LEVEL 2 CERTIFICATE
FURTHER MATHEMATICS
8360/1

Paper 1 Non-Calculator

Mark scheme

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Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Glossary for Mark Schemes

GCSE examinations are marked in such a way as to award positive achievement wherever possible. Thus, for GCSE Mathematics papers, marks are awarded under various categories.

If a student uses a method which is not explicitly covered by the mark scheme the same principles of marking should be applied. Credit should be given to any valid methods. Examiners should seek advice from their senior examiner if in any doubt.

M	Method marks are awarded for a correct method which could lead to a correct answer.
M dep	A method mark dependent on a previous method mark being awarded.
A	Accuracy marks are awarded when following on from a correct method. It is not necessary to always see the method. This can be implied.
B	Marks awarded independent of method.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
ft	Follow through marks. Marks awarded following a mistake in an earlier step.
SC	Special case. Marks awarded within the scheme for a common misinterpretation which has some mathematical worth.
oe	Or equivalent. Accept answers that are equivalent. eg, accept 0.5 as well as $\frac{1}{2}$
[a, b]	Accept values between *a* and *b* inclusive.
3.14…	Accept answers which begin 3.14 eg 3.14, 3.142, 3.1416

Examiners should consistently apply the following principles.

Diagrams

Diagrams that have working on them should be treated like normal responses. If a diagram has been written on but the correct response is within the answer space, the work within the answer space should be marked. Working on diagrams that contradicts work within the answer space is not to be considered as choice but as working, and is not, therefore, penalised.

Responses which appear to come from incorrect methods

Whenever there is doubt as to whether a candidate has used an incorrect method to obtain an answer, as a general principle, the benefit of doubt must be given to the candidate. In cases where there is no doubt that the answer has come from incorrect working then the candidate should be penalised.

Questions which ask candidates to show working

Instructions on marking will be given but usually marks are not awarded to candidates who show no working.

Questions which do not ask candidates to show working

As a general principle, a correct response is awarded full marks.

Misread or miscopy

Candidates often copy values from a question incorrectly. If the examiner thinks that the candidate has made a genuine misread, then only the accuracy marks (A or B marks), up to a maximum of 2 marks are penalised. The method marks can still be awarded.

Further work

Once the correct answer has been seen, further working may be ignored unless it goes on to contradict the correct answer.

Choice

When a choice of answers and/or methods is given, mark each attempt. If both methods are valid then M marks can be awarded but any incorrect answer or method would result in marks being lost.

Work not replaced

Erased or crossed out work that is still legible should be marked.

Work replaced

Erased or crossed out work that has been replaced is not awarded marks.

Premature approximation

Rounding off too early can lead to inaccuracy in the final answer. This should be penalised by 1 mark unless instructed otherwise.

Continental notation

Accept a comma used instead of a decimal point (for example, in measurements or currency), provided that it is clear to the examiner that the candidate intended it to be a decimal point.

Q	Answer	Mark	Comments
1	**Alternative method 1**		
	$\frac{11-2}{-2-1}$ or $\frac{2-11}{1--2}$ or -3	M1	oe
	$11 = (\text{their } -3)(-2) + c$ or $2 = (\text{their } -3)(1) + c$ or $c = 5$	M1	do not award if –3 from first M mark becomes 3 in this M mark
	$y = -3x + 5$	A1	condone $y = 5 - 3x$
	Alternative method 2		
	$\frac{11-2}{-2-1}$ or $\frac{2-11}{1--2}$ or -3	M1	oe
	$y - 11 = (\text{their } -3)(x - -2)$ or $y - 2 = (\text{their } -3)(x - 1)$	M1	do not award if –3 from first M mark becomes 3 in this M mark
	$y = -3x + 5$	A1	condone $y = 5 - 3x$
	Alternative method 3		
	Setting up two simultaneous equations $11 = -2m + c$ and $2 = m + c$	M1	oe
	$m = -3$ or $c = 5$	M1dep	must see correct equations
	$y = -3x + 5$	A1	condone $y = 5 - 3x$
	Additional Guidance		
	$m = -3$ and/or $c = 5$ from a diagram		M1, M1
	Second M mark is not dependent in alt 1 and alt 2		
	Penalise further incorrect work eg $y + 3x = 5$ or $y = 2x$		M1, M1, A0

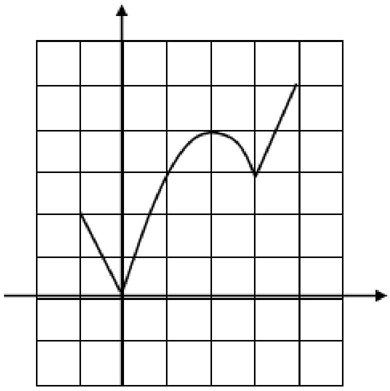
Q	Answer	Mark	Comments
2	Both fractions written with a common denominator (could be written as a single fraction) which is a multiple of 6a and 4 with at least one correct (term of the) numerator	M1	oe eg $\frac{20}{24a}$ or $\frac{6a^2}{24a}$ or $\frac{4(5)}{4(6a)}$ or $\frac{20+6a^2}{24a}$ allow decimals in fraction eg $\frac{5+1.5a^2}{6a}$
	$\frac{10+3a^2}{12a}$	A1	
	Additional Guidance		
	Penalise further working		
	$\frac{10+3a^2}{12}$ is likely to come from correct working		M1, A0

Q	Answer	Mark	Comments
3	$-18 < 5x$ or $8 - 26 < 5x$ or $-5x < 26 - 8$ or $-5x < 18$ or $x > -3.6$ or $-x < 3.6$	M1	5x or x term isolated on one side of a correct inequality
	-3	A1	
	Additional Guidance		
	Trial and improvement (with no incorrect working) with correct answer. Could be as little as one trial		M1, A1
	Trial and improvement with incorrect answer or choice		M0, A0
	$-5x < 18$ but $x < -3.6$ (error) answer -3 (common double error, answer should be -4 following the first error)		M1, A0
	$8 - 5x = 26$ leading to $x = -3$		M1, A1
	$8 - 5x = 26$ not leading to $x = -3$		M0, A0

Q	Answer	Mark	Comments
4	**Alternative method 1**		
	$px - p + 6x + 2k = 4x + 8$ or $px + 6x = 4x$ or $p + 6 = 4$	M1	oe
	$p = -2$	A1	This could imply first M mark if not seen
	$2k$ – their $p = 8$ or $2k$ = their $p + 8$	M1	oe could be awarded by substituting a value of x with $p = -2$
	$k = 3$	A1ft	need to check back for ft mark
	Alternative method 2		
	A correct equation obtained by substituting a value for x in the identity	M1	eg $x = 0$ $2k - p = 8$ $x = 1$ $p - p + 6 + 2k = 12$ $x = 2$