frac{1}{3}$, 5		A1	Allow −0.33 or better for $-\frac{1}{3}$
					Total 5 marks

12	(a)	$n(3n^2+5n-12n-20)$ **or** $n(3n^2-7n-20)$ **or** $(3n^2+5n)(n-4)$ **or** $(n^2-4n)(3n+5)$ **or** $3n^3+5n^2-12n^2-20n$		2	M1 for a correct partial expansion (may be unsimplified) (allow one error in the expansion of $(n-4)(3n+5)$ e.g. for any 3 correct terms **or** for 4 out of 4 correct terms ignoring signs **or** for $3n^2-7n\ldots$ **or** for $\ldots-7n-20$)
			$3n^3-7n^2-20n$		A1 oe e.g. if correct answer seen allow further factorisation to $n(3n^2-7n-20)$
	(b)	$\frac{12}{4x}+\frac{2(x+2)}{4x}+\frac{x}{4x}$ oe **or** $\frac{12+2(x+2)+x}{4x}$ oe $\frac{3(8x)}{8x^2}+\frac{4x(x+2)}{8x^2}+\frac{2x^2}{8x^2}$ oe **or** $\frac{3(8x)+4x(x+2)+2x^2}{8x^2}$ oe		3	M1 for three correct fractions with a common denominator **or** a single correct fraction
		$\frac{12+2x+4+x}{4x}$ oe **or** $\frac{24x+4x^2+8x+2x^2}{8x^2}$ oe **or** $\frac{6x^2+32x}{8x^2}$ oe **or** $\frac{3x^2+16x}{4x^2}$ oe **or** $\frac{6x+32}{8x}$ oe			M1 for a correct single fraction with brackets expanded
			$\frac{3x+16}{4x}$		A1 oe $\frac{16+3x}{4x}$
					Total 5 marks

11	(a)	$(3x \pm 2y)(3x \pm 2y)$ or $(3x)^2 - (2y)^2$		2	M1
			$(3x+2y)(3x-2y)$		A1
	(b)	$\frac{7(4x)}{32x} - \frac{8(x+3)}{32x}$ oe or $\frac{7(4x)}{8(4x)} - \frac{8(x+3)}{8(4x)}$ oe or $\frac{28x}{32x} - \frac{8(x+3)}{32x}$ oe or $\frac{28x}{32x} - \frac{8x+24}{32x}$ oe or $\frac{28x-8(x+3)}{32x}$ oe or $\frac{7x}{8x} - \frac{2(x+3)}{8x}$ oe or $\frac{7x-2(x+3)}{8x}$ oe		3	M1 for two correct fractions with common denominator **or** a single correct fraction
		$\frac{28x-8x-24}{32x}$ oe or $\frac{20x-24}{32x}$ oe or $\frac{7x-2x-6}{8x}$ oe or $\frac{20x}{32x} - \frac{24}{32x}$ oe or $\frac{28x}{32x} - \frac{8x}{32x} - \frac{24}{32x}$ oe			M1 for correct fraction(s) with bracket(s) expanded **and** dealing with the negative signs
			$\frac{5x-6}{8x}$		A1 or $\frac{-6+5x}{8x}$
					Total 5 marks

7	(a)(i)		23, 24 ,27, 29, 30, 31, 33	1	B1 in any order with no repeats
	(a)(ii)		27, 33	1	B1 in any order with no repeats
	(b)	eg 1. Yes, no members/numbers/values in common 2. Yes, nothing in common 3. Yes, no common members/numbers/values 4. Yes, they share no common members/numbers/values 5. Yes, there is not the same members/numbers/values in both sets 6. Yes, there is no intersection or there is nothing in B and C 7. Yes, as there are no members/numbers/values the same (in B and C) 8. Yes, no members/numbers/values in B are in C or vice versa 9. Yes, there are no members/numbers in B that are multiples of 3 10. Yes, there are no members/numbers/values in that empty set 11. Yes, 23, 29, 31 not in C 12. Yes, 24, 27, 30, 33 are not in B Allow sector for set This is not an exhaustive list Allow element(s) for members/numbers/values	Yes, there are no multiples of 3 in set *B*	1	B1 for Yes and a statement which indicates correct meanings of intersection and empty set. If no box is ticked, then the 'Yes' must be stated in the answer
	(c)		23, 25, 29, 31	2	B2 for the four correct numbers and no additions (B1 for three correct values with no more than one incorrect or for four correct values with no more than one incorrect)
					Total 5 marks

8	1575 = (area) × 21 oe **or** (area =) 75 **or** 1575 = $\pi \times r^2 \times 21$ oe **or** $r^2 = \frac{1575}{21\pi} \left(= 23.8(732...)\right)$ oe **or** $r = \sqrt{\frac{1575}{21\pi}} \left(= 4.88(602...)\right)$ oe		3	M1 for finding the area using Vol = cross sectional area × height **or** finding r or r^2 using vol = $\pi r^2 h$ NB r^2 and r can be rounded or truncated
	$\frac{84}{"75"}$ oe or $\frac{84}{\pi "4.88"^2}$ oe or $\frac{84}{\pi "23.8"}$ oe			M1 for $\frac{84}{\text{area of circle}}$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	1.12		A1 accept 1.06 – 1.121
				Total 3 marks

9	(a)		35 000 000	1	B1
	(b)	$8.2 \times 10^5 + 6\,780\,000$ oe or $820\,000 + 6\,780\,000$ oe or 7 600 000 or 76×10^5 oe or 7.6×10^n where $n \neq 6$		2	M1 Allow correct mixture of ordinary numbers and standard form numbers
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	7.6×10^6		A1
					Total 3 marks

10	(a)		1	1	B1
	(b)		6	1	B1 Accept y^6
	(c)		$125a^{12}c^6$	2	B2 for $125a^{12}c^6$ B1 for a product in the form ka^pc^q where 2 from k, p or q are correct eg $5a^{12}c^6$ or $125a^{12}3c^6$ Accept multiplication signs between terms (Allow $125a^{12}$ or $125c^6$ or $a^{12}c^6$ as long as not added to any other terms)
					Total 4 marks

11	$(CM)^2+(12\div2)^2=9^2$ oe or $9^2-(12\div2)^2\ (=81-36=45)$		4	M1 *AM = MB* *CAM = CBM*	M2 for $(\cos^{-1}(CAM)=)\dfrac{12\div2}{9}=48.1(896...)$ **and** $(CM=)(12\div2)\times\tan"48.1..."(=6.7\ldots)$ or $(CM=)9\times\sin"48.1..."(=6.7\ldots)$
	$\sqrt{9^2-(12\div2)^2}$ oe $(=\sqrt{81-36}=\sqrt{45}=3\sqrt{5}=6.7(08...))$			M1	
	("7"+ 9 + 9 + 12) × 21.5(0) or 37 × 21.5(0)			M1	
	Working required	795.5(0)		A1 dep on M2 SC B3 for awrt 789 for using 6.7…	
					Total 4 marks

12	(a)	$(2y \pm 1)(3y \pm 4)$ or $(2y \pm 4)(3y \pm 1)$ or $2y(3y - 4) + 1(3y - 4)$ or $3y(2y + 1) - 4(2y + 1)$		2	M1 NB factors must be in the form $(ay + b)$ where a and b are integers Condone use of a different letter to y
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$(2y + 1)(3y - 4)$		A1 or $(3y - 4)(2y + 1)$ Ignore further working if solving a quadratic to find roots.
	(b)	$\frac{3(2x+1)}{12x} + \frac{4(7-5x)}{12x}$ **or** $\frac{3x(2x+1)}{12x^2} + \frac{4x(7-5x)}{12x^2}$ **or** $\frac{3(2x+1)+4(7-5x)}{12x}$ oe **or** $\frac{3x(2x+1)+4x(7-5x)}{12x^2}$ oe		3	M1 for two correct fractions with common denominator with the intention to add **or** a single correct fraction NB $12x$ can be written as $(3)(4x)$ or $(4)(3x)$ for this mark or $12x^2$ can be written as $(3x)(4x)$ for this mark
		$\frac{6x+3+28-20x}{12x}$ oe or $\frac{6x^2+3x+28x-20x^2}{12x^2}$ oe or $\frac{31x-14x^2}{12x^2}$ oe			M1 for a correct single fraction with **all** brackets expanded
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\frac{31-14x}{12x}$		A1 or $\frac{14x-31}{-12x}$
					Total 5 marks

