International GCSE Maths				
Apart from questions 1, 8, 10, 11d, 12c, 14, 15ab, 17 (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	e.g. $\frac{16}{5}$ **and** $\frac{11}{6}$ or $\frac{96}{30}$ **and** $\frac{55}{30}$		3	M1 for two correct improper fractions
	e.g. $\frac{\cancel{16}^{8}}{5}\times\frac{11}{\cancel{6}^{3}}$ **or** $\frac{176}{30}$ **or** $\frac{5280}{900}$ oe			M1 correct cancelling or multiplication of numerators and denominators without cancelling
	e.g. $\frac{16}{5}\times\frac{11}{6}=\frac{176}{30}=\frac{88}{15}=5\frac{13}{15}$ **or** $\frac{16}{5}\times\frac{11}{6}=\frac{176}{30}=5\frac{26}{30}=5\frac{13}{15}$ **or** $\frac{\cancel{16}^{8}}{5}\times\frac{11}{\cancel{6}^{3}}=\frac{88}{15}=5\frac{13}{15}$ **or** $\frac{96}{30}\times\frac{55}{30}=\frac{5280}{900}=\frac{88}{15}=5\frac{13}{15}$ NB: a student can show initially that $5\frac{13}{15}=\frac{88}{15}$ and they need to show that LHS = $\frac{88}{15}$	shown		A1 Dep on M2 for conclusion to $5\frac{13}{15}$ from correct working – either sight of the result of the multiplication e.g. $\frac{176}{30}$ must be seen and equated to $\frac{88}{15}$ or $5\frac{26}{30}$ **or** correct cancelling prior to the multiplication to $\frac{88}{15}$ NB: use of decimals scores no marks
				Total 3 marks

2	$a = 7$		4	B1
	$\frac{b + \text{their } a}{2} = 8.5$ oe **or** $b = 10$			M1 ft their value of a **or** for setting up an equation for b **or** $b = 10$
	$\frac{\text{their } a + \text{their } a + \text{their } b + c}{4} = 9$ oe or ($c =$) $9 \times 4 - (2 \times \text{their } a + \text{their } b)$ oe			M1 for a calculation involving c using their values **or** for a calculation leading to c using their values
		7, 10, 12		A1
				Total 4 marks

3	a		Correct number line	2	B2 for a fully correct number line e.g. shaded circle at −2, unshaded circle at 1 and a line drawn between them B1 for a shaded circle at −2 **or** an unshaded circle at 1 **or** circles at −2 and 1 with line in between but shading incorrect
	b		−3, −2, −1, 0, 1, 2	2	B2 fully correct values with no extras B1 for 5 correct values and none incorrect **or** all 6 correct values with no more than one additional incorrect value
					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

7	0.024 × 50 000 (= 1200) oe or 1.024 × 50 000 (= 51 200) oe or 1.024^2 × 50 000 (= 52 428.8) oe or 0.024 × 50 000 × 3 (= 3600) oe 0.024 × 50 000 × 3 + 50 000 (= 53 600) oe		3	M1	M2 for $50\,000 \times 1.024^3$
	0.024 × (50 000 + '1200') (= 1228.8) oe **and** 0.024 × (50 000 + '1200' + '1228.8') (= 1258.2912) **or** '1200' + '1228.8' + '1258.2912' (= 3687.(0912)) **or** 1.024 × '52 428.8'			M1 for completing method to find total amount in the account	
		53 687		A1 accept 53 687 – 53 688	
				accept (1 + 0.024) or $\left(1+\frac{2.4}{100}\right)$ as equivalent to 1.024 throughout	
					Total 3 marks

8	(5 – 2) × 180 ÷ 5 (= 108) **or** 360 ÷ 5 (= 72)		5	M1	for method to find an interior or exterior angle of a pentagon
	(6 – 2) × 180 ÷ 6 (= 120) **or** 360 ÷ 6 (= 60)			M1	for method to find an interior or exterior angle of a hexagon
	360 – 108 – 120 (= 132) **or** 60 + 72 (= 132) **or** (180 – '120') + (180 – '108')			M1	dep on M2 for a correct method to find angle *EDI* using correct figures
	360 – '72' – '60' – '132' (= 96)			M1	for a complete method to find angle *x*
		96		A1	dep on correct working
				Note:	Angles may be seen on diagram throughout
					Total 5 marks

