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

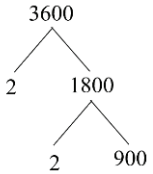
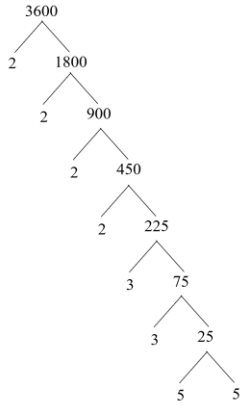
3 (a)	$54 \div 9 \times 4$ oe or $\frac{4}{9} \times 54$ oe		2	M1 Allow $0.44(44\ldots) \times 54$ or $\frac{24}{54}$
	Correct answer scores full marks (unless from obvious incorrect working	24		A1
(b)	$\frac{"24"+n}{54+n} = \frac{1}{2}$ or $\frac{30}{60}$ or 54 – "24" (= 30) and "30" – "24" or 2 × "30" – 54		2	M1 ft if "24" < 27 or $\frac{6}{60}$
	Correct answer scores full marks (unless from obvious incorrect working)	6		A1
				Total 4 marks

4	2×0.75 (= 1.5) oe or $2 \times 0.75 \times 2$ (= 3) oe		5	M1 for area of rectangle
	$\pi \times (0.5 \div 2)^2$ (= 0.1963) or $\frac{1}{2} \times \pi \times (0.5 \div 2)^2$ (= 0.09817)			M1 for area of circle **or** area of semicircle
	"1.5" – "0.09817" (= 1.4018…) or "3" – "0.1963" (= 2.8036…)			M1
	"1.4018" × 2 × 250 ÷ 4 (= 175.228…) or "2.8036" × 250 ÷ 4 (= 175.228…) or "1.4018" × 250 ÷ 4 (= 87.6…)			M1or for 87 – 88
	Correct answer scores full marks (unless from obvious incorrect working)	175		A1 Allow 175 – 176
				Total 5 marks

5	$LW = 180$ oe ($9LW = 1620$) or $4L \times (L + W) = 1620$ oe or $5W \times (L + W) = 1620$ oe or $4L = 5W$ oe ($L = \frac{5}{4}W$ oe or $W = \frac{4}{5}L$ oe)		5	M2 for any two correct equations from (i) $LW = 180$ oe ($9LW = 1620$) (ii) $4L \times (L + W) = 1620$ oe (iii) $5W \times (L + W) = 1620$ oe (iv) $4L = 5W$ oe ($L = \frac{5}{4}W$ oe or $W = \frac{4}{5}L$ oe) (M1 for one correct equation **or** $1620 \div 9$ (= 180))
	$L \times "\frac{4}{5}L" = "180"$ oe or $W \times "\frac{5}{4}W" = "180"$ oe or $4L \times \left(L + \frac{4}{5}L\right) = 1620$ oe or $5W \times \left(\frac{5}{4}W + W\right) = 1620$ oe or $9L\left("\frac{4}{5}L"\right) = 1620$ oe or $9\left("\frac{5}{4}W"\right)W = 1620$ oe or $4\left("\frac{180}{W}"\right)^2 + 4("180") = 1620$ oe or $5("180") + 5\left("\frac{180}{L}"\right)^2 = 1620$ oe			M1 for a correct equation in terms of one variable only
	Correct answer scores full marks (unless from obvious incorrect working)	$L = 15$ and $W = 12$		A2 for both correct (A1 for one correct) Award 4 marks for $L = 12$ and $W = 15$ dep on M3
				Total 5 marks

