<table>
<tr><th>Question</th><th>Solution</th><th>Notes</th></tr>
<tr><td>1. Work out the value of $\left(\frac{323.7}{8.9}\right)^3$, giving your answer correct to 3 significant figures. (3 marks)</td><td>(323.7/8.9) ≈ 36.3707865

$(36.29213483)^3 \approx 48112.51707$

$(323.7/8.9)^3 \approx$ 48100.</td><td>M1 – for 36.37078…

M1 - (36.3707865)^3 ≈ 48112.5170795

For raising their value to the power of 3.

A1 - 48100.</td></tr>
<tr><td>2. (a) Solve $5k + 7 \leq 30$ (2 marks)

(b) p is an integer and $5p + 7 \leq 30$
Write down the largest possible value of p.
(1 mark)</td><td>(a)
$$5k + 7 \leq 30$$ $$5k \leq 23$$ $$k \leq \frac{23}{4}$$
(b) $p = 5$</td><td>M1 – for isolating k
A1 - $k \leq \frac{23}{4}$

Accept $k \leq 5.75$

(b) B1 - $p = 5$</td></tr>
<tr><td>3. A farmer found the weight of 100 chickens.
The table gives information about the weights.
<table>
<tr><th>Weight (w kg)</th><th>Frequency</th></tr>
<tr><td>$0.5 < w \leq 1.5$</td><td>6</td></tr>
<tr><td>$1.5 < w \leq 2.5$</td><td>19</td></tr>
</table></td><td>(a) $2.5 < w \leq 3.5$

(b) Find the midpoints of each interval: 1, 2, 3, 4, 5, 6.

Calculate the product of each midpoint and its corresponding frequency and sum them up:
$$1 * 6 + 2 * 19 + 3 * 39 + 4 * 16 + 5 * 13 + 6 * 7 = 332$$
Then divide the sum by the total frequency:
$$\left(\frac{332}{100}\right) = 3.32$$</td><td>(a) B1 –
$2.5 < w \leq 3.5$

(b)

M1 – for attempting to find the midpoints.

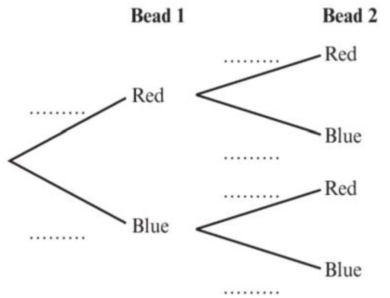
M1 – for calculating the product of each midpoint and its corresponding frequency, and finding the sum.

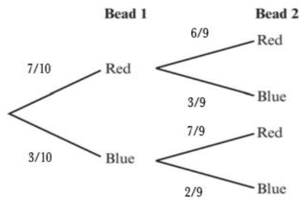
M1 – Their sum divided by the total frequency</td></tr>
</table>

<table>
<tr>
<td>
<table>
<tr><td>$2.5 < w \leq 3.5$</td><td>39</td></tr>
<tr><td>$3.5 < w \leq 4.5$</td><td>16</td></tr>
<tr><td>$4.5 < w \leq 5.5$</td><td>13</td></tr>
<tr><td>$5.5 < w \leq 6.5$</td><td>7</td></tr>
</table>

(a) Find the class interval that contains the median weight. (1 mark)

(b) Work out an estimate for the mean weight of the chickens. Give your answer correct to one decimal place. (4 marks)
</td>
<td>So the mean weight is approximately 3.3 to one decimal place.</td>
<td>A1 – 3.3 (to 1 dp)</td>
</tr>
<tr>
<td>
4. A bag contains 7 red beads and 3 blue beads. A bead is chosen at random from the bag, the colour is recorded, and the bead is not replaced. A second bead is chosen, and the colour recorded.



(a) Complete this tree diagram to show the outcomes of the experiment. (3 marks)
</td>
<td>
(a)


(b) $P(B,B) = \frac{3}{10} \times \frac{2}{9} = \frac{6}{90} = \frac{1}{15}$

(c)$P(R,B)\ or\ P(B,R) = \frac{7}{10} \times \frac{3}{9} + \frac{3}{10} \times \frac{2}{9} = \frac{42}{90} = \frac{7}{15}$
</td>
<td>
(a) B1 – for $\frac{7}{10}\ and\ \frac{3}{10}$

B1 – for $\frac{6}{9}\ and\ \frac{3}{9}$

B1 – for $\frac{7}{9}\ and\ \frac{2}{9}$

(b) M1 – for the product on their values along the branches for $P(B,B)$
A1 - $\frac{1}{15}$ o.e.