9	a		$2^6 \times 3 \times 11^4$	2	B2	oe, accept 2 811 072
					B1	for $2^a \times 3^b \times 11^c$ oe where two of *a*, *b* and *c* are correct
	b		$2^9 \times 3^5 \times 11^8$	2	B2	cao
					B1	for $2^a \times 3^b \times 11^c$ oe where two of *a*, *b* and *c* are correct **or** $2.666... \times 10^{13}$ **or** an equivalent expression for e.g. $2^2 \times 2^7 \times 3^5 \times 11^3 \times 11^5$
						Total 4 marks

10	$7^2-(10\div 2)^2\,(=24)$ or $\dfrac{\sin\left(\frac{1}{2}x\right)}{5}=\dfrac{\sin 90}{7}$ oe or $\cos x=\dfrac{7^2+7^2-10^2}{2\times 7\times 7}$ oe or $\sin\left(\frac{1}{2}x\right)=\dfrac{5}{7}$ oe or $\cos y=\dfrac{5}{7}$ oe		5	M1 or use of sine rule or cosine rule to find angle (x) of the apex or angle y $\left(=90-\frac{1}{2}x\right)$
	$\sqrt{7^2-(10\div 2)^2}$ $(=\sqrt{24}=2\sqrt{6}=4.898...)$ or $(x=)\,2\times\sin^{-1}\left(\dfrac{5\times\sin 90}{7}\right)(=91.169\ldots)$ oe or $(x=)\,2\times\sin^{-1}\left(\dfrac{5}{7}\right)(=91.169\ldots)$ oe or $(x=)\cos^{-1}\left(\dfrac{7^2+7^2-10^2}{2\times 7\times 7}\right)(=91.169\ldots)$ oe or $(x=)\,2\left(90-\cos^{-1}\left(\dfrac{5}{7}\right)\right)\left(=2(90-44.415)...=91.169...\right)$ Allow 5 from correct working			M1 for complete method to find height of triangle or the angle (x) of the apex $\cos^{-1}\left(\frac{5}{7}\right)(=44.415...)$ **and** $5\times\tan'44.415...'(=4.898...)$ or $7\times\sin'44.415...'(=4.898...)$ **or** $\sin^{-1}\left(\frac{5}{7}\right)(=45.584...)$ **and** $\dfrac{5}{\tan'45.584...'}(=4.898...)$ or $7\times\cos'45.584...'(=4.898...)$
	E.g. $6\times 10+\dfrac{(10\div 2)\times'\sqrt{24}'}{2}\times 2$ $(=60+10\sqrt{6}=84.494...)$ **or** $5\times\left(6+6+'\sqrt{24}'\right)(=60+10\sqrt{6}=84.494...)$ **or** $\left(\frac{1}{2}\times 7\times 7\times\sin'91.169...'+10\times 6\right)(=60+10\sqrt{6}=84.494...)$			M1 for method to find the total area of the pentagon allow answers in the range 84.49 – 85
	E.g. '84.494' ÷ 16 (= 5.28...) or $\left(60+10\sqrt{6}\right)\div 16\,(=5.28...)$			M1 for method to find the number of tins required using their area
		6		A1 dep on at least M2
				Total 5 marks

11	a		8, 23, 40, 68, 101, 120	1	B1	
	b			2	M1	ft from table for at least 5 points plotted correctly at end of interval **or** ft from sensible table for all 6 points plotted consistently within each interval in the **freq table** at the correct height
			Correct cf graph		A1	accept curve or line segments accept graph that is not joined to (0,0)
	c		17 – 20	1	B1	ft their cf graph
	d	E.g. Reading at 23 minutes (= a) **and** then $(120 - a) \div 120 \times 100$		2	M1	ft from their cf graph reading off at 23 minutes and a method to work out 120 minus this value as a percentage of 120
			25(%) – 29(%)		A1	ft from their cf graph dep on M1 seen
						Total 6 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	$\left(4^{k+3}=\right)\left(2^2\right)^{k+3}$ oe **or** $\left(16=\right)2^4$ $\left(16=\right)4^2$ **or** $\left(2^k=\right)\left(4^{\frac{1}{2}}\right)^k$ oe $\left(4^{k+3}=\right)\left(16^{\frac{1}{4}}\right)^{k+3}$ oe **or** $\left(2^k=\right)\left(16^{\frac{1}{4}}\right)^k$ oe		4	M1 for $\left(2^2\right)^{k+3}$ 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
	$\left(4^{k+3}=\right)\left(2^2\right)^{k+3}$ oe **and** $\left(16=\right)2^4$ $\left(16=\right)4^2$ **and** $\left(2^k=\right)\left(4^{\frac{1}{2}}\right)^k$ oe $\left(4^{k+3}=\right)\left(16^{\frac{1}{4}}\right)^{k+3}$ oe **and** $\left(2^k=\right)\left(16^{\frac{1}{4}}\right)^k$ oe			M1 for $\left(2^2\right)^{k+3}$ 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