12	(a)	$\frac{4(x+1)-3(x-2)}{(x-2)(x+1)}$ **or** $\frac{4(x+1)}{(x-2)(x+1)}-\frac{3(x-2)}{(x-2)(x+1)}$		3	M1	for expressing both fractions correctly with a common denominator.
		$\frac{4x+4-3x+6}{(x-2)(x+1)}$ **or** $\frac{4x+4-3x+6}{x^2-x-2}$			M1	for removing brackets in a single fraction with a correct denominator. Allow denominator to be expanded. Allow one error in the expansion of the numerator.
			$\frac{x+10}{(x-2)(x+1)}$		A1	accept $\frac{x+10}{x^2-x-2}$ oe
	(b)	$2x(x-5)=2x^2-10x$ **or** $2x(x-3)=2x^2-6x$ **or** $(x-5)(x-3)=x^2-5x-3x+15(=x^2-8x+15)$		3	M1	for multiplying $2x$ by a bracket with both terms correct **or** the 2 brackets with at least 3 out of 4 terms correct or at least 2 out of 3 terms correct
		$(2x^2-10x)(x-3)=2x^3-6x^2-10x^2+30x$ **or** $(2x^2-6x)(x-5)=2x^3-10x^2-6x^2+30x$ **or** $2x(x^2-5x-3x+15)=2x^3-10x^2-6x^2+30x$ **or** $2x(x^2-8x+15)=2x^3-16x^2+30x$			M1	(dep) for multiplying the product of $2x$ and the 1st bracket (ft from the 1st stage) by the 2nd bracket and getting at least 3 out of 4 terms correct **or** multiplying the product of the 2 brackets (ft from the 1st stage) by the $2x$, and getting at least 3 out of 4 or 2 out of 3 terms correct
			$2x^3-16x^2+30x$		A1	
						Total 6 marks

Question	Working	Answer	Mark	Notes
21 (a)	Factorising numerator as $(5x + 4)(2x + 3)$		3	M1
	Factorising denominator as $(2x + 3)(2x – 3)$			M1
		$\frac{5x+4}{2x-3}$		A1
(b)	$(8^{5y} =) 2^{15y}$ or $(4^n =) 2^{2n}$ or 2^{5y+2}		4	M1
	$2^{5y+2} = 2^{15y - 2n}$ oe			M1 e.g. $2^{2n} = 2^{15y - 5y - 2}$
	$5y + 2 = 15y – 2n$ oe			M1 Correct equation using the powers
		$n = 5y – 1$		A1 Dep on M2 (accept $5y – 1$)
				Total 7 marks

22	$(2865 =) \frac{30}{2}(2 \times -6 + 29d)$		4	M1 Correct expression for sum of 30 terms
	$d = 7$			A1 Correct value for d
	$-6 + 8 \times$ "7" or (nth term =) $-6 +$ "7"$(n – 1)$			M1 ft their d. Dep on M1
		50		A1
				Total 4 marks

12	(a)		$16p^6q^8$	2	B2 for all three correct terms (B1 for 2 correct terms in a product of 3 terms or for $(4p^3q^4)^2$ or $(4096p^{18}q^{24})^{\frac{1}{3}}$)
	(b)	eg $\frac{2\times10}{3x\times10}+\frac{4\times6}{5x\times6}-\frac{9\times3}{10x\times3}$ $(=\frac{20}{30x}+\frac{24}{30x}-\frac{27}{30x})$		2	M1 for a common denominator for all 3 terms with at least 2 correct equivalent fractions (no need for signs) [NB: fraction can be done in 2 parts]
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{17}{30x}$		A1 or $\frac{17}{30}x^{-1}$
	(c)	eg $4x(x-5)=4x^2-20x$ or $4x(2x+3)=8x^2+12x$ or $(x-5)(2x+3)=2x^2+3x-10x-15$ $=2x^2-7x-15$		3	M1 allow one error in the expansion of $4x(x-5)$ or $4x(2x+3)$ or $(x-5)(2x+3)$
		eg $(4x^2-20x)(2x+3)=8x^3+12x^2-40x^2-60x$ or $(8x^2+12x)(x-5)=8x^3+12x^2-40x^2-60x$ or $4x(2x^2+3x-10x-15)=8x^3+12x^2-40x^2-60x$ or $4x(2x^2-7x-15)=8x^3-28x^2-60x$			M1ft but dep on previous M1 for correctly expanding – allow one extra error or one omission.
		Working required	$8x^3-28x^2-60x$		A1 dep on M1 May be factorised if $8x^3-28x^2-60x$ seen
					Total 7 marks

12	a		$4e^5f^3$	2	B2	(B1 for 2 out of 3 terms correct in a 3 term product)
	b	E.g. $\frac{3(2x+1)+4(x-2)}{12}$ or $\frac{3(2x+1)}{12}+\frac{4(x-2)}{12}$		3	M1	for expressing both fractions correctly with a common denominator. Allow as two separate fractions.
		E.g. $\frac{6x+3+4x-8}{12}$			M1	for removing brackets correctly in a correct single fraction
			$\frac{10x-5}{12}$		A1	accept $\frac{5(2x-1)}{12}$

c	$(4^{k+3}=)(2^2)^{k+3}$ oe **or** $(16=)2^4$ $(16=)4^2$ **or** $(2^k=)\left(4^{\frac{1}{2}}\right)^k$ oe $(4^{k+3}=)\left(16^{\frac{1}{4}}\right)^{k+3}$ oe **or** $(2^k=)\left(16^{\frac{1}{4}}\right)^k$ oe		4	M1 for $(2^2)^{k+3}$ oe **or** 2^4 **or** 4^2 **or** $\left(4^{\frac{1}{2}}\right)^k$ oe **or** $\left(16^{\frac{1}{4}}\right)^{k+3}$ oe **or** $\left(16^{\frac{1}{4}}\right)^k$ oe
	$(4^{k+3}=)(2^2)^{k+3}$ oe **and** $(16=)2^4$ $(16=)4^2$ **and** $(2^k=)\left(4^{\frac{1}{2}}\right)^k$ oe $(4^{k+3}=)\left(16^{\frac{1}{4}}\right)^{k+3}$ oe **and** $(2^k=)\left(16^{\frac{1}{4}}\right)^k$ oe			M1 for $(2^2)^{k+3}$ oe **and** 2^4 **or** 4^2 **and** $\left(4^{\frac{1}{2}}\right)^k$ oe **or** $\left(16^{\frac{1}{4}}\right)^{k+3}$ oe **and** $\left(16^{\frac{1}{4}}\right)^k$ oe
	E.g. $2k + 6 = 4 + k$ **or** $k+3=2+\frac{1}{2}k$ **or** $\frac{1}{2}(k+3)=1+\frac{1}{4}k$			M1 for a correct linear equation in k
		−2		A1 dep on at least M2
				Total 9 marks

Question	Working	Answer	Mark	Notes
25	$(N + 1)^2 = (N^2 + 2N + 1)$ and $(N - 1)^2 = (N^2 - 2N + 1)$		3	M1
	$(N^2 + 2N + 1) - (N^2 - 2N + 1) = 4N$			M1 Must reach $4N$ correctly
		$N = 5x$ oe Therefore $4N = 20x$		A1 Dep. on M2. A correct conclusion (i.e. 20 "x") following fully correct working
	Alt: $N = 5x$ oe in both A and B			M1
	$(5x + 1)^2 = (25x^2 + 10x + 1)$ and $(5x - 1)^2 = (25x^2 - 10x + 1)$			M1
		$(25x^2 + 10x + 1) - (25x^2 - 10x + 1) = 20x$		A1 Dep. on M2. Subtraction of two correct brackets to reach 20 "x"
	Alt: $A^2 - B^2 = (A + B)(A - B)$ $A + B = 2N$ and $A - B = 2$			M1
	$A^2 - B^2 = 2N \times 2 = 4N$			M1
		$N = 5x$ oe Therefore $4N = 20x$		A1 Dep. on M2. A correct conclusion (i.e. 20 "x") following fully correct working
				Total 3 marks