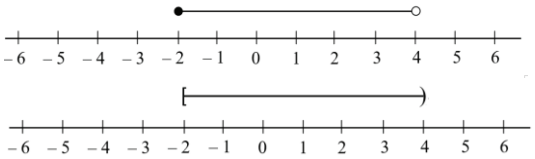
Elimination						
6	$5a+3p=1.96$ and $3a+2p=1.22$ oe **or** $5a+3p=196$ and $3a+2p=122$ oe		M2 for an arithmetical method (must see the calculation to find 0.22 or 0.26 or 0.74 and 0.48 oe) E.g. 6.1(0) – 5.88 (= 0.22) oe **or** 3.92 – 3.66 (= 0.26) oe **or** 1.96 – 1.22 (= 0.74) oe and 1.22 – "0.74" (= 0.48)		5	M1 for setting up both equations oe Allow the use of apples and pears oe throughout, e.g. 5 apples + 3 pears = 1.96 and 3 apples + 2 pears = 1.22
	E.g. $15a+9p=5.88$ $15a+10p=6.1\ 0$ Subtracting $(-p=-0.22)$	E.g. $10a+6p=3.92$ $9a+6p=3.66$ Subtracting $(a=0.26)$				M1 for a correct method to eliminate a or p: coefficients of a or p the same **and** correct operation to eliminate selected variable (condone any one arithmetic error) **or** to find the cost of 1 apple and 1 pear
	E.g. $5a+3p=1.96$ and $6a+4p=2.44$ oe Subtracting					
	E.g. $5a+3("0.22")=1.96$ or $3a+2("0.22")=1.22$	E.g. $5("0.26")+3p=196$ or $3("0.26")+2p=1.22$	E.g. 3 × 0.22 (= 0.66) 1.96 – "0.66" (= 1.3(0)) "1.3(0)" ÷ 5 (= 0.26) **or** 5 × 0.26 (= 1.3(0)) 1.96 – "1.3(0)" (= 0.66) "0.66" ÷ 3 (= 0.22) **or** Apple and pear is 0.48 oe			M1 (dep on M2) for substituting their value found (must be > 0) of one variable into one of the equations **or** for repeating above method to find second variable **or** for third working column allow $k(a+p)=k(0.48)$ **or** for a complete arithmetical method to find the other value
	E.g $a+p=0.48$ oe					
	$10\times"0.26"+10\times"0.22"$ or $(a+p=)\,0.48\times10$ oe or $k(a+p)=k(0.48)\times\frac{10}{k}$					M1 (dep on M3) can be implied by $10(a+p)$ provided a and p must be > 0
	Working required			4.8(0)		A1 dep M2
						Total 5 marks

Substitution				
6	$5a+3p=1.96$ and $3a+2p=1.22$ oe **or** $5a+3p=196$ and $3a+2p=122$ oe		5	M1 for setting up both equations oe Allow the use of apples and pears oe throughout, e.g. 5 apples + 3 pears = 1.96 and 3 apples + 2 pears = 1.22
	E.g. $3\left(\frac{1.96-3p}{5}\right)+2p=1.22$ or $5\left(\frac{1.22-2p}{3}\right)+3p=1.96$ or $3a+2\left(\frac{1.96-5a}{3}\right)=1.22$ or $5a+3\left(\frac{1.22-3a}{2}\right)=1.96$ or $p = 0.22$ or $a = 0.26$			M1 for correctly writing a or p in terms of the other variable **and** correctly substituting (condone any one arithmetic error)
	E.g. $(a=)\frac{1.96-3(0.22)}{5}$ or $(a=)\frac{1.22-2(0.22)}{3}$ or $(p=)\frac{1.96-5(0.26)}{3}$ or $(p=)\frac{1.22-3(0.26)}{2}$			M1 (dep on M2) for substituting their value found (must be > 0) of one variable into one of the equations **or** for repeating above method to find second variable
	$10\times"0.26"+10\times"0.22"$			M1 (dep on M3) can be implied by $10(a + p)$ provided a and p must be > 0
	Working required	4.8(0)		A1 dep M2
				Total 5 marks

<table>
<tr><td>7</td><td>E.g.
$2 \times 2 \times 900$ or $2^2 \times 900$ or $2 \times 3 \times 600$ or
$2 \times 5 \times 360$ or $3 \times 3 \times 400$ or $3^2 \times 400$ or
$3 \times 5 \times 240$ or $5 \times 5 \times 144$ or $5^2 \times 144$
E.g.
<table><tr><td>2</td><td>3600</td></tr><tr><td>2</td><td>1800</td></tr><tr><td></td><td>900</td></tr></table>
E.g.
 