(c) M1 for $P(R,B)\ or\ P(B,R)$
A1 - $\frac{7}{15}$ o.e.
</td>
</tr>
</table>

<table>
<tr>
<td>(b) Find the probability that both beads are blue. (2 marks)
(c) Find the probability that both beads are of a different colour. (2 marks)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. (a) Solve $5x - 17 = 14 - 3x$ (2 marks)

(b) Expand and simplify $4(2x - 5y) - 2(3x + 5y)$
(3 marks)</td>
<td>(a) $5x - 17 = 14 - 3x$
$8x = 31$
$x = \frac{31}{8}$

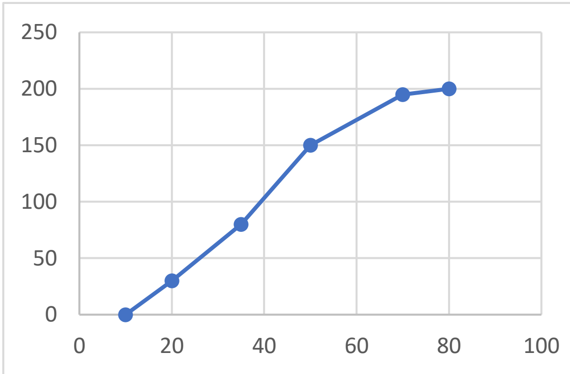
(b) $4(2x - 5y) - 2(3x + 5y)$
=
$8x - 20y - 6x - 10y = 2\boldsymbol{x} - 30\boldsymbol{y}$</td>
<td>(a) M1 – Collecting like terms
A1 - $x = \frac{31}{8}$

(b) M1 – For expanding brackets
B1- For collecting like terms
A1 - $2\boldsymbol{x} - 30\boldsymbol{y}$</td>
</tr>
<tr>
<td>6. The table gives information about the heights, in centimetres, of 200 dolls.

<table>
<tr><th>Height (h cm)</th><th>Frequency</th></tr>
<tr><td>$10 < h \leq 20$</td><td>30</td></tr>
<tr><td>$20 < h \leq 35$</td><td>50</td></tr>
<tr><td>$35 < h \leq 50$</td><td>70</td></tr>
<tr><td>$50 < h \leq 70$</td><td>45</td></tr>
<tr><td>$70 < h \leq 80$</td><td>5</td></tr>
</table>

(a) Complete the cumulative frequency table. (1 mark)

(b) On the grid, draw a cumulative frequency graph for your table.
(2 marks)</td>
<td>Complete the cumulative frequency table: 150 , 195, 200. (1 mark)



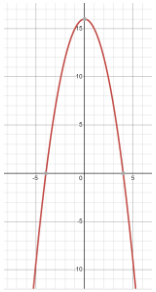
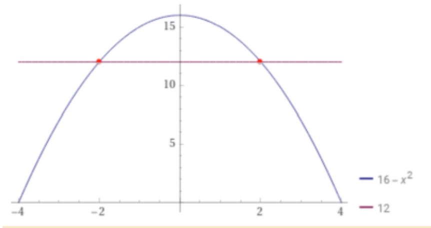
(c) Line drawn across from 100 and down to the x-axis. Be generous here. 38 – 40 cm.</td>
<td>(a) B1 – for all 3 correct: 150, 195, 200

(b) M1- plotting their points from their cumulative Frequency table

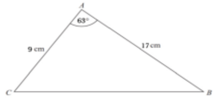
A1- For a lovely drawn ogive, a nice smooth curve drawn with al points correct.

(c)B1- for using 100 shown on the graph.
B1 - 38 – 40 cm (generous, follow through).</td>
</tr>
</table>