17		eg $2n$, $2n + 2$, $2n + 4$ **or** $2n - 2$, $2n$, $2n + 2$ etc		3	M1	3 consecutive even numbers in algebraic form (any letter can be used)
		eg $(2n + 4)^2 - (2n)^2$ $(= 4n^2 + 8n + 8n + 16 - 4n^2 (= 16n + 16))$ **or** $(2n + 2)^2 - (2n - 2)^2$ $(= 4n^2 + 4n + 4n + 4 - (4n^2 - 4n - 4n + 4) (= 16n))$			M1	for squaring the largest and smallest even numbers and subtracting (no need to expand or simplify for this mark)
		eg $8(2n + 2) = 16n + 16$ **or** eg $16n + 16 = 8(2n + 2)$ **or** eg $16n = 8(2n)$ **or** eg $8n + 8n = 8(n + n)$ **or** eg $\frac{16n+16}{2n+2} = 8$	Correctly shown		A1	dep on M2 for use of algebra to show correct conclusion (SCB1 for eg $(p + 4)^2 - p^2$) (SCB2 for use of eg $(p + 4)^2 - p^2 = 8p + 16 = 8(p + 2)$ If the student shows this and also says "it is true for all numbers, so it must be true for even numbers" oe then this would gain M2A1
		Alternative				**Total 3 marks**
		eg a, b, c are consecutive even numbers where $a < b < c$ **and** one of $b = \frac{a + c}{2}$ **or** $a + c = 2b$ **or** $c - a = 4$ oe		3	M1	3 numbers defined as consecutive even numbers with one correct equation, writing one term in terms of one or more of the others or $c - a = 4$
		eg a, b, c are consecutive even numbers where $a < b < c$ **and** all of $b = \frac{a + c}{2}$ **and** $a + c = 2b$ **and** $c - a = 4$ oe			M1	3 numbers defined as consecutive even numbers with three correct equations that involve all letters in some place
		Now $c^2 - a^2 = (c - a)(c + a) = 4 \times 2b = 8b$	Correctly shown		A1	dep on M2 for use of algebra to show correct conclusion
						Total 3 marks

15	E.g. n, $n + 1$, $n + 2$ $(n^2 =)n^2$ $((n+1)^2 =)n^2+n+n+1=n^2+2n+1$ oe $((n+2)^2 =)n^2+2n+2n+4=n^2+4n+4$ oe or E.g. $n-1$, n, $n + 1$ $((n-1)^2 =)n^2-n-n+1=n^2-2n+1$ oe $(n^2 =)n^2$ $((n+1)^2 =)n^2+n+n+1=n^2+2n+1$ oe		3	M1 for 3 appropriate terms for their 3 numbers **and** for correctly finding the expansion of at least 2 squares (Allow 2 × middle number + 2)
	$n^2+n^2+2n+2n+4\,(=2n^2+4n+4)$ oe and $2(n+1)^2=2n^2+2n+2n+2(=2n^2+4n+2)$ oe or $n^2-2n+1+n^2+2n+1\,(=2n^2+2)$ oe			M1 for finding the sum of first and last square **and** double the square of the middle (Allow 2 × middle number + 2)
	E.g. $2n^2+4n+4=2n^2+4n+2+2$ oe or $2(x+1)^2+2=2(x+1)^2+2$ oe or $2n^2+2=2n^2+2$ oe	Complete proof		A1 for conclusion from two correct expressions e.g. $2n^2 + 4n + 4$ **and** $2n^2 + 4n + 2$
				Total 3 marks

18	eg $(2n + 1)^2 + (2n – 1)^2$ or $(2n + 1)^2 + (2n + 3)^2$ oe		3	M1	for setting up a correct algebraic expression (any letter can be used) must have intention to add (may come after expanding)
	Eg $4n^2 + 4n + 1 + 4n^2 – 4n + 1$ **or** $8n^2 + 2$ **or** $4n^2 + 4n + 1 + 4n^2 + 12n + 9$ **or** $8n^2 + 16n + 10$ oe			M1	correct expansion of brackets and correct signs or a correct result.
	eg $8 \times n^2 + 2$ $\frac{8n^2+16n+10}{8} = n^2 + 2n + \frac{10}{8}$ which shows a remainder of 2 or $10 – 8 = 2$ or $\frac{8n^2+16n+10}{8} = n^2 + 2n + 1$ remainder 2 oe $\frac{8n^2+16n+10}{8} = n^2 + 2n + 1 + \frac{2}{8}$ oe $8(n^2 + 2n + 1) + 2$ oe	shown clearly		A1	conclusion dep on M2 for eg $8n^2 + 2$ **and** a suitable conclusion (may be shown as a calculation/in numbers). The conclusion must be an intention to show that the result is a multiple of 8 and there is 2 remaining.
					Total 3 marks

19	$(PT =) \frac{12 \times 4}{3} (= 16)$		3	M1	NB: 16 from 12 + 4 is incorrect working
	$(r =)$ (“16” + 3) ÷ 2			M1	
		9.5		A1	oe
					Total 3 marks

19	eg $2n$, $2n + 2$, $2n + 4$ **or** $2n - 2$, $2n$, $2n + 2$ etc		3	M1	for 3 consecutive even numbers in algebraic form (any letter can be used)
	eg $(2n)^2 + (2n+4)^2 (= 4n^2 + 4n^2 + 16n + 16 = 8n^2 + 16n + 16)$ **or** $2(2n+2)^2$ $(= 2(4n^2 + 8n + 4) = 8n^2 + 16n + 8)$ **or** $2(2n+2)^2 + 8$ $(= 2(4n^2 + 8n + 4) + 8 = 8n^2 + 16n + 16)$			M1	for the sum of the squares of the largest and smallest even numbers and adding **or** the square of the middle even number multiplied by 2 (no need to expand or simplify for this mark)
	eg $(2n)^2 + (2n+4)^2 = 8n^2 + 16n + 16$ and $2(2n+2)^2 + 8 = 8n^2 + 16n + 16$ **or** $(2n)^2 + (2n+4)^2 = 8n^2 + 16n + 16$ and $2(2n+2)^2 = 8n^2 + 16n + 8$ and $8n^2 + 16n + 16 - (8n^2 + 16n + 8) = 8$ **or** $(2n)^2 + (2n+4)^2 = 8n^2 + 16n + 16$ and $8n^2 + 16n + 16 = 8n^2 + 16n + 8 + 8 = 2(2n+2)^2 + 8$ **or** $2(2n+2)^2 + 8 = 8n^2 + 16n + 16$ and $8n^2 + 16n + 16 = 4n^2 + 4n^2 + 16n + 16 = (2n)^2 + (2n+4)^2$ *Working required*	Correctly shown		A1	dep on M2 for use of algebra to show correct conclusion (SCB1 for eg $(p + 4)^2 + p^2$ or $2(p + 2)^2$ or $2(p + 2)^2 + 8$) (SCB2 for use of eg $(p + 4)^2 + p^2 = 2p^2 + 8p + 16$ and $2(p + 2)^2 + 8 = 2p^2 + 8p + 16$ If the student shows this and also says "it is true for all numbers, so it must be true for even numbers" oe or defines p, $p + 2$, $p + 4$ as even numbers, then this would gain M2A1
					Total 3 marks

17	eg $4n$, $4n + 4$, $4n + 8$ **or** $4n$, $4(n + 1)$, $4(n + 2)$ **or** $4n - 4$, $4n$, $4n + 4$ **or** $4(n - 1)$, $4n$, $4(n + 1)$		3	M1	for correct expressions for 3 consecutive multiples of 4 (any letter can be used) may just see the first and third multiple for this mark
	eg $(4n + 8)^2 - (4n)^2$ $(= 16n^2 + 64n + 64 - 16n^2)$ **or** $(4(n + 2))^2 - (4n)^2$ $(= 16n^2 + 64n + 64 - 16n^2)$ **or** $(4n + 4)^2 - (4n - 4)^2$ $(= 16n^2 + 32n + 16 - 16n^2 + 32n - 16)$ **or** $(4(n + 1))^2 - (4(n - 1))^2$ $(= 16n^2 + 32n + 16 - 16n^2 + 32n - 16)$			M1	for squaring the largest and smallest multiple of 4 and subtracting (no need to expand or simplify for this mark)
	eg $(4n + 8)^2 - (4n)^2 = 16n^2 + 64n + 64 - 16n^2 = 64n + 64$ **or** $(4n + 8)^2 - (4n)^2 = (4n + 8 + 4n)(4n + 8 - 4n) = 8(8n + 8) = 64n + 64$ **or** $(4(n + 2))^2 - (4n)^2 = 16n^2 + 64n + 64 - 16n^2 = 64n + 64$ **or** $(4(n + 2))^2 - (4n)^2 = (4(n + 2) + 4n)(4(n + 2) - 4n) = 8(8n + 8) = 64n + 64$ **or** $(4n + 4)^2 - (4n - 4)^2 = 16n^2 + 32n + 16 - 16n^2 + 32n - 16 = 64n$ **or** $(4n + 4)^2 - (4n - 4)^2 = (4n + 4 + 4n - 4)(4n + 4 - 4n + 4) = 8n \times 8 = 64n$ **or** $(4(n + 1))^2 - (4(n - 1))^2 = 16n^2 + 32n + 16 - 16n^2 + 32n - 16 = 64n$ **or** $(4(n + 1))^2 - (4(n - 1))^2 = (4(n + 1) + 4(n - 4))(4(n + 1) - 4(n - 4)) = 8n \times 8 = 64n$	correctly shown		A1	dep on M2, for use of algebra to show correct conclusion
	Working required				**Total 3 marks**