</td><td></td><td>3</td><td>M1 for at least 2 correct stages in prime factorisation which give 2 prime factors – may be in a factor tree or a table or listed eg 2, 2, 900
(see LHS for examples of the amount of work needed for the award of this mark, allow no more than one mistake ft in factor tree or table
(eg one mistake with 2 prime factors ft: $3600 = 1800 \times 20 = 2 \times 900 \times 4 \times 5$ or $360 = 2 \times 2 \times 90$)</td></tr>
<tr><td></td><td>E.g. $2 \times 2 \times 2 \times 2 \times 3 \times 3 \times 5 \times 5$
E.g.
<table><tr><td>2</td><td>3600</td></tr><tr><td>2</td><td>1800</td></tr><tr><td>2</td><td>900</td></tr><tr><td>2</td><td>450</td></tr><tr><td>3</td><td>225</td></tr><tr><td>3</td><td>75</td></tr><tr><td>5</td><td>25</td></tr><tr><td>5</td><td>5</td></tr><tr><td></td><td>(1)</td></tr></table>
E.g.
 
</td><td></td><td></td><td>M1 for 2, 2, 2, 2, 3, 3, 5, 5 or 2^4 , 3^2 , 5^2 or $2^4 + 3^2 + 5^2$ (ignore 1s) (may be a fully correct factor tree or ladder)</td></tr>
<tr><td></td><td>Working required</td><td>$2^4 \times 3^2 \times 5^2$</td><td></td><td>A1 dep on M2
can be any order (allow $2^4 . 3^2 . 5^2$)
(SCB1 for $3.6 \times 2^3 \times 5^3$)</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Total 3 marks</td></tr>
</table>

8	$0.22x = 5.48$ oe or (1% =) $5.48 \div 22$ (= 0.24909…) or $100 \div 22$ (= 4.54…)			M1
	(x =) $5.48 \div 0.22$ oe or (100% =) $5.48 \div 22 \times 100$ or "0.24909…" × 100 or 5.48 × "4.54…"			M1
	Correct answer scores full marks (unless from obvious incorrect working)	24.9		A1 awrt 24.9
				Total 3 marks

8 **ALT** **1**	$0.22x = 5\,480\,000$ oe or (1% =) $5\,480\,000 \div 22$ (= 249 090.9091…) or $100 \div 22$ (= 4.54…)			M1
	$5\,480\,000 \div$ "0.22" oe or (100% =) $5\,480\,000 \div 22 \times 100$ or "249 090.9091…"× 100 or $5\,480\,000 \times$ "4.54…"			M1
	Correct answer scores full marks (unless from obvious incorrect working)	24 900 000		A1 awrt 24 900 000
				Total 3 marks

9	(i)	$-7+3 \leq 2x < 5+3$ oe or $\frac{-7}{2} \leq x - \frac{3}{2} < \frac{5}{2}$ oe or $-7+3 \leq 2x$ oe **and** $2x < 5+3$ oe or ($x =$) -2 or ($x =$) 4		3	M1 or one side of the inequality correct, i.e.. $x \geq -2$ oe or $x < 4$ Condone = rather than $\leq$ or $<$ or any other sign for the M marks.
		$\frac{-7+3}{2} \leq x < \frac{5+3}{2}$ or $\frac{-7}{2} + \frac{3}{2} \leq x < \frac{5}{2} + \frac{3}{2}$ or $\frac{-7+3}{2} \leq x$ oe **and** $x < \frac{5+3}{2}$ or ($x =$) -2 and ($x =$) 4			M1
		Correct answer scores full marks (unless from obvious incorrect working)	$-2 \leq x < 4$		A1 allow $x \geq -2$ and $x < 4$ Allow [−2, 4)
	(ii)			2	M1 ft for drawing a line from −2 to 4 or (indep) for a closed circle or [at −2 or (indep) for an open circle or) or [at 4 Only allow a follow through for a double ended inequality in (i)
			Correct diagram		A1 ft for correct diagram Only allow a follow through for a double ended inequality in (i)
					Total 5 marks