(c) Use your graph to find an estimate for the height of the dolls. (2 marks)		
7. (a) Solve $\frac{4x+3}{2x-1} = \frac{6x}{3x-1}$ (5 marks) (b) Solve $\frac{4x-3}{2} + \frac{2x-3}{3} = 5$ (3 marks)	7 (a) $\frac{4x+3}{2x-1} = \frac{6x}{3x-1}$ $(4x+3)(3x-1) = (6x)(2x-1)$ $12x^2 + 5x - 3 = 12x^2 - 6x$ $5x - 3 = -6x$ $11x = 3$ $\boldsymbol{x} = \frac{3}{11}$ (b) $\frac{4x-3}{2} + \frac{2x-3}{3} = 5$ $3(4x-3) + 2(2x-3) = 30$ $12x - 9 + 4x - 6 = 30$ $16x - 15 = 30$ $x = \frac{45}{16}$	(a) **M1** – cross multiplying **M1**- Attempt at FOIL **B1** – for $12x^2 + 5x - 3$ **M1**- rearranging and solving for x **A1** - $\boldsymbol{x} = \frac{3}{11}$ (b) **M1** eliminating the denominators **M1** manipulating and rearranging for x. **A1** $\boldsymbol{x} = \frac{45}{16}$
8. A polygon has an interior angle that is eight times the size of the exterior angle. How many sides does this polygon have? (4 marks)	Let x be the exterior angle of said polygon. The sum of the interior and corresponding exterior angle is $180°$. So: $8x + x = 180$ $9x = 180$ $x = 20$ The exterior angles add up to $360°$, so $\frac{360}{20} = 18\ \boldsymbol{sides}$.	**B1** – for implying that the sum of the interior and corresponding exterior angle is $180°$. **M1** - $8x + x = 180$ **B1**- for using the fact that the sum of the exterior angles add up to $360°$ **A1**- $\frac{360}{20} = 18\ \boldsymbol{sides}$

9. (a) Complete the table of values for $y = 16 - x^2$ (2 marks) (b) On the grid, draw the graph of $y = 16 - x^2$ for all values of x from -5 to 5. (2 marks) (c) Use your graph to find solutions to the equation $16 - x^2 = 12$. (2 marks)	(a) Values are $-9, 0, 7, 12, 15, 16, 15, 12, 7, 0, -9$ (b)  (c)  $\boldsymbol{x} = \pm 2$	(a) **B1** for 2 values correct **B1** for all values correct (b) **M1** for plotting their points **A1** for the correct curve drawn. (c) **M1** for using their graph **A1** f.t. $\boldsymbol{x} = \pm 2$ For 2 answers. Follow through their work.
10. O is the centre of a circle. A, B, C and D are points on the circumference of the circle. Angle $ABD = 19°$. (a) (i) Write down the size of Angle ACB. (1 mark) (ii) Give a reason for your answer. (1 mark) (b) (i) Write down the size of Angle BAD. (1 mark) (ii) Give a reason for your answer.	(a) (i) $19°$ (ii) Angles in the same segment on the same chord are equal. (b)(i) $90°$ (ii) Angles in a semi-circle are $90°$ (c) $180 - (90 + 19) = 71°$.	(a) (i) **B1** $19°$ (ii) **B1** Angles in the same segment on the same chord are equal. (b) **B1** (i) $90°$ (ii) **B1** Angles in a semi-circle are $90°$ (c) **B1** $180 - (90 + 19) = 71°$.

(1 mark) (c) Work out the size of Angle ABD. (1 mark)		
11. Vashti recorded the distance, in kilometres, that she ran each day for 13 days. Here are her results: 2 , 9, 11, 12, 13, 5, 5, 6, 16, 5, 14, 15, 13 Find the interquartile range of her results. (5 marks)	Arrange the data in ascending order: 2, 5, 5, 5, 6, 9, 11, 12, 13, 13, 14, 15, 16 The Median is 11 $Q_1 = 5$ (The median of 2, 5, 5, 5, 6, 9) $Q_3 = 13.5$ (The median of 12, 13, 13, 14, 15, 16) $IQR = Q_3 - Q_1 = 13.5 - 5 = 8.5.$	**B1**- arranging the data in ascending (or descending) order **M1** – Finding the Median **B1** – finding Q_1 or Q_3 **M1** – Their $(Q_3 - Q_1)$ **A1** – 8.5
12. Expand and simplify $(x+2)(x+3)(x+4)$ (4 marks)	$(x+2)(x+3)(x+4)$ $=(x+2)(x^2+7x+12)$ $= \boldsymbol{x}^3 + 9\boldsymbol{x}^2 + 26\boldsymbol{x} + 24$	**M1** Attempt to FOIL two of the brackets (evidence of x^2) **M1** Attempt at expanding all 3 brackets (evidence of x^3) **M1** Collecting like terms **A1** $\boldsymbol{x}^3 + 9\boldsymbol{x}^2 + 26\boldsymbol{x} + 24$
13. The table below gives the average price of a semi-detached house in Scotland in 2021 and 2022. (a) Work out the percentage increase in average price of a semi-detached house from 2021 to 2022. Give your answer to 1 decimal place. (2 marks) (b) The average price of a semi-detached house in 2021 was 12.08% greater than the price in 2020. Work out the price of a semi-detached house in 2017. Give your answer to 3 significant figures. (2 marks)	(a) $\frac{208623-190009}{190009} \times 100 = 9.796... = 9.8\%.$ (b) Let x be the price of a semi-detached house in 2020 So $112.08\%\ x = 190009$ So the $x = \frac{190\ 009}{112.08\%} = 169\ 500 \approx 170\ 000\ (3sf).$	(a) **M1** $\frac{208623-190009}{190009} \times 100$ **A1** $9.796... = 9.8\%\ (1\boldsymbol{dp})$ (b) **M1**- $112.08\%\ x = 190009$ **A1** $169\ 500 \approx 170\ 000\ (3sf).$