13	e.g. $\begin{pmatrix}5\\3\end{pmatrix}-\begin{pmatrix}-2\\4\end{pmatrix}$ **or** $\begin{pmatrix}5\\3\end{pmatrix}+\begin{pmatrix}2\\-4\end{pmatrix}$		2	M1 **or** for $\begin{pmatrix}7\\a\end{pmatrix}$ where $a \neq -1$ **or** $\begin{pmatrix}b\\-1\end{pmatrix}$ where $b \neq 7$
		$\begin{pmatrix}7\\-1\end{pmatrix}$		A1
				Total 2 marks

14	*BFD* = 39°	*BED* = 39°		4	B1
	BDE = 180 – (18 + 39)	*EBD* = 18° **and** *BDE* = 180 – (18 + 39)			M1
			123		A1
					B1 dep on M1 for all correct circle theorems relevant for their method e.g. alternate segment theorem **and** opposite angles in a cyclic quadrilateral sum to 180^o **or** alternate segment theorem **and** angles in same segment are equal
					Total 4 marks

15 a	E.g. $x = 4.57....$ **and** $100x = 457.57....$ **or** $10x = 45.757....$ **and** $1000x = 4575.7....$ **or** $x = 0.57....$ **and** $100x = 57.57....$ **or** $10x = 5.757....$ **and** $1000x = 575.7....$		2	M1	for selecting 2 recurring decimals that when subtracted give a whole number or terminating decimal eg 453 or 4530 etc eg $100x = 457.57....$ and $x = 4.57....$ or $1000x = 4575.7....$and $10x = 45.757....$ with intention to subtract. (If recurring dots not shown then allow $10x = 45.757$, $100x = 457.57$, and $1000x = 4575.7$ to at least 5sf) **or** $4 + 0.5757$ **and** eg $x = 0.57....$, $100x = 57.57....$ with intention to subtract.
	E.g. $100x - x = 457.57.... - 4.57.... = 453$ **and** $\frac{453}{99} = \frac{151}{33}$ or $4\frac{19}{33}$ **or** $1000x - 10x = 4575.7.... - 45.757.... = 4530$ **and** $\frac{4530}{990} = \frac{151}{33}$ or $4\frac{19}{33}$ **or** $100x - x = 57.57.... - 0.57.... = 57$ **and** $\frac{57}{99}$ or $\frac{19}{33}$ (so) $4.\dot{5}\dot{7} = 4\frac{19}{33}$ **or** $1000x - 10x = 575.7.... - 5.757.... = 570$ **and** $\frac{570}{990}$ or $\frac{57}{99}$ or $\frac{19}{33}$ (so) $4.\dot{5}\dot{7} = 4\frac{19}{33}$	Shown		A1	for completion to $\frac{151}{33}$ or $4\frac{19}{33}$

15 b	E.g. $\frac{2}{6-3\sqrt{2}}\times\frac{6+3\sqrt{2}}{6+3\sqrt{2}}$ or $\frac{2}{6-3\sqrt{2}}\times\frac{-6-3\sqrt{2}}{-6-3\sqrt{2}}$		3	M1	for rationalising the denominator by multiplying numerator and denominator by $6+3\sqrt{2}$ (or $-6-3\sqrt{2}$)
	$\frac{12+6\sqrt{2}}{36-18\sqrt{2}+18\sqrt{2}-18}$ or $\frac{12+6\sqrt{2}}{18}$ or $\frac{12+6\sqrt{2}}{6^2-\left(3\sqrt{2}\right)^2}$ or $\frac{12+6\sqrt{2}}{6^2-9\times2}$			M1	(numerator may be expanded or denominator may be 4 terms which need to be all correct)
		$\frac{2+\sqrt{2}}{3}$		A1	or for stating $a = 2$ and $b = 3$ for $\frac{2+\sqrt{2}}{3}$ from correct working dep on M2
					Total 5 marks