10	$0.0027 = \frac{5.4}{(V)}$ oe		5	M1 for correctly using density $= \frac{\text{mass}}{\text{volume}}$
	$(V =) \frac{5.4}{0.0027} = 2000$			M1 for correctly rearranging for V
	$\pi \times 10^2 \times h = 2000$ oe			M1ft their 2000 for $\pi \times 10^2 \times h =$ their V
	$(h =) \frac{2000}{\pi \times 10^2}$ oe (= 6.3661…)			M1ft their 2000 dep on previous M1 for correctly rearranging for h
	Correct answer scores full marks (unless from obvious incorrect working)	6.4		A1 awrt 6.4
				Total 5 marks

11	(a)		(12), 36, 64, 76, 86, 90	1	B1
	(b)			2	M1 ft from table for at least 5 points plotted correctly (± 0.5 squares) at end of interval **or** ft from (CF) table for all 6 points plotted consistently (± 0.5 squares) within each interval in the **freq table** at the correct height
			Correct cf diagram		A1 accept curve or line segments accept graph that is not joined to (25, 0)
	(c)	E.g. reading at 42 minutes and reading at 52 minutes		2	M1 for correct use of 42 and 52, ft from a cum freq graph provided method is shown – e.g. a line vertically drawn to the graph from readings of 42 and 52 on the Time axis to meet the graph and then a horizontal line to the CF axis (even if wrongly read scale) **or** clear marks on the graph and CF axis that correspond to the correct readings **or** correct values from the CF axis
		Correct answer scores full marks (unless from obvious incorrect working)	25 – 29		A1 ft Accept a single value in range 25 to 29 or ft from their cumulative frequency graph provided method is shown
					Total 5 marks

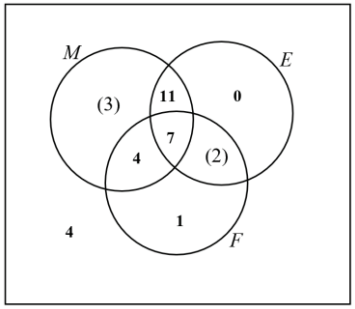
12	(a)	$\tan 20 = \frac{100}{d}$ oe or $\tan(90-20) = \frac{d}{100}$ oe or $\frac{d}{\sin(90-20)} = \frac{100}{\sin 20}$ oe		3	M1
		$(d =)\frac{100}{\tan 20}$ (= 274.747…) or $(d =)100 \times \tan(90-20)$ (= 274.747…) or $(d =)\frac{100}{\sin 20} \times \sin(90-20)$ (= 274.747…)			M1
		Correct answer scores full marks (unless from obvious incorrect working)	275		A1 awrt 275
	(b)	$\tan 25 = \frac{100+h}{275}$ oe or $\tan 25 = \frac{y}{275}$ oe or $275 \times \tan 25$ (=128....) or $\tan(90-25) = \frac{275}{100+h}$ oe or $\tan(90-25) = \frac{275}{y}$ oe or $\frac{100+h}{\sin 25} = \frac{275}{\sin(90-25)}$ or 128.1 – 128.2 (y is the height of cliff and radio mast)		3	M1 ft part (a) Allow $(hyp =)\sqrt{100^2 + 275^2}$ $(= \sqrt{85486.321} = 292.380)$ or $(hyp =)\frac{100}{\sin 20} \times \sin 90$ (= 292.380)
		$(h =)275 \times \tan 25 - 100$ = 28.1169... or $(h =)\frac{275}{\tan(90-25)} - 100$ (= 28.1169...) or $(h =)\frac{275}{\sin(90-25)} \times \sin 25 - 100$ (= 28.1169...)			M1 ft part (a) $(h =)\frac{"292.380"}{\sin(90-25)} \times \sin(25-20)$ (= 28.1169...)
		Correct answer scores full marks (unless from obvious incorrect working)	28.1		A1 Accept answers in the range 28 – 28.2
					Total 5 marks

