

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. $\frac{16^8}{5} \times \frac{11}{6^3}$ 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 $\frac{16^8}{5} \times \frac{11}{6^3} = \frac{88}{15} = 5\frac{13}{15}$ 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
	$433.5 \div 3.4$ or $433.5 \div \frac{17}{5}$ or $433.5 \div 3\frac{2}{5}$ or $\frac{433.5}{'204'} \times 60$ oe			M1 for use of speed = distance \div time Allow $433.5 \div 3.24 (= 133.796\dots)$ for this mark only
		127.5		A1 oe allow 128
				Total 3 marks

5	a	$(x=) 270 \div (12 \times 5) (= 4.5)$ oe		3	M1
		$\pi \times '4.5'^2 \times 2 \times '4.5' (= 182.25\pi)$ oe			M1 ft dep on M1
		573			A1 accept 572 – 573
	b	1 000 000	1	B1	or $(1 \times) 10^6$ 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	$0.024 \times 50\,000 (= 1200)$ oe or $1.024 \times 50\,000 (= 51\,200)$ oe or $1.024^2 \times 50\,000 (= 52\,428.8)$ oe or $0.024 \times 50\,000 \times 3 (= 3600)$ oe $0.024 \times 50\,000 \times 3 + 50\,000 (= 53\,600)$ oe		3	M1	M2 for $50\,000 \times 1.024^3$
	$0.024 \times (50\,000 + '1200') (= 1228.8)$ oe and $0.024 \times (50\,000 + '1200' + '1228.8') (= 1258.2912)$ or $'1200' + '1228.8' + '1258.2912' (= 3687.(0912))$ or $1.024 \times '52\,428.8'$			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	

10	$7^2 - (10 \div 2)^2 (= 24)$ or $\frac{\sin\left(\frac{1}{2}x\right)}{5} = \frac{\sin 90}{7}$ oe or $\cos x = \frac{7^2 + 7^2 - 10^2}{2 \times 7 \times 7}$ oe or $\sin\left(\frac{1}{2}x\right) = \frac{5}{7}$ oe or $\cos y = \frac{5}{7}$ 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 $(x =) 2 \times \sin^{-1}\left(\frac{5 \times \sin 90}{7}\right) (= 91.169...)$ oe or $(x =) 2 \times \sin^{-1}\left(\frac{5}{7}\right) (= 91.169...)$ oe or $(x =) \cos^{-1}\left(\frac{7^2 + 7^2 - 10^2}{2 \times 7 \times 7}\right) (= 91.169...)$ oe or $(x =) 2\left(90 - \cos^{-1}\left(\frac{5}{7}\right)\right) (= 2(90 - 44.415)... = 91.169...)$ 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 $\frac{5}{\tan'45.584...'} (= 4.898...)$ or $7 \times \cos'45.584...' (= 4.898...)$
	E.g. $6 \times 10 + \frac{(10 \div 2) \times \sqrt{24}}{2} \times 2 (= 60 + 10\sqrt{6} = 84.494...)$ or $5 \times (6 + 6 + \sqrt{24}) (= 60 + 10\sqrt{6} = 84.494...)$ 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. $'84.494' \div 16 (= 5.28...)$ or $(60 + 10\sqrt{6}) \div 16 (= 5.28...)$			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 fit from table for at least 5 points plotted correctly at end of interval or fit 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 fit their cf graph
	d	E.g. Reading at 23 minutes (= <i>a</i>) and then $(120 - a) \div 120 \times 100$		2	M1 fit 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 fit 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	$(4^{k+3} =)(2^2)^{k+3}$ 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

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	$BFD = 39^\circ$	$BED = 39^\circ$		4	B1
	$BDE = 180 - (18 + 39)$	$EBD = 18^\circ$ and $BDE = 180 - (18 + 39)$			M1
			123		A1
					<p>B1 dep on M1 for all correct circle theorems relevant for their method e.g.</p> <p><u>alternate segment theorem</u> and <u>opposite angles</u> in a <u>cyclic quadrilateral</u> sum to 180°</p> <p>or</p> <p><u>alternate segment theorem</u> and angles in <u>same segment</u> are equal</p>
					Total 4 marks

15 a	<p>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 $1000x = 575.7....$</p>		2	<p>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.</p>
	<p>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) $4.\dot{5}\dot{7} = 4\frac{19}{33}$</p>	Shown		<p>A1 for completion to $\frac{151}{33}$ or $4\frac{19}{33}$</p>