14. Here is triangle ABC.  (a) Find the length of BC. Give your answer correct to 3 significant figures. (3 marks) (b) Find the area of triangle ABC. Give your answer correct to 3 significant figures. (3 marks)	(a) Let $BC = x$. Using the Cosine Rule: $x^2 = 9^2 + 17^2 - (2)(9)(17)Cos63°$ $x^2 = 68.31565$ $x = 8.2653 \ldots \approx 8.27$ **cm** (b) $Area = \frac{1}{2}(17)(9)Sin(63°) = 68.161999 \ldots \approx$ 68.2 $\boldsymbol{cm}^2$ (3.s.f)	(a) **M1**- Using the Cosine Rule: **M1** – Simplifying and solving for x **A1** - 8.27 **cm** (b) **M1**- Using the rule $\frac{1}{2}(a)(b)Sin(C)$ **M1** – Substituting correct values **A1** – $68.2\boldsymbol{cm}^2$
15. Solve the simultaneous equations, giving your answers to two decimal places. (6 marks) $x^2 + y^2 = 25$ $x - 2y = 4$	$x^2 + y^2 = 25 \ldots Eq. 1$ $x - 2y = 4 \ldots Eq. 2$ From Equation 2, $x = 2y + 4 \ldots Eq. 3$ Substituting $Eq. 3$ into $Eq. 1$: $(2y + 4)^2 + y^2 = 25$ $5y^2 + 16y - 9 = 0$ Solving for $y : y = -3.6881 \ldots,$ 0 .48806 … Substituting into Equation 2 we get: $x = 2(-3.6881) + 4 = -3.376 \ldots$ $x = 2(0.48806) + 4 = 4.97612 \ldots$	**M1** – rearranging Eq. 2 for x or for y. **M1** – Subst. into Eq, 1. **M1**- Rearranging to get a 3 term quadratic of the form $ax^2 + bx + c = 0$. **M1** – Solving a 3 term quadratic using any method. **A1** -3.6881 *and* $0.48806 \ldots$ (or -3.376 and 4.97612) **A1** – Both x and corresponding y answers.

<table>
<tr><th></th><th></th><th></th></tr>
<tr><td>

16. A piece of string is cut into two parts. The first part is bent into the shape of a square. The second part is bent into the shape of a rectangle with one side 5 cm long and the other side twice the length of the square's side. Let x represent the side of the square.

(a) Write down an expression for the area of the square. (1 mark)

(b) Write down an expression for the area of the rectangle. (1 mark)

(c) Given that the sum of the areas of the square and the rectangle is $25\ cm^2$, find the value of x to 2 decimal places. (4 marks)

(d) Hence find the original length of the string. Give your answer to 3 significant figures (3 marks)

</td><td>

(a) x^2

(b) $2x \times 5 = 10x$

(c)
$x^2 + 10x - 25 = 0$
$x = -12.071, 2.0711$
$\boldsymbol{x} = 2.07\ only.$ (2dp)

(d) The original length of the string is:

$$4x + 4x + 10 = 8x + 10 = 8(2.07) + 10 = 26.56\ cm = 26.6\ (3sf)$$

</td><td>

(a) **B1** x^2

(b) **B1** $2x \times 5 = 10x$

(c) **M1** for $\mathrm{x}^2 + 10x - 25 = 0$
M1 for solving a 3 term quadratic:
$x^2 + 10x - 25 = 0$
A1 – both solutions $x = -12.071, 2.0711$
A1 $\boldsymbol{x} = 2.07\ \boldsymbol{only}.$ (2dp) (reject -12.071)