13	15.5 or 16.5 or 24.5 or 25.5 or 125 or 135		3	B1 Accept $16.4\dot{9}$ for 16.5 $25.4\dot{9}$ for 25.5 $134.\dot{9}$ for 135
	$\frac{(YZ)}{\sin(125)} = \frac{16.5}{\sin(24.5)}$ oe			M1 for substitution into sine rule $\frac{(YZ)}{\sin(LB_2)} = \frac{UB_1}{\sin(LB_3)}$ oe where $16 < UB_1 \leq 16.5$ **and** $125 \leq LB_2 < 130$ **and** $24.5 \leq LB_3 < 25$
	Working required	32.6		A1 Accept 32.5 to 32.6 from correct working
				Total 3 marks

14	(a)(i)		**b** – **a**	1	B1 oe
	(ii)	E.g. (*KI* = *KJ* + *JI* =) 2(**b** – **a)** + 2**b** oe		2	M1ft (i) for any valid correct path (oe) in capitals or lower case letters
		Correct answer scores full marks (unless from obvious incorrect working)	4**b** – 2**a**		A1 oe simplified
	(iii)	E.g. (*LD* = *LF* + *FE* + *ED* =) (**b** – **a)** + (**b** – **a)** – **a** oe		2	M1ft (i) for any valid correct path (oe) in capitals or lower case letters
		Correct answer scores full marks (unless from obvious incorrect working)	2**b** – 3**a**		A1 oe simplified
	(b)	(*GHIJKL* =) $6 \times 5 \times 2^2$ (= 120) or (*GABH* =) $5 \times 2^2 - 5$ (= 15) or 3×5 (= 15) or (Number of triangles in shaded region =) $(6 \times 4) - 6$ (= 18)		3	M1
		"120" – (6 × 5) or 6 × "15" or "18" × 5			M1
		Correct answer scores full marks (unless from obvious incorrect working)	90		A1
					Total 8 marks

15	(a)		$\frac{3}{9}$ $\frac{2}{9}, \frac{4}{9}, \frac{3}{9}$	2	B1 for lower 1st game branch probability B1ft for all values correct on 2nd game branches
	(b)	$\left(\frac{2}{9}\times\frac{3}{9}\right)$ or $\left(\frac{3}{9}\times\frac{2}{9}\right)$ or $\left(\frac{4}{9}\times\frac{4}{9}\right)$ oe or		3	M1 ft from their tree diagram for one correct product from *WL* or *L W* or *DD* (allow probabilities to 2 dp truncated or rounded)
		$\left(\frac{2}{9}\times\frac{3}{9}\right) + \left(\frac{3}{9}\times\frac{2}{9}\right) + \left(\frac{4}{9}\times\frac{4}{9}\right)$ oe			M1 ft for a fully correct method
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{28}{81}$		A1 Allow 0.345 ... (2 dp truncated or rounded) or 34.5% (2 sf truncated or rounded)
	(c)	$\left(\frac{2}{9}\times\frac{4}{9}\times\frac{3}{9}\right)$ or $\left(\frac{4}{9}\times\frac{4}{9}\times\frac{4}{9}\right)$		3	M1ft from their tree diagram for any combination of *WLD* or *DDD* (allow probabilities to 2 dp truncated or rounded)
		$6\times\left(\frac{2}{9}\times\frac{4}{9}\times\frac{3}{9}\right) + \left(\frac{4}{9}\times\frac{4}{9}\times\frac{4}{9}\right)$			M1ft for a fully correct method
		Correct answer scores full marks (unless from obvious incorrect working)	$\frac{208}{729}$		A1 Allow 0.285 ... (2 dp truncated or rounded) or 28.5% (2 sf truncated or rounded)
					Total 8 marks