16 a	E.g. $x^2 + 4x – 2x – 8$ (= $x^2 + 2x – 8$) **or** $x^2 – 2x + x – 2$ (= $x^2 – x – 2$) **or** $x^2 + 4x + x + 4$ (= $x^2 + 5x + 4$)		3	M1	for multiplying out two brackets correctly with no more than one error
	E.g. $x^3 + 2x^2 – 8x + x^2 + 2x – 8$ or $x^3 + 4x^2 – 2x^2 – 8x + x^2 + 4x – 2x – 8$ **or** $x^3 – x^2 – 2x + 4x^2 – 4x – 8$ or $x^3 – 2x^2 + x^2 – 2x + 4x^2 – 8x + 4x – 8$ **or** $x^3 + 5x^2 + 4x – 2x^2 – 10x – 8$ or $x^3 + 4x^2 + x^2 + 4x – 2x^2 – 8x – 2x – 8$			M1	for at least 3 terms correct out of a maximum of 6 terms **or** for at least 4 terms correct out of a maximum of 8 terms
		$x^3 + 3x^2 – 6x – 8$		A1	
b	E.g. $(x – 5)^2 – 5^2$ (+ 40) or $(x – 5)^2 – 25$ (+ 40) $\left(x^2 + 2ax + a^2\left(+b^2\right)\right)$ $2a = –10$ or $a = –5$		2	M1	for a correct first step **or** for equating coefficients
		$(x – 5)^2 + 15$		A1	accept $a = –5$, $b = 15$ SC B1 for $\left(–x + 5\right)^2 + 15$ or $\left(5 – x\right)^2 + 15$
					Total 5 marks

17	$y(6y + 5) – 2y^2 = 6$	$x\left(\frac{x-5}{6}\right)-2\left(\frac{x-5}{6}\right)^2=6$		5	M1	for substitution of linear equation into quadratic **or** multiplying linear equation by y e.g. $xy – 6y^2 = 5y$ **and** intention to subtract the two equations
	E.g. $4y^2 + 5y – 6$ (= 0) oe $4y^2 + 5y = 6$	E.g. $4x^2 – 10x – 266$ (= 0) oe $4x^2 – 10x = 266$			A1	(dep on M1) writing the correct quadratic expression in form $ax^2 + bx + c$ (= 0) allow $ax^2 + bx = c$
	E.g. $(4y − 3)(y + 2)$ (= 0) $(y =) \frac{-5\pm\sqrt{5^2-4\times4\times-6}}{2\times4}$ $4\left[\left(y+\frac{5}{8}\right)^2-\left(\frac{5}{8}\right)^2\right]=6$ oe	E.g. $(2x – 19)(x + 7)$ (= 0) $(x =) \frac{5\pm\sqrt{(-5)^2-4\times2\times(-133)}}{2\times2}$ $4\left[\left(x-\frac{10}{8}\right)^2-\left(\frac{10}{8}\right)^2\right]=266$ oe			M1	(dep on M1) for a complete method to solve their 3-term quadratic equation (allow one sign error and some simplification – allow as far as $\frac{-5\pm\sqrt{25+96}}{8}$ or $\frac{5\pm\sqrt{25+1064}}{4}$
	$(y =) \frac{3}{4}$ and $(y =) −2$	$(x =) \frac{19}{2}$ and $(x =) −7$			A1	Dep on first M1 for having two correct x values or two correct y values
			$x = \frac{19}{2}, y = \frac{3}{4}$ $x = −7, y = −2$		A1	Dep on first M1 Must be paired and labelled correctly
						Total 5 marks

18	E.g. 28 ÷ 2 (= 14) **or** 1cm^2 = 2 students		5	M1	for method to find the frequency density for the first bar **or** any correct value on the fd axis **or** can be implied by a correct frequency (30 or 24 or 36)
	2 × 20 (= 40) 1 × 30 (= 30) 1 × 24 (= 24) 3 × 12 (= 36) **or** 40, 30, 24, 36			M1	for method to find the missing frequencies (at least 3 correct)
	1 × 28 + 3 × '40' + 4.5 × '30' + 5.5 × '24' + 7.5 × '36' (= 685) or 28 + 120 + 135 + 132 + 270 (= 685)			M1	(indep ft) for a method to find the total (mid value × frequency) for at least **4** products using **their** values in the table (need not be evaluated) Allow consistent use of end points for at least **4** products which must be added
	'685' ÷ (28 + '40' + '30' + '24' + '36') (= 4.335...) or '685' ÷ 158 (= 4.335...)			M1	(dep on previous M1)
		4.34		A1	accept 4.33 - 4.34
					Total 5 marks