(d) The original length of the string is:

$$4x + 4x + 10 = 8x + 10 = 8(2.07) + 10 =$$
$$26.56\ cm = 26.6\ (3sf)$$

M1 for 4x (Perimeter of the square) or

$4x + 10$ (Perimeter of the rectangle)

M1 Subst their x into $8(x) + 10$

A1 $26.6\ (3sf)$

</td></tr>
<tr><td>

17.

$$f(x) = \frac{2x+3}{8} \quad ; \quad x \in \boldsymbol{R}.$$
$$g(x) = x - 7 \quad ; \quad x \in \boldsymbol{R}.$$

(a) Find $fg(x)$ (3 marks)

(b) Find $f^{-1}(x)$ (3 marks)

(c) Solve the equation $fg(x) = f^{-1}(x)$

</td><td>

(a) $f\big(g(x)\big) = \frac{2(x-7)+3}{8} = \frac{2x-11}{8}$

(b) Let $y = f(x)$
Interchanging x and y, and solving for y.

$$y = \frac{2x+3}{8}$$
$$x = \frac{2y+3}{8}$$
$$y = \frac{8x-3}{2}$$

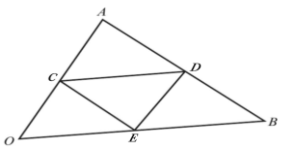
</td><td>

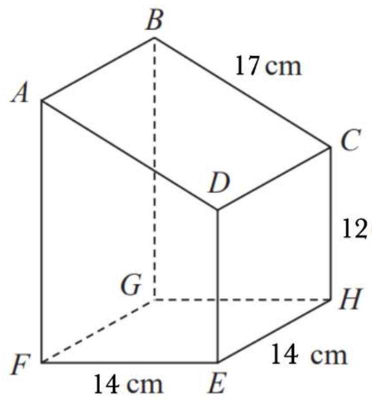
(a)
M1 for substituting $g(x)$ into $f(x)$
M1 Algebraic manipulation
A1 $\frac{2x-11}{8}$

(b)
M1 Interchanging x and y at some stage
M1 Algebraic Manipulation
A1 $f^{-1}(x) = \frac{8x-3}{2}$

</td></tr>
</table>

(3 marks)	$\boldsymbol{f^{-1}(x)} = \frac{8\boldsymbol{x}-3}{2}$ (c) $f\ g(x) = f^{-1}(x)$ $\frac{2x-11}{8} = \frac{8x-3}{2}$ $(2x-11) = 8(8x-3)$ $x = \frac{1}{30}$	(c) **M1** Equating their $f\ g(x) = f^{-1}(x)$ **M1** Algebraic Manipulation **A1** : $x = \frac{1}{30}$
18. Show that $\frac{\sqrt{96}-\sqrt{2}\sqrt{3}}{\sqrt{6}}$ simplifies to an integer. (3 marks)	$\frac{\sqrt{96}-\sqrt{2}\sqrt{3}}{\sqrt{6}}$ $\frac{4\sqrt{6}-\sqrt{6}}{\sqrt{6}}$ $\frac{3\sqrt{6}}{\sqrt{6}} = 3$	**B1** - $\sqrt{96} = 4\sqrt{6}$ **M1** – simplifying to $\frac{3\sqrt{6}}{\sqrt{6}}$ **A1** For the answer 3
19. The 7th term in an arithmetic series is 33. The 12th term of the same arithmetic series is 58. Find the sum of the first 20 terms of the sequence. (6 marks)	$a + 6d = 33$ $a + 11d = 58$ Solve simultaneously to get $d = 5, a = 3.$ Use $S_n = \frac{n}{2}(2a + (n-1)d)$. $S_{20} = \frac{20}{2}(2 \times 3 + 19 \times 5) = 1010$.	**B1** $a + 6d = 33$ or $a + 11d = 58$ **M1** solving simultaneously (any method) **A1** $d = 5$ or $a = 3$ **A1** $d = 5$ and $a = 3$ **M1** Use of $S_n = \frac{n}{2}(2a + (n-1)d)$. **A1** 1010
20. The straight line L passes through the points $(7, 17)$ and $(9, 21)$. Find the equation of the line that is parallel to L and passes through the point $(-2, 5)$. Give you answer in the form $ax +$	$m = \frac{21-17}{9-7} = \frac{4}{2} = 2$ Parallel lines have equal gradients. Finding the equation of the line with gradient 2 that passes through $(-2,5)$.	**M1** for use of the formula to find the gradient **A1** for finding the gradient of 2. **B1** for stating/using that parallel lines have equal gradient. **M1** for finding the equation of the line with their unchanged gradient and the point $(-2,5)$. **M1** for algebraic manipulation **A1** for the correct equation in the correct form