15	b	E.g. $\frac{2}{6-3\sqrt{2}} \times \frac{6+3\sqrt{2}}{6+3\sqrt{2}} \text{ or } \frac{2}{6-3\sqrt{2}} \times \frac{-6-3\sqrt{2}}{-6-3\sqrt{2}}$		3	M1 for rationalising the denominator by multiplying numerator and denominator by $6+3\sqrt{2}$ (or $-6-3\sqrt{2}$)
		$\frac{12+6\sqrt{2}}{36-18\sqrt{2}+18\sqrt{2}-18} \text{ or } \frac{12+6\sqrt{2}}{18} \text{ or } \frac{12+6\sqrt{2}}{6^2-(3\sqrt{2})^2} \text{ or } \frac{12+6\sqrt{2}}{6^2-9 \times 2}$			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	<p>E.g. $x^2 + 4x - 2x - 8 (= x^2 + 2x - 8)$</p> <p>or</p> <p>$x^2 - 2x + x - 2 (= x^2 - x - 2)$</p> <p>or</p> <p>$x^2 + 4x + x + 4 (= x^2 + 5x + 4)$</p>		3	M1 for multiplying out two brackets correctly with no more than one error
		<p>E.g. $x^3 + 2x^2 - 8x + x^2 + 2x - 8$ or $x^3 + 4x^2 - 2x^2 - 8x + x^2 + 4x - 2x - 8$</p> <p>or</p> <p>$x^3 - x^2 - 2x + 4x^2 - 4x - 8$ or $x^3 - 2x^2 + x^2 - 2x + 4x^2 - 8x + 4x - 8$</p> <p>or</p> <p>$x^3 + 5x^2 + 4x - 2x^2 - 10x - 8$ or $x^3 + 4x^2 + x^2 + 4x - 2x^2 - 8x - 2x - 8$</p>			<p>M1 for at least 3 terms correct out of a maximum of 6 terms</p> <p>or</p> <p>for at least 4 terms correct out of a maximum of 8 terms</p>
			$x^3 + 3x^2 - 6x - 8$		A1
	b	<p>E.g. $(x - 5)^2 - 5^2 (+ 40)$ or $(x - 5)^2 - 25 (+ 40)$ $(x^2 + 2ax + a^2 (+ b^2))$ $2a = -10$ or $a = -5$</p>		2	M1 for a correct first step or for equating coefficients
			$(x - 5)^2 + 15$		<p>A1 accept $a = -5, b = 15$</p> <p>SC B1 for $(-x + 5)^2 + 15$ or $(5 - x)^2 + 15$</p>
					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. $(4y - 3)(y + 2) (= 0)$ $(y =) \frac{-5 \pm \sqrt{5^2 - 4 \times 4 \times -6}}{2 \times 4}$ $4\left[\left(y + \frac{5}{8}\right)^2 - \left(\frac{5}{8}\right)^2\right] = 6$ oe	E.g. $(2x - 19)(x + 7) (= 0)$ $(x =) \frac{5 \pm \sqrt{(-5)^2 - 4 \times 2 \times (-133)}}{2 \times 2}$ $4\left[\left(x - \frac{10}{8}\right)^2 - \left(\frac{10}{8}\right)^2\right] = 266$ 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. $28 \div 2 (= 14)$ or $1\text{cm}^2 = 2$ 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)
	$2 \times 20 (= 40)$ $1 \times 30 (= 30)$ $1 \times 24 (= 24)$ $3 \times 12 (= 36)$ or 40, 30, 24, 36			M1	for method to find the missing frequencies (at least 3 correct)
	$1 \times 28 + 3 \times '40' + 4.5 \times '30' + 5.5 \times '24' + 7.5 \times '36' (= 685)$ or $28 + 120 + 135 + 132 + 270 (= 685)$			M1	(indep ft) for a method to find the total (mid value \times 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
	$'685' \div (28 + '40' + '30' + '24' + '36') (= 4.335\dots)$ or $'685' \div 158 (= 4.335\dots)$			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
	$(k =) \frac{13.5}{7.85 - 3.35}$			M1 for correct substitution into $k = \frac{t_{LB}}{a_{UB} - h_{LB}}$ 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
	$(a =) 3 \times 2t - '18'$ or $(t =) -\frac{-18}{2 \times 3} \left(= \frac{18}{6} \right)$	$(v =) 3 \left[(t-3)^2 - (3)^2 \right] (+33) \text{ or }$ $(v =) 3 \left[(t-3)^2 - (3)^2 (+11) \right]$		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
	$6t - 18 = 0 \text{ or } t = 3$	$(v =) 3 \left[(t-3)^2 - (3)^2 \right] + 33 \text{ or }$ $(v =) 3 \left[(t-3)^2 - (3)^2 + 11 \right]$		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
	$3 \times '3'^2 - 18 \times '3' + 33$	$(v =) 3(t-3)^2 + 6 \text{ or }$ $(v =) 3 \left[(t-3)^2 + 2 \right]$		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 4 th 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 $m_1 \times m_2 = -1$
	$'7.5' = '-\frac{3}{5}' \times '0.5' + c$ 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