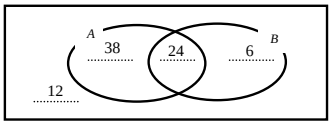
20	$h = f\left(\frac{x+1}{2}\right) = 1 + \frac{1}{\frac{x+1}{2}}$ $\left(= 1 + \frac{2}{x+1}\right)$	$\frac{2}{x-1} - 1$ or $\frac{3-x}{x-1}$	4	M1	for $1 + \frac{1}{\frac{x+1}{2}}$
	$\left(y = 1 + \frac{2}{x+1}\right)$ $y - 1 = \frac{2}{x+1}$ or $y(x+1) = 1(x+1) + 2$			M1	(dep on M1) for a correct first step to change the subject
	$x + 1 = \frac{2}{y-1}$ or $xy - x = 3 - y$			M1	(dep on M1)
	$x = \frac{2}{y-1} - 1$ or $x = \frac{3-y}{y-1}$			A1	oe
					Total 4 marks
	Alternative scheme				
	$h = f\left(\frac{x+1}{2}\right) = 1 + \frac{1}{\frac{x+1}{2}}$ $\left(= 1 + \frac{2}{x+1} = \frac{x+3}{x+1}\right)$	$\frac{3-x}{x-1}$	4	M1	for $1 + \frac{1}{\frac{x+1}{2}}$
	$\left(y = \frac{x+3}{x+1}\right)$ $y(x+1) = (x+3)$			M1	(dep on M1) for a correct first step to change the subject
	$xy - x = 3 - y$			M1	(dep on M1)
	$x = \frac{3-y}{y-1}$			A1	oe
					Total 4 marks
Note: Allow candidates to swap *x* and *y* when finding the inverse					

21	(a)	$x(x^2-1)$ or $(x^2-x)(x+1)$	$x^3 - x$	1	B1 for correct expansion of a pair of brackets and then $x^3 - x$ written down
	(b)	(One of the numbers) is even **or** multiple of 2 **or** 2 is a factor	Proof	3	M1
		(One of the numbers) is a multiple of 3 **or** 3 is a factor			M1
		Hence a multiple of 6			A1
					Total 4 marks

Question		Working	Answer	Mark		Notes
17		(Term n =) $\frac{1}{2}n(n+1)$ or (Term n +1 =) $\frac{1}{2}(n+1)(n+2)$ $\frac{1}{2}n(n+1)+\frac{1}{2}(n+1)(n+2)$ $\frac{1}{2}(n+1)(n+n+2)=\frac{1}{2}(n+1)(2n+2)$ or $\frac{1}{2}n^2+\frac{1}{2}n+\frac{1}{2}n^2+\frac{1}{2}n+n+1 \rightarrow$ n^2+2n+1	$(n+1)^2$ shown	4	M1 M1 M1 A1	Algebraic representation of one of the two consecutive terms in sequence Adding two consecutive terms Factorisation or multiplying out correctly to get to n^2+2n+1 Dep on M3
						Total 4 marks

18	(a)		$\frac{3}{4}$ oe	1	B1	
	(b)	$\frac{x-5}{4(x-5)-3}$	$\frac{x-5}{4x-23}$	2	M1 A1	 cao
	(c)	$y=\frac{x}{4x-3}$ or $x=\frac{y}{4y-3}$ $y(4x-3)=x$ or $x(4y-3)=y$ $4xy-3y=x$ or $4xy-3x=y$ $4xy-x=3y$ or $4xy-y=3x$ $x(4y-1)=3y$ or $y(4x-1)=3x$	$\frac{3x}{4x-1}$ oe	3	M1 M1 A1	Moving the denominator to the other side of the equation Factorising the variable on one side in a correct expression
	(d)	Tangent drawn at $x=-0.5$ (G =) $18 \div 3$ oe	$5 \rightarrow 7$	3	M1 M1 A1	Drawing a tangent at $x=-0.5$ Correct method to work out the gradient of the tangent at $x=-0.5$ or $x=+0.5$ Dep on 1st M1 **SC B1 B1 for drawing a tangent at $x=+0.5$ and gradient = $-3 \rightarrow -4$**
						Total 9 marks

15	eg $(2m + 1)(2n + 1)$ or eg $(2m - 1)(2n + 3)$		4	M2	Product of 2 <u>different</u> odd numbers (in the form $2n + k$ where k is odd). Must have different letters/variables. (M1 for the product of same or different odd numbers where the variable is the same eg $(2n + 1)(2n - 1)$ or $(2n + 1)(2n + 3)$)
	eg $4mn + 2m + 2n + 1$ or eg $4n^2 + 4n + 1$ or eg $4n^2 - 1$ or eg $4n^2 + 8n + 3$			M1	dep M1 Multiplying out the two brackets with odd numbers correctly.
	eg $2(2mn + m + n) + 1$ therefore odd	Proved		A1	dep M3 Factorising <u>and</u> a conclusion **or** stating that the 3 leading terms are all even, hence result is odd.
					Total 4 marks

16	(a)		12, 38, 24, 6	2	B2	B2 for all 4 correct values, in correct regions. B1 for 2 or 3 correct values in correct regions
	(b) (i)		$\frac{24}{80}$ oe	1	B1ft	0.3 ft their 24
	(ii)	eg 62 + "12" or 80 – "6" oe		2	M1ft	A complete method to find the number of elements in the required set.
			$\frac{74}{80}$ oe		A1 ft	0.925 Penalise incorrect probability notation once only
						Total 5 marks

22	$y=(x-4)^2-4^2\ (+5)$ oe **or** $x=(y-4)^2-4^2\ (+5)$		3	M1	for a correct first step in order to complete the square
	$y=4\pm\sqrt{11+x}$ **or** $x=4\pm\sqrt{11+y}$			A1	allow $y=4+\sqrt{11+x}$ **or** $x=4+\sqrt{11+y}$
		$4-\sqrt{x+11}$		A1	oe
					Total 3 marks

22 ALT	$x^2-8x+(5-y)=0$ $(x=)\dfrac{8\pm\sqrt{(-8)^2-4\times1\times(5-y)}}{2\times1}$ **or** $y^2-8y+(5-x)=0$ $(y=)\dfrac{8\pm\sqrt{(-8)^2-4\times1\times(5-x)}}{2\times1}$		3	M1	for a correct first step in preparation for use of quadratic formula and substitution into the quadratic formula (allow one sign error)
	$y=4\pm\sqrt{11+x}$ **or** $x=4\pm\sqrt{11+y}$			A1	allow $y=4+\sqrt{11+x}$ **or** $x=4+\sqrt{11+y}$
		$4-\sqrt{x+11}$		A1	oe
					Total 3 marks

22 ALT	Using $ax^2+bx+c=a(x+p)^2+q$				
	$\left(p=\frac{b}{2a}\right)=\frac{-8}{2}(=-4)$ **and** $q=(4)^2-8(4)+5(=-11)$		3	M1	for finding p and q
	$y=4\pm\sqrt{11+x}$ **or** $x=4\pm\sqrt{11+y}$			A1	allow $y=4+\sqrt{11+x}$ **or** $x=4+\sqrt{11+y}$
		$4-\sqrt{x+11}$		A1	oe
					Total 3 marks

17	$(\text{fg}(k)=)\dfrac{3k+1}{2(3k+1)-4}$ oe or $\dfrac{3k+1}{2(3k+1)-4}=2$ oe or $(\text{fg}(k)=)\dfrac{3k+1}{6k-2}$ oe or $\dfrac{3k+1}{6k-2}=2$ oe or $x=2(2x-4)$ or $x=4x-8$ or $x=\dfrac{8}{3}$ oe		3	M1 for a correct expression for fg(k) or fg(x) or for f(x) = 2 Allow x instead of k for all marks
	$3k+1=2(6k-2)$ oe or $3k+1=2(2(3k+1)-4)$ oe or $3k+1=12k-4$ oe or $3k+1=\dfrac{8}{3}$ oe			M1 dep on M1 for **correctly** removing the denominator to form a correct equation or for g(k) = $\dfrac{8}{3}$
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\dfrac{5}{9}$		A1 oe eg 0.55(555…) rounded or truncated or $0.5\dot{}$ (must show recurring)
				Total 3 marks