15 (a) **ALT**		$\frac{3}{9}$ $\frac{2}{9}, \frac{4}{9}, \frac{3}{9}$	2	B1 for lower 1st game branch probability B1ft for all values correct on 2nd game branches
(b)	1 and $\left(\frac{2}{9}\times\frac{2}{9}\right)$ or $\left(\frac{4}{9}\times\frac{2}{9}\right)$ or $\left(\frac{4}{9}\times\frac{3}{9}\right)$ or $\left(\frac{3}{9}\times\frac{3}{9}\right)$ oe		3	M1ft from their tree diagram for 1 and one correct product from *WW*, *DW*, *DL* or *LL* (allow probabilities to 2 dp truncated or rounded)
	$1-\left[\left(\frac{2}{9}\times\frac{2}{9}\right)+2\left(\frac{4}{9}\times\frac{2}{9}\right)+2\left(\frac{4}{9}\times\frac{3}{9}\right)+\left(\frac{3}{9}\times\frac{3}{9}\right)\right]$ oe			M1ft for a fully correct method
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{28}{81}$		A1 Allow 0.345 ... (2 dp truncated or rounded) or 34.5% (2 sf truncated or rounded)
(c)	1 and $\left(\frac{2}{9}\times\frac{2}{9}\times\frac{2}{9}\right)$ or $\left(\frac{2}{9}\times\frac{2}{9}\times\frac{4}{9}\right)$ or $\left(\frac{2}{9}\times\frac{2}{9}\times\frac{3}{9}\right)$ or $\left(\frac{2}{9}\times\frac{4}{9}\times\frac{4}{9}\right)$ or $\left(\frac{2}{9}\times\frac{3}{9}\times\frac{3}{9}\right)$ or $\left(\frac{4}{9}\times\frac{4}{9}\times\frac{3}{9}\right)$ or $\left(\frac{4}{9}\times\frac{3}{9}\times\frac{3}{9}\right)$ or $\left(\frac{3}{9}\times\frac{3}{9}\times\frac{3}{9}\right)$ oe		3	M1ft from their tree diagram for 1 and one correct product from *WWW* or *WWD* or *WWL* or *WDD* or *WLL* or *DDL* or *DLL* or *LLL* (allow probabilities to 2 dp truncated or rounded)
	$1-\left[\begin{array}{l}\left(\frac{2}{9}\times\frac{2}{9}\times\frac{2}{9}\right)+3\left(\frac{2}{9}\times\frac{2}{9}\times\frac{4}{9}\right)+3\left(\frac{2}{9}\times\frac{2}{9}\times\frac{3}{9}\right)+3\left(\frac{2}{9}\times\frac{4}{9}\times\frac{4}{9}\right)\\+3\left(\frac{2}{9}\times\frac{3}{9}\times\frac{3}{9}\right)+3\left(\frac{4}{9}\times\frac{4}{9}\times\frac{3}{9}\right)+3\left(\frac{4}{9}\times\frac{3}{9}\times\frac{3}{9}\right)+\left(\frac{3}{9}\times\frac{3}{9}\times\frac{3}{9}\right)\end{array}\right]$ oe			M1ft for a fully correct method
	Correct answer scores full marks (unless from obvious incorrect working)	$\frac{208}{729}$		A1 Allow 0.285 ... (2 dp truncated or rounded) or 28.5% (2 sf truncated or rounded)
				Total 8 marks

16	(a)	$(11 - x) + (x) + (18 - x) + 3 = 25$ oe or $(11 - x) + (x) + (18 - x) + 3 + 7 = 25 + 7$ oe or $x + y + z = 25 - 3$ and $x + z = 11$ and $x + y = 18$ oe where $y = M \cap E \cap F'$ and $z = M \cap F \cap E'$		2	M1 for setting up a correct equation
		Correct answer scores full marks (unless from obvious incorrect working)	7		A1 (allow 7 in the Venn diagram if no answer is given in (a))
	(b)			2	B2 ft for $18 - x$, x and $11 - x$ dep on M1 in part (a) and ($x < 12$) (NB 0, 1 and 4 are fixed) for 6 correct remaining values (B1 ft for 4 or 5 correct remaining values) Allow just E to be blank if other sections are populated with a number
	(c)	$\frac{3+"11"}{25}$ or $\frac{3+(18-"7")}{25}$ or 0.56 oe	$\frac{14}{25}$	1	B1ft for $18 - x$, x and $11 - x$ oe
					Total 5 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 $c=3$