$by + c = 0$, where a, b and c are integers. (6 marks)	$y - y_1 = m(x - x_1)$ $y - 5 = 2(x + 2)$ $y - 5 = 2x + 4$ $-2x + y - 9 = 0$ Or $2x - y + 9 = 0$	$-2x + y - 9 = 0$ Or $2x - y + 9 = 0$
21. OAB is a triangle. C, D and E are the midpoints of OA, AB and OB respectively. OC and OE are equal to $\boldsymbol{a}$ and $\boldsymbol{b}$ respectively.  (a) Find $\overrightarrow{CE}$ (1 mark) (b) Show that $\overrightarrow{AB}$ and $\overrightarrow{CE}$ are parallel. (3 marks)	(a) $\overrightarrow{CE} = \overrightarrow{CO} + \overrightarrow{OE}$ $= -a + b$ $= b - a$ (b) $\overrightarrow{AB} = \overrightarrow{A0} + \overrightarrow{OB}$ $= -2a + 2b$ $= 2b - 2a$ $= 2(b - a) = 2\overrightarrow{CE}$ Since $\overrightarrow{AB} = 2\overrightarrow{CE}$, $\overrightarrow{AB}$ and $\overrightarrow{CE}$ are parallel.	(a) **B1** for $b - a$ (b) **M1** for $\overrightarrow{AB} = \overrightarrow{A0} + \overrightarrow{OB}$ (may be implied) **M1** for $2(b - a)$ o.e. **B1** for the conclusion.
22.	Factorise the numerator: $2x^2 - 5x - 12 = (2x + 3)(x - 4)$	**B1** factorising $2x^2 - 5x - 12 = (2x + 3)(x - 4)$ **B1** factorising

Simplify fully $\frac{2x^2-5x-12}{3x^2-12x}$ (4 marks)	Factorise the denominator: $$3x^2-12x=3x(x-4)$$ So $\frac{2x^2-5x-12}{3x^2-12x}=\frac{(2x+3)(x-4)}{3x(x-4)}=\frac{2x+3}{3x}$.	$$3x^2-12x=3x(x-4)$$ **M1** Simplifying by cancelling out $(x-4)$ in the numerator and denominator. **A1** $\frac{2x+3}{3x}$.
23. The diagram shows a prism ABCDEFGH with a horizontal square base, EFGH, of side $14\ cm$.  Trapezium $ADEF$ is a cross section of the prism where DE and AF are vertical edges $DE=CH=12\ cm$ $AD=BC=17\ cm$ (a) Work out the length of FH, giving your answer in the form $k\sqrt{2}\,cm$. (2 marks)	(a) Using Pythagoras: $FH=\sqrt{14^2+14^2}=\sqrt{2\times14^2}=14\sqrt{2}$. (b) Let the angle between CF and the base EFGH be α. $$Tan\alpha=\frac{12}{14\sqrt{2}}$$ $\alpha=31.219698458°\approx 31.2°$ (to 1 d.p) (c) Area of Trapezium $=\frac{h}{2}(a+b)$ $$235.5=\frac{14}{2}(12+AF)$$ Solve to get $AF=21.643\approx 21.6\ cm\ (to\ 1d.p.)$	(a) **M1** for use of Pythagoras **A1** $k=14$ (b) **M1** for $Tan\alpha=\frac{12}{14\sqrt{2}}$ **M1** for use of $Tan^{-1}(\frac{12}{14\sqrt{2}})$ **A1** $\alpha\approx 31.2°$ (to 1 d.p) (c) **M1** Use of $\frac{h}{2}(a+b)$ **M1** for algebraic manipulation **A1** for $21.6\ cm$

(b) Find the size of the angle between CF and the base EFGH. Give your answer correct to 1 decimal place. (3 marks) (c)Trapezium $ADEF$ has an area of $235.5\ cm^2$. Work out the length of AF. Give your answer correct to one decimal place. (3 marks)		