18	(a)		$-4\mathbf{a} + 4\mathbf{b}$	1	B1	oe eg $4(\mathbf{b} - \mathbf{a})$
	(b)	$4\mathbf{a} + \frac{1}{4}(-4\mathbf{a} + 4\mathbf{b})$ oe or $4\mathbf{a} + \frac{1}{4}[\overrightarrow{AB}]$ **or** $4\mathbf{b} - \frac{3}{4}(-4\mathbf{a} + 4\mathbf{b})$ oe or $4\mathbf{b} - \frac{3}{4}[\overrightarrow{AB}]$		2	M1ft	for a correct expression ft their (a) where $[\overrightarrow{AB}]$ is their answer to (a) of the form $m\mathbf{a} + n\mathbf{b}$, $m, n \neq 0$
		Correct answer only scores full marks (unless from obviously incorrect working)	$3\mathbf{a} + \mathbf{b}$		A1	allow $\mathbf{b} + 3\mathbf{a}$
						Total 3 marks

19	(a)		$-\frac{1}{2}$	1	B1	oe Accept $x = -\frac{1}{2}$, accept $x \neq -\frac{1}{2}$ Do not allow inequalities, eg $x > -\frac{1}{2}$ or $x \leq -\frac{1}{2}$
	(b)	$\frac{3x - 4}{2(3x - 4) + 1}$		2	M1	for a correct unsimplified expression for $gf(x)$
		Correct answer only scores full marks (unless from obviously incorrect working)	$\frac{3x - 4}{6x - 7}$		A1	oe eg $\frac{4 - 3x}{7 - 6x}$ Correct answer seen followed by incorrect subsequent working scores M1A0
						Total 3 marks

Question		Working	Answer	Mark	Notes
16		e.g. $\sqrt[3]{\frac{960}{405}}\left(=\frac{4}{3}\right)$ (=1.3...)or $\sqrt[3]{\frac{405}{960}}\left(=\frac{3}{4}\right)$(=0.75) $\left(\frac{3}{4}\right)^2\times 928$ **or** $928\div\left(\frac{4}{3}\right)^2$ oe	522	3	M1 for a correct linear scale factor M1 for a complete method A1
17	(a)		−11	1	B1
	(b)		0.5 oe	1	B1
	(c)	g(−1.5) = 1 ÷ (1 – 2 × −1.5) (=0.25) **or** fg(x) = $4-3\times\left(\frac{1}{1-2x}\right)$ oe	3.25 oe	2	M1 g(−1.5) must be the correct calculation alone. A1
18		7.5 **or** 8.5 **or** 4.65 **or** 4.55 25 **or** 15 $\frac{4.55}{25-7.5}$	0.26 oe	4	M1 M1 M1 for $\frac{LB_1}{UB-LB_2}$ with $4.55 \le LB_1 < 4.6$ **and** $20 < UB \le 25$ **and** $7.5 \le LB_2 < 8$ A1 for 0.26 from correct working

16	0.42 ÷ 0.6 (= 0.7) oe			M1 (indep)
	1 – "0.7" (= 0.3) oe **OR** 1 – 0.6 (= 0.4) oe			M1 (indep)
	"0.3" × "0.4" oe **OR** 1 – (0.42 + 0.6 × "0.3" + "0.4" × "0.7") oe			M1 for a complete method
		0.12	4	A1 oe
				Total 4 marks

17	a		9	1	B1
	b		f(x) ≥ 0	1	B1 accept $y \geq 0$ or f ≥ 0
	c	(g(2) =) $\frac{4}{2+3}\left(=\frac{4}{5}\right)$ oe			M1 **or** for sight of fg(x) e.g. $\left(\frac{4}{x+3}-4\right)^2$
			10.24	2	A1 oe e.g. $\frac{256}{25}$
					Total 4 marks

23	$x^2 - 12x + 25$		4	M1 for substituting g(x) into f(x)
	$(x-6)^2 - 6^2 (+25)$ **or** $(x-6)^2 - 11$ **or** $x^2 - 12x + (25 - y) = 0$ oe **or** $y^2 - 12y + (25 - x) = 0$ oe			M1 ft (dep on M1) for a correct first step in order to complete the square. Allow y in place of x. **or** Correctly setting up an equation = 0
	$(x-6)^2 = y + 11$ **or** $(y-6)^2 = x + 11$ **or** $x = \frac{12 \pm \sqrt{144 - 4(25 - y)}}{2}$ oe or $x = 6 \pm \sqrt{11 + y}$			M1 ft (dep on M2) for a correct rearrangement for their completed the square quadratic **or** correctly substituting into the quadratic formula (allow just + or just – instead of $\pm$) Allow same equations with x and y swapped
		$6 - \sqrt{11 + x}$		A1 oe must be in terms of x and have minus only before the square root.
				Total 4 marks

14 (a)			5	1	B1 cao
(b)	$y(x-6)=2x$ or $yx-6y=2x$	$x(y-6)=2y$ or $xy-6x=2y$		3	M1 for multiplying the denominator
	$x(y-2)=6y$	$y(x-2)=6x$			M1 for isolating the x or y terms **and** factorising
			$\frac{6x}{x-2}$		A1 accept $\frac{-6x}{2-x}$ (must be a function of x)
					Total 4 marks

19	eg $(\text{fg}(x) =)(2x+1)^2 - 4$		4	M1 for finding fg(x)
	eg $4x^2 + 4x - 3\ (> 0)$ or $4x^2 + 4x - 3 (= 0)$ **or** $(2x+1)^2 > 4$ or $(2x+1)^2 = 4$			M1 For a correct expansion and fg(x) written as a 3 term quadratic or a start to write quadratic in correct form for completing square
	$-\frac{3}{2}$ oe (**and**) $\frac{1}{2}$ oe			A1 for finding the two correct critical values (dep on previous M1) (values seen with any signs between)
		$x < -\frac{3}{2}$, $x > \frac{1}{2}$		A1 two fully correct inequalities, oe (dep on 2nd M1)
				Total 4 marks

17	$y=\frac{k}{\sqrt{x}}$ or $ky=\frac{1}{\sqrt{x}}$ or $\sqrt{x}=\frac{k}{y}$ oe		3	M1 (NB. Not for $y=\frac{1}{\sqrt{x}}$) Constant of proportionality must be a symbol such as k (Allow c for k for this mark only)	M2 for $c^4=\frac{k}{\sqrt{c^2}}$ oe
	$c^4=\frac{k}{\sqrt{c^2}}$ oe or $k=c^4\times\sqrt{c^2}$ oe			M1 for substitution of x and y into a correct formula	
	Correct answer scores full marks (unless from obvious incorrect working)	$y=\frac{c^5}{\sqrt{x}}$		A1 oe e.g $y=c^5\times\frac{1}{\sqrt{x}}$ Award 3 marks if answer is $y=\frac{k}{\sqrt{x}}$ on the answer line and $k=c^5$ clearly given in the body of working of the script	
					Total 3 marks

18	(a)		$\frac{k}{x}$	1	B1 allow kx^{-1}
	(b)(i)		-46	1	B1 cao
	(ii)	$\frac{3\left(2-3x^4\right)}{2-\left(2-3x^4\right)}$ or $\frac{6-9x^4}{2-2+3x^4}$ oe or $\frac{6-9x^4}{3x^4}$ oe		2	M1
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{2-3x^4}{x^4}$		A1 allow $\frac{2}{x^4}-3$ oe
					Total 4 marks

Q	Working	Answer	Mark	Notes	
25	$y=3\left(x^2-4x\right)+7$ **or** $y=3\left(x^2-4x+\frac{7}{3}\right)$ or $\frac{y-7}{3}=x^2-4x$ or $y=3(x-2)^2$.....		4	M1	for a correct equation for a first step to complete the square
	eg $y=3\left(\left(x-2\right)^2-2^2\right)+7$ **or** $y=3\left(\left(x-2\right)^2-2^2+\frac{7}{3}\right)$ **or** $y=3\left(x-2\right)^2-5$ oe or			M1	
	$\left(x-2\right)^2=\frac{y+5}{3}$ oe eg $(x-2)^2=\frac{y-7}{3}+4$ or $x-2=(\pm)\sqrt{\frac{y+5}{3}}$ oe			M1	
	Correct answer scores full marks (unless from obvious incorrect working)	$2-\sqrt{\frac{x+5}{3}}$		A1 oe	NB: note only negative square root. Must be in terms of x **any equivalent form**
	Note: Allow candidates to swap x and y when finding the inverse				**Total 4 marks**
25 Alt	$3x^2-12x+(7-y)=0$		4	M1	for a correct first step
	$(x=)\frac{12\pm\sqrt{144-12(7-y)}}{6}$			M1	
	$(x=)2\pm\sqrt{\frac{60+12y}{36}}$ oe			M1	
	Correct answer scores full marks (unless from obvious incorrect working)	$2-\sqrt{\frac{x+5}{3}}$		A1 oe	NB: note only negative square root. Must be in terms of x **any equivalent form**
					Total 4 marks