18	E.g. $y = 0.4x....$ **and** $10y = 4.x....$ $(10y - y = 4.x - 0.4$ oe) **or** $10y = 4.x....$ **and** $100y = 4x.x....$ $(100y - 10y = 4x - 4$ oe) **or** $100y = 4x.x....$ **and** $1000y = 4xx.x....$ $(1000y - 100y = 4xx - 4x$ oe)		3	M1 for selecting 2 correct recurring decimal expressions and then a demonstration to subtract (If recurring dots not shown then allow each expression to 1 dp e.g. $y = 0.4x....$ **and** $100y = 4x.x....$ as a pair **and** $100y - y$ or $4x.x.... - 0.4x....$) or an answer of $y = \frac{4x-4}{90}$ oe
	E.g. $9y = 4\frac{x}{10} - \frac{4}{10} = \frac{40+x-4}{10}$ oe or $90y = 40 + x - 4$ oe or $900y = 400 + 10x + x - 40 - x$ oe			M1 for a correct subtraction with correct expressions simplified
	Working required	$\frac{36+x}{90}$		A1 dep on M2 oe
				Total 3 marks

19 (a)	E.g. $x+y+x+y+x=100$ oe or $3x+2y=100$ oe $\left(y=\frac{100-3x}{2}\right)$			3	M1 for a correct equation for the perimeter of the shape **or** for a correct expression for the area of triangle *CED*
	E.g. $\frac{1}{2}\times x\times x\times\sin 60$ $\left(=\frac{1}{2}\times x\times x\times\frac{\sqrt{3}}{2}\right)$ $\left(=\frac{x^2\sqrt{3}}{4}\right)$	E.g. $x^2=\left(\frac{x}{2}\right)^2+h^2$ **and** $=\frac{1}{2}\times x\times\frac{x\sqrt{3}}{2}\left(=\frac{x^2\sqrt{3}}{4}\right)$			
	$x"\left(\frac{100-3x}{2}\right)"+"\frac{x^2\sqrt{3}}{4}"$ oe				M1 for the area of the shape in terms of x only
	E.g. $x\left(\frac{200-6x}{4}\right)+\frac{x^2\sqrt{3}}{4}$ or $\frac{x}{4}(200-6x+x\sqrt{3})$ or $\frac{200x-6x^2}{4}+\frac{x^2\sqrt{3}}{4}$ or $\frac{x}{4}(200x-6x^2+x^2\sqrt{3})$		Shown		A1 for the area given in correct form with full working shown (at least one intermediate step before the answer)
(b) (i)	$\left(\frac{dR}{dx}=\right)50-\frac{3}{2}\times 2\times x+2\times\frac{x\sqrt{3}}{4}=0$ oe			2	M1 for differentiation of correct expression with 2 out of 3 terms correct and equated to 0 (can be implied by subsequent working)
	Correct answer scores full marks (unless from obvious incorrect working)		$\frac{100}{6-\sqrt{3}}$		A1 for a correct expression
(ii)			Correct reason	1	B1 for correct reason R is a quadratic with negative coefficient of x^2 E.g. the graph of R is ∩ shaped or (allow $\frac{d^2R}{dx^2}<0$ oe)
					Total 6 marks