19	7.75, 7.85, 3.35, 3.45, 13.5, 14.5		3	B1 for sight of a correct upper or lower bound Accept $3.44\dot{9}$ for 3.45 or $7.84\dot{9}$ for 7.85 or $14.4\dot{9}$ for 14.5
	$(k =)\ \dfrac{13.5}{7.85-3.35}$			M1 for correct substitution into $k = \dfrac{t_{LB}}{a_{UB} - h_{LB}}$ where $13.5 \leq t_{LB} < 14$ **and** $7.8 < a_{UB} \leq 7.85$ **and** $3.35 \leq h_{LB} < 3.4$
		3		A1 accept 3.0
				Total 3 marks

20	$(v=)\ 3t^2 - 9 \times 2t + 33$			5	M1	for differentiating at least 2 terms correctly
	$(a=)\ 3 \times 2t - \text{'18'}$ or $(t=) -\frac{-18}{2\times 3}\left(=\frac{18}{6}\right)$	$(v=)3\left[(t-3)^2-(3)^2\right](+33)$ **or** $(v=)3\left[(t-3)^2-(3)^2(+11)\right]$			M1	dep ft must be a two term linear equation **or** for the use of $(t=)-\frac{b}{2a}$ **or** for a **correct** first step for completing the square on at least a two term quadratic
	$6t - 18 = 0$ **or** $t = 3$	$(v=)3\left[(t-3)^2-(3)^2\right]+33$ **or** $(v=)3\left[(t-3)^2-(3)^2+11\right]$			M1	dep on at least M2 for equating their acceleration to 0 **or** for a **correct** method for completing the square on at least a two term quadratic
	$3\times'3'^{2}-18\times'3'+33$	$(v=)3(t-3)^2+6$ **or** $(v=)3\left[(t-3)^2+2\right]$			M1	dep on at least M2 for substituting their t into v **or** for a seeing a **correct** simplified expression after completing the square
			6		A1	
						Total 5 marks

21	E.g. $a + 3d = 6$ oe		6	M1	for forming an equation for the 4th term of the sequence
	E.g. $\frac{11}{2}(2a+10d) = (a+5d)^2 + 18$			M1	for forming an equation for the sum of the first 11 terms of the sequence
	E.g. $a = 6 - 3d$ **and** $\frac{11}{2}[2(6-3d)+10d] = (6-3d+5d)^2 + 18$ or $d = \frac{6-a}{3}$ **and** $\frac{11}{2}\left[2a+10\left(\frac{6-a}{3}\right)\right] = \left(a+5\left(\frac{6-a}{3}\right)\right)^2 + 18$			M1	dep on M2 for a correct first step to solve the two equations (writing the equation in terms of one variable) **Note:** If $\frac{11}{2}(2a+10d) = (a+5d)^2 + 18$ is expanded then this must be a correct expansion E.g. $11a + 55d = a^2 + 10ad + 25d^2 + 18$
	E.g. $2d^2 + d - 6(=0)$ oe **or** $2a^2 - 27a + 36(=0)$ oe			A1	for a correct 3 term quadratic equation
	$d = 1.5$ oe **and** $a = 1.5$ oe			A1	for a correct value of d **and** a
		30		A1	cao
					Total 6 marks

22	$\left(\frac{-1+2}{2}, \frac{5+10}{2}\right)$ **or** (0.5, 7.5) oe		5	M1	
	$\frac{10-5}{2-(-1)}\left(=\frac{5}{3}\right)$ oe			M1	
	$m \times$ '$\frac{5}{3}$' $= -1$ oe **or** $m = -\frac{3}{5}$ oe			M1	ft their gradient for use of $m_1 \times m_2 = -1$
	'7.5' = '$-\frac{3}{5}$' × '0.5' + c **or** $c = 7.8$ oe **or** $y - '7.5' = '-\frac{3}{5}'(x - '0.5')$			M1	ft dep on first M1 and third M1
		$5y + 3x = 39$		A1	oe where p, q and r must be integers
					Total 5 marks