17	(a)		2.5	1	B1	oe e.g. $2\frac{1}{2}, \frac{5}{2}$ Accept $x = 2.5$ oe and $x \neq 2.5$ oe Any response that contains 2.5 oe is also acceptable, **APART FROM** $x > 2.5$ oe or $x < 2.5$ oe or $x \geq 2.5$ oe or $x \leq 2.5$ oe
	(b)	(gh(x)=) $\frac{11}{2(x^2+4)-5}(=1)$		3	M1	
		$11 - 3 = 2x^2$ oe eg $x^2 = 4$ **or** $2x^2 - 8 = 0$ **or** $x^2 - 4 = 0$			M1	correct expansion and rearrangement with x term on one side and number terms the other side **or** all terms on one side in an equation
		Correct answer scores full marks (unless from obvious incorrect working)	2		A1	cao, an answer of ±2 gains M2 only If no other marks awarded, award SCB1 for answer of 2.2 oe
						Total 4 marks

14	1 + 1.45 (= 2.45) or $1 + \frac{29}{20}$ $(= \frac{49}{20})$ or B = 1.45A oe or B = $\frac{29}{20}$A oe or A + 1.45A or A + $\frac{29}{20}$A or 2.45A or (A : B =) 100 : 145 oe or 100 + 145 (= 245) oe or (B : C =) 3 : 2 oe or $B = 1.5C$ oe			5	B1 must identify ratios with Abel and Bahira or Bahira and Chanda Allow any letters for A, B and C
	A + 1.45A = 15 435 or 15 435 ÷ "2.45" or 15 435 ÷ "$\frac{49}{20}$" or 15 435 ÷ "245" × 100 or 63 × 100 (= 6300)	M2 for 15 435 ÷ $\left(\frac{1}{1.45}+1\right)$ (= 9135) oe or 15 435 ÷ $\left(\frac{49}{29}\right)$ (= 9135) oe			M1 for a method to find Abel's savings or for 6300
	15 435 – "6300" or 1.45 × "6300" or 145 × "63" (= 9135)				M1 for a method to find Bahira's savings or for 9135
	"9135" ÷ $\frac{3}{2}$ oe or "9135" × $\frac{2}{3}$ oe				M1 for a method to find to find Chanda's savings
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)		6090		A1
					Total 5 marks

15	(a)		(x =) 2	1	B1 Accept $x = 2$ and $x \neq 2$ x cannot be 2 Any response that contains 2 is also acceptable **DO NOT ACCEPT WHEN WRITTEN WITH INEQUALITY SIGNS** $x > 2$ or $x < 2$ or $x \geq 2$ or $x \leq 2$ **DO NOT ACCEPT** 2 with another number eg 2 & 3
	(b)	$y(x-2)=3x+1$ oe or $yx-2y=3x+1$ oe	$x(y-2)=3y+1$ oe or $yx-2x=3y+1$ oe	3	M1
		$x(y-3)=1+2y$ oe	$y(x-3)=1+2x$ oe		M1 for factorising correctly
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$\frac{1+2x}{x-3}$		A1 oe eg $\frac{-1-2x}{3-x}$ (must be in terms of x)
					Total 4 marks

25		$(y=)2(x^2-12x)+7$ **or** $(y=)2\left(x^2-12x+\frac{7}{2}\right)$ **or** $\frac{y-7}{2}=x^2-12x$	$(x=)2(y^2-12y)+7$ **or** $(x=)2\left(y^2-12y+\frac{7}{2}\right)$ **or** $\frac{x-7}{2}=y^2-12y$			M1 for a correct first step in order to complete the square For each method mark the function must be correct
		eg $(y=)2((x-6)^2-6^2)+7$ **or** $(y=)2\left((x-6)^2-6^2+\frac{7}{2}\right)$ **or** $(y=)2(x-6)^2-65$ oe **or** $\frac{y-7}{2}=(x-6)^2-6^2$ oe	eg $(x=)2((y-6)^2-6^2)+7$ **or** $(x=)2\left((y-6)^2-6^2+\frac{7}{2}\right)$ **or** $(x=)2(y-6)^2-65$ oe **or** $\frac{x-7}{2}=(y-6)^2-6^2$ oe			M1 dep on M1
		$(x-6)^2=\frac{y+65}{2}$ oe **or** $(x-6)^2=\frac{y-7}{2}+6^2$ oe	$(y-6)^2=\frac{x+65}{2}$ oe **or** $(y-6)^2=\frac{x-7}{2}+6^2$ oe			M1
		Correct answer scores full marks (unless from obvious incorrect working)		$6+\sqrt{\frac{x+65}{2}}$	4	A1 oe eg $6+\sqrt{\frac{x-7}{2}+36}$ Must be in terms of x M3A0 for $6\pm\sqrt{\frac{x+65}{2}}$ or $6\pm\sqrt{\frac{y+65}{2}}$ or $6+\sqrt{\frac{y+65}{2}}$
						Total 4 marks
Note: Allow candidates to swap x and y when finding the inverse						

25 ALT		$2x^2-24x+7-y(=0)$			M1 for a correct first step
		$(x=)\dfrac{24\pm\sqrt{576-8(7-y)}}{4}$ or $(x=)\dfrac{24+\sqrt{576-8(7-y)}}{4}$	$2\left((x-6)^2-6^2\right)+7-y(=0)$ or $2\left((x-6)^2-6^2+\dfrac{7}{2}\right)-y(=0)$		M1 dep on M1
		$(x=)6\pm\sqrt{\dfrac{y+65}{2}}$	$(x-6)^2=\dfrac{y+65}{2}$		M1
		Correct answer scores full marks (unless from obvious incorrect working)	$6+\sqrt{\dfrac{x+65}{2}}$	4	A1 oe eg $6+\sqrt{\dfrac{x-7}{2}+36}$ Must be in terms of x M3A0 for $6\pm\sqrt{\dfrac{x+65}{2}}$ or $6\pm\sqrt{\dfrac{y+65}{2}}$ or $6+\sqrt{\dfrac{y+65}{2}}$
					Total 4 marks
Note: Allow candidates to swap x and y when finding the inverse					

15	(a)		9	1	B1	allow $9\sqrt{3}$
	(b)	$\frac{21}{3-\sqrt{2}}\times\frac{3+\sqrt{2}}{3+\sqrt{2}}$ **or** $\frac{21}{3-\sqrt{2}}\times\frac{-3-\sqrt{2}}{-3-\sqrt{2}}$		3	M1	for explicitly multiplying the numerator and the denominator by $3+\sqrt{2}$ or $-3-\sqrt{2}$
		eg $\frac{21\left(3+\sqrt{2}\right)}{9-3\sqrt{2}+3\sqrt{2}-2}$ **or** $\frac{21\left(3+\sqrt{2}\right)}{3^2-2}$ **or** $\frac{21\left(3+\sqrt{2}\right)}{9-2}$ **or** $\frac{21\left(3+\sqrt{2}\right)}{7}$ **or** $\frac{63+21\sqrt{2}}{9-2}$ **or** $\frac{63+21\sqrt{2}}{7}$			M1	dep on M1 (denominator may be 4 terms which all need to be correct) $\frac{21}{3-\sqrt{2}}\times\frac{3+\sqrt{2}}{3+\sqrt{2}}=9+3\sqrt{2}$ scores M1M0
		Working required	$9+\sqrt{18}$		A1	dep on M2 SCB1 for $9+\sqrt{18}$ gained with no method marks awarded SCB2 for $9+\sqrt{18}$ gained if you would award 1st M1 but not 2nd M1 (total 2 marks)
						Total 4 marks

16	(a)		6	1	B1	cao
	(b)	$9-\sqrt{4x^2}\,(<0)$		3	M1	for substituting g(x) in f(x), allow incorrect inequality sign or = sign
		eg $9-2x\,(<0)$ **or** $9 < 2x$ **or** $81 < 4x^2$ **or** $9^2 < 4x^2$			M1	for removing the square root, allow incorrect inequality sign or = sign
		Working required	$x > \frac{9}{2}$		A1	(dep on M1) oe eg $x > 4.5$, $\frac{9}{2} < x$, $4.5 < x$
						Total 4 marks

Question		Working	Answer	Mark	Notes	
19	(a)		$y \geq -3$	1	B1	Accept $g^{-1}(x) \geq -3$
	(b)	$(x+3)^2 - 3^2$ **or** $(x+3)^2 - 9$ **or** $(y+3)^2 - 3^2$ **or** $(y+3)^2 - 9$			M1	for completing the square
		$y+9 = (x+3)^2$ **or** $x+9 = (y+3)^2$			M1	
		$\sqrt{y+9} = x+3$ **or** $\sqrt{x+9} = y+3$			M1	
			$-3+\sqrt{x+9}$	4	A1	oe M3A0 for $-3+\sqrt{y+9}$ and for $-3\pm\sqrt{x+9}$