20	$\left(\frac{-6+5}{2}, \frac{2+3}{2}\right) = \left(-\frac{1}{2}, \frac{5}{2}\right)$ oe		7	M1 for finding the midpoint of *AB*
	$\frac{2-3}{-6-5}\left(=\frac{-1}{-11}=\frac{1}{11}\right)$ oe			M1 for finding the gradient of *AB*
	$\frac{1}{11} = -1$ **or** $(m =) -11$			M1ft their gradient of *AB* (indep) for the correct use of $m_1 \times m_2 = -1$
	$"\frac{5}{2}" = "-11"\left("-\frac{1}{2}"\right) + c$ oe **or** $y - "\frac{5}{2}" = "-11"\left(x - "-\frac{1}{2}"\right)$ **and** $(y =) "-11"(-1) - 3 (= 8)$ **or** $(y =) "-11"\left(-1 - "-\frac{1}{2}"\right) + "\frac{5}{2}" (= 8)$			M1 for an expression that gives the *y* value at *C*
See alt methods	(Perp =) $\sqrt{\left(8-\frac{5}{2}\right)^2 + \left(-1--\frac{1}{2}\right)^2}\left(=\frac{\sqrt{122}}{2}\right)$ **and** $(AB =) \sqrt{3-2^{\,2} + 5--6^{\,2}}\ (=\sqrt{122})$			M1
	(Area of triangle =) $\frac{1}{2} \times \sqrt{122} \times \frac{\sqrt{122}}{2}$			M1 for a complete method
	Correct answer scores full marks (unless from obvious incorrect working)	30.5		A1 oe Allow answers in the range 30.4 – 30.5
				Total 7 marks

Q20 Alternative ways of finding the area of the triangle (final 2 M marks)				
Alt1	$(11 \times 6) - (0.5 \times 1 \times 11) - (0.5 \times 5 \times 6) - (0.5 \times 5 \times 6)$			M1 for any 3 correct triangles
	$(11 \times 6) - (0.5 \times 1 \times 11) - (0.5 \times 5 \times 6) - (0.5 \times 5 \times 6)$			M1 for a complete method
	Correct answer scores full marks (unless from obvious incorrect working)			
Alt 2	$(AC = BC =)\sqrt{5^2 + 6^2}\ (= \sqrt{61})$			M1 for AC is perp to BC
	(Area of triangle =) $\frac{1}{2} \times \sqrt{61} \times \sqrt{61}$			M1 for a complete method
	Correct answer scores full marks (unless from obvious incorrect working)			
Alt 3	$\sqrt{\left(8 - \frac{5}{2}\right)^2 + \left(-1 - -\frac{1}{2}\right)^2}\left(= \frac{\sqrt{122}}{2}\right)$ **and** $(AM =)\sqrt{\left(-6 - -\frac{1}{2}\right)^2 + \left(2 - \frac{5}{2}\right)^2}\left(= \frac{\sqrt{122}}{2}\right)$ or $(BM =)\sqrt{\left(5 - -\frac{1}{2}\right)^2 + \left(3 - \frac{5}{2}\right)^2}\left(= \frac{\sqrt{122}}{2}\right)$			M1 for the height of the triangle, AM and BM where M is the midpoint of AB
	(Area of triangle =) $2 \times \frac{1}{2} \times \frac{\sqrt{122}}{2} \times \frac{\sqrt{122}}{2}$			M1 for a complete method
	Correct answer scores full marks (unless from obvious incorrect working)			
Alt 4	$(AC = BC =)\sqrt{5^2 + 6^2}\ (= \sqrt{61})$ and $(AB =)\sqrt{3 - 2^{\ 2} + 5 - -6^{\ 2}}\ (= \sqrt{122})$			M1 for finding AC, BC and AB
	$\sqrt{\left(\frac{\sqrt{122} + 2\sqrt{61}}{2}\right)\left(\frac{\sqrt{122} + 2\sqrt{61}}{2} - \sqrt{122}\right)\left(\frac{\sqrt{122} + 2\sqrt{61}}{2} - \sqrt{61}\right)\left(\frac{\sqrt{122} + 2\sqrt{61}}{2} - \sqrt{61}\right)}$			M1 for applying Heron's formula
	Correct answer scores full marks (unless from obvious incorrect working)			