24	(a)		13	1	B1
	(b)	$y=2\left(x^2-10x\right)+9$ **or** $y=2\left(x^2-10x+\frac{9}{2}\right)$			M1 for a correct equation for a first step in order to complete the square
		e.g. $y=2\left(\left(x-5\right)^2-5^2\right)+9$ **or** $y=2\left(\left(x-5\right)^2-5^2+\frac{9}{2}\right)$ **or** $y=2\left(x-5\right)^2-41$ oe			M1 dep
		$\left(x-5\right)^2=\frac{y+41}{2}$ oe			M1
			$5+\sqrt{\frac{x+41}{2}}$	4	A1 oe
					Total 5 marks
Note: Allow candidates to swap *x* and *y* when finding the inverse					

24 Alt	(a)		13	1	B1
	(b)	$2x^2 - 20x + (9 - y) = 0$			M1 for a correct first step
		$x = \frac{20 \pm \sqrt{400 - 8(9-y)}}{4}$ **or** $x = \frac{20 + \sqrt{400 - 8(9-y)}}{4}$			M1 dep
		$x = 5 \pm \sqrt{\frac{41+y}{2}}$ oe			M1
			$5 + \sqrt{\frac{x+41}{2}}$	4	A1 oe
					Total 5 marks
Note: Allow candidates to swap *x* and *y* when finding the inverse					

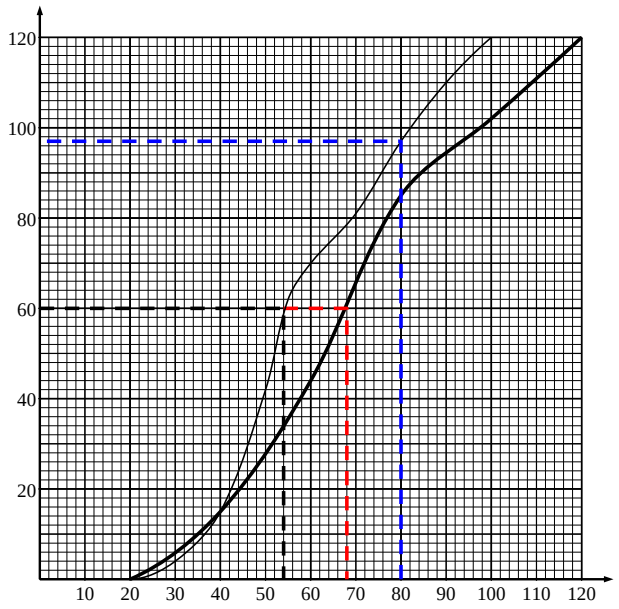
24 Alt	(a)		13	1	B1
	(b)	$2x^2-20x+(9-y)(=0)$			M1 for a correct first step
		e.g. $2\left((x-5)^2-5^2\right)+9-y\,(=0)$ **or** $2\left((x-5)^2-5^2+\frac{9}{2}\right)-y\,(=0)$ **or** $2(x-5)^2-41-y\,(=0)$			M1 dep
		$(x-5)^2=\frac{y+41}{2}$ oe			M1
			$5+\sqrt{\frac{x+41}{2}}$	4	A1 oe
					Total 5 marks
Note: Allow candidates to swap *x* and *y* when finding the inverse					

21		(fg(x) =) $(x + 3)^2 - 2(x + 3)$ oe		5	M1 for substituting g(x) into f(x)
		(fg(x) =) $x^2 + 4x + 3$			A1 Allow $y^2 + 4y + 3$
		$(x + 2)^2 - 4 + 3$ **or** $(x + 2)^2 - 1$ **or** $x^2 + 4x + (3 - y) = 0$ **or** $y^2 + 4y + (3 - x) = 0$			M1 ft (dep on M1) for correctly completing the square on their 3 term quadratic **or** Correctly setting up an equation
		$(x + 2)^2 = y + 1$ **or** $(y + 2)^2 = x + 1$ **or** $x = \frac{-4 \pm \sqrt{16 - 4(3 - y)}}{2}$ or $x = -2 \pm \sqrt{1 + y}$			M1 ft (dep on M2) for a correct rearrangement for their completed the square quadratic **or** correctly substituting into the quadratic formula Allow same equations with x and y swapped
			$-2 + \sqrt{x + 1}$		A1 oe
					Total 5 marks

25	(a)	$(x-3)^2$ or $(3-x)^2$ or $(y-3)^2$ or $(3-y)^2$		4	M1	
		14 or – 14			M1	As part of an expression in x or y or an equation in x and y
		$3\pm\sqrt{14-x}$ or $3\pm\sqrt{14-y}$			M1	Can be ± or – or +
			$3+\sqrt{14-x}$		A1	oe must be in x
25	alt (a)	Alternative method: $x^2-6x+(y-5)=0$ oe or $y^2-6y+(x-5)=0$ oe		4	M1	rearrange to form a quadratic in x or y terms can be in any order but must be in an equation equal to zero
		$y=\frac{6\pm\sqrt{36-4(x-5)}}{2}$ or $x=\frac{6\pm\sqrt{36-4(y-5)}}{2}$			M1	correct substitution into quadratic formula
		$3\pm\sqrt{14-x}$ or $3\pm\sqrt{14-y}$			M1	Can be ± or – or +
			$3+\sqrt{14-x}$		A1	oe must be in x
	(b)		$x \leqslant 14$	1	B1	oe **must** ft from part (a) dep on an answer in correct form
						Total 5 marks

Question	Working	Answer	Mark	Notes
23 (a)	$y = \frac{\sqrt{x^2+k^2}}{x}, x^2y^2 = x^2+k^2 \;\; x^2(y^2-1) = k^2$		3	M1 for squaring and rearranging correctly to the form $x^2(y^2-1) = k^2$
	$\frac{k}{\sqrt{p^2-1}} = k$			M1 (dep) for "$f^{-1}(p)$" = k
		$\sqrt{2}$		A1
	Alternative method $p = f(k)$			M1
	$p = \frac{\sqrt{k^2+k^2}}{k}$			M1
		$\sqrt{2}$		A1
(b)	$(gf(a) =)\left(\frac{\sqrt{a^2+k^2}}{a}\right)^2$ or $(gf(x) =)\left(\frac{\sqrt{x^2+k^2}}{x}\right)^2$		3	M1
	$ka^2 - a^2 = k^2$			M1 (dep) for rearranging gf = k and isolating correctly the terms in a^2
		$\frac{k}{\sqrt{k-1}}$		A1 oe eg $\sqrt{\frac{k^2}{k-1}}$

14



24	(a)	g(2) = 7 × 2 – 6 (= 8) **or** $5(7\times2-6)^2-10(7\times2-6)+7$		2	M1
		Working not required, so correct answer scores full marks	247		A1
	(b)	eg $y = 5(x^2-2x)+7$ **or** $y=5(x^2-2x+\frac{7}{5})$ oe eg $y = 5[(x-1)^2-1^2]+7$ **or** $y=5\left((x-1)^2-1^2+\frac{7}{5}\right)$ oe	eg $x=5(y^2-2y)+7$ **or** $x=5(y^2-2y+\frac{7}{5})$ eg $x=5\left((y-1)^2-1^2\right)+7$ **or** $x=5\left((y-1)^2-1^2+\frac{7}{5}\right)$ oe	4	M1 **or** eg $\frac{y-7}{5}=x^2-2x$ M1 **or** eg $\frac{y-7}{5}=(x-1)^2-1^2$
		$(x-1)^2=\frac{y-2}{5}$ oe	$(y-1)^2=\frac{x-2}{5}$ oe		M1 **or** eg $(x-1)^2=\frac{y-7}{5}+1$
		Working not required, so correct answer scores full marks(unless from obvious incorrect working)	$1+\sqrt{\frac{x-2}{5}}$		A1 Must be in terms of x, oe eg $1+\sqrt{\frac{x-7}{5}+1}$ (NB: $f^{-1}(x)=1\pm\sqrt{\frac{x-2}{5}}$ is 3 marks)
		Alternative for (b)			**Total 6 marks**
		Let $x = 5y^2-10y+7$ [⇔] $5y^2-10y+(7-x)=0$ oe		4	M1
		$[y=]\frac{10\pm\sqrt{100-20(7-x)}}{10}$			M1
		$1\pm\sqrt{\frac{x-2}{5}}$			M1
		Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$1+\sqrt{\frac{x-2}{5}}$		A1 Must be in terms of x
					Total 6 marks

15	(a)		$-\frac{1}{3}$	1	B1 oe allow $-0.\dot{3}$ or -0.33 or better allow $x = -\frac{1}{3}$ or $x \neq -\frac{1}{3}$
	(b)	$\frac{2x-3}{3(2x-3)+1}$		2	M1 for substituting f(x) into g(x) Allow $\frac{f}{3f+1}$
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{2x-3}{6x-8}$		A1 oe (do not isw incorrect cancelling)
	(c)	$y(3x+1) = x$ and $3xy + y = x$ or $x(3y+1) = y$ and $3xy + x = y$		3	M1 for moving the denominator to the other side of the equation and expanding correctly
		$x(1-3y) = y$ or $x(3y-1) = -y$ or $y(1-3x) = x$ or $y(3x-1) = -x$			M1 for collecting and factorising the variable on one side in a correct equation
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{x}{1-3x}$		A1 oe eg $-\frac{x}{3x-1}$ or $\frac{-x}{-1+3x}$ oe
					Total 6 marks

16	(a)		-0.5	1	B1	oe eg $-\frac{1}{2}, \frac{-1}{2}, \frac{1}{-2}, -1/2$
	(b)	$(3x-5)y=2$ **or** $(3y-5)x=2$ **or** $3xy-5y=2$ **or** $3xy-5x=2$ oe or $3y-5=\frac{2}{x}$ **or** $3x-5=\frac{2}{y}$ oe		2	M1	remove denominator or get to the stage $3y-5=\frac{2}{x}$ or $3x-5=\frac{2}{y}$
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{2+5x}{3x}$		A1oe	eg $\frac{2}{3x}+\frac{5}{3}$ or $\frac{\frac{2}{x}+5}{3}$ **must be in terms of *x***
	(c)	$5\left(x^2-4x\right)$.....**or** $5\left(x^2-4x\text{.....}\right)$ **or** $5(x-2)^2\ldots$		3	M1	
		$5\left[(x-2)^2-(-2)^2\right]$.....**or** $5\left[(x-2)^2-(-2)^2\text{.....}\right]$ **or** $5(x-2)^2-20$ ..... **or** $5\left[(x-2)^2+\frac{3}{5}\right]$			M1	$(-2)^2$ can be 2^2 or 4 or $\left(\pm\frac{4}{2}\right)^2$
		Correct answer scores full marks (unless from obvious incorrect working)	$5(x-2)^2+3$		A1	
						Total 6 marks
Alternative mark scheme for 16c						
		$ax^2-2abx+ab^2+c$		3	M1	for multiplying out $a(x-b)^2+c$ to obtain $ax^2-2abx+ab^2+c$ oe
		2 of: $a=5$ $2ab=20$ oe $ab^2+c=23$ oe			M1	for equating coefficients and making 2 correct statements
			$5(x-2)^2+3$		A1	

Question		Working	Answer	Mark	Notes
14	a		-6.5 oe	1	B1
	b	$4y = 3x - 5$ **or** $4x = 3y - 5$	$\frac{4x+5}{3}$ oe	2	M1 A1
	c	$\sqrt{19-3}$ oe **or** f(4) **or** $\frac{3\sqrt{19-3}-5}{4}$ **or** $\frac{3\sqrt{19-x}-5}{4}$ oe	1.75 oe	2	M1 A1 for 1.75oe (and no other solution)
	d		$x > 19$	2	B2 for $(x) > 19$ or an equivalent statement in words If not B2 then award B1 for $(x) \geq 19$

21	a	$5-(x \pm q)^2+9$ oe **or** $p-(x-3)^2$ oe **or** $p-q^2+2qx-x^2$ and one of $2q=6$ **or** $p-q^2=5$			M1	may be seen in working eg $-[(x-3)^2-9-5]$ **or** expanding $p-(x-q)^2$ correctly and equating one of the coefficient of x or the constant term
			$14-(x-3)^2$	2	A1	fully correct SCB1 for $(x-3)^2-14$
	b	e.g. $(x-3)^2=14-y$ [or $(y-3)^2=14-x$]			M1	correct steps to isolate their bracket ft from (a) dep on expression in form $\pm p \pm (x-q)^2$
		$x=3\pm\sqrt{14-y}$ [or $y=3\pm\sqrt{14-x}$]			M1	complete method to find y in terms of x or x in terms of y. Condone + for $\pm$ ft from (a) dep on expression in form $\pm p \pm (x-q)^2$
		$(f^{-1}(x)=)\ 3-\sqrt{14-x}$			M1	for the correct inverse
					M1	method to solve $0<3-\sqrt{14-x}$ or a lower bound of 5 clearly shown, eg $x>5$ as part of the answer
			$5<x\leq 14$	5	A1	cao
						Total 7 marks

Question	Working	Answer	Mark	Notes
19 (a)		4.5	1	B1oe $4.5, x = 4.5, x \neq 4.5$ Allow anything with 4.5, $\frac{9}{2}$ or $4\frac{1}{2}$ apart from $x < 4.5, x > 4.5, x \leq 4.5, x \geq 4.5$
(b)	$(g(4)) = \frac{5}{2\times4-9}(=-5)$ **or** $5\left(\frac{5}{2\times4-9}\right)+7$ oe		2	M1
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	–18		A1
(c)	$(y =)3(x^2-4x)+.....$ **or** $y = 3(x^2-4x+.....)$ where ….can be number(s) or nothing		4	M1 **or** $3x^2-12x+(8-y)=0$oe
	$(y =)3(x-2)^2.....$ **or** $y = 3[(x-2)^2....]$ could have: $y-8 = 3[(x-2)^2....]$ oe			M1 **or** $(x =)\frac{12\pm\sqrt{144-12(8-y)}}{6}$ may have + rather than ±
	$(x-2)^2 = \frac{y+4}{3}$ oe or an answer of $2\pm\sqrt{\frac{4+x}{3}}$			M1 **or** $(x =)2\pm\sqrt{\frac{4+y}{3}}$ may have + rather than ±
	Working not required, so correct answer scores full marks (unless from obvious incorrect working)	$2+\sqrt{\frac{x+4}{3}}$		A1 oe eg $2+\frac{\sqrt{12+3x}}{3}$
NB: Allow candidates to swap *x* and *y* (or other letter) at any stage when finding the inverse – but the answer must be in terms of *x*				
				Total 7 marks

16	(a)		−4	1	B1	
	(b)	(f(2.6) =) 5 × 2.6 – 7 (= 6) **or** $gf(x) = \frac{5(5x-7)}{5x-7+4}$ oe		2	M1	for finding f(2.6) **or** gf(x)
			3		A1	
	(c)	$5\left(\frac{5x}{x+4}\right)-7=2$ **or** $\frac{5x}{x+4}=\frac{2+7}{5}$ oe		3	M1	
		$25x = 9(x + 4)$ oe			M1	for removing the denominator $(x + 4)$ in a correct equation
			2.25		A1	oe
	ALT (c)	fg(x) = 2 ⇒ g(x) = $f^{-1}(2)$ (=9/5) and attempt at f^{-1} or $f^{-1}(2)$			M1	
		$x = g^{-1}$("9/5")			M1	
			2.25		A1	oe
	(d)	$y=\frac{5x}{x+4}$ $y(x+4)=5x$ **or** $x=\frac{5y}{y+4}$ $x(y+4)=5y$		3	M1	
		e.g. $4y = x(5 – y)$ **or** e.g. $4x = y(5 – x)$			M1	for a correct rearrangement and factorising
			$\frac{4x}{5-x}$		A1	oe e.g. $\frac{-4x}{x-5}$
						Total 9 marks

17	(a)	g(3) = – 7 **or** f(3 – 10) = $(3 – 10)^2 + 6$ **or** $3^2 – 20\times3+106$ oe		2	M1	
			55		A1	
	(b)	$(x – 10)^2 + 6 = x^2 + 6$		3	M1	Using f(x – 10) and setting equal to $x^2 + 6$
		$x^2 – 10x – 10x + 100$ oe			M1	for $(x – 10)^2$ expanded correctly.
			5		A1	dep 1st M1
	(c)		0	1	B1	accept $x \neq 0$ or $x = 0$
	(d)	eg $yx = 2x – 4$ oe or $xy = 2y – 4$ oe or $4 = 2x – yx$ or $4 = 2y – yx$		3	M1	Removing denominator equation may be rearranged
		eg $4 = x(2 – y)$ oe or $4 = y(2 – x)$ oe or $\frac{4}{x} = 2 – y$ or $\frac{4}{y} = 2 – x$ or $\frac{4}{2 – y} = x$ or $\frac{4}{2 – x} = y$			M1	for correct factorisation or implied factorisation
			$\frac{4}{2 – x}$ or $\frac{–4}{x – 2}$		A1	oe
						Total 9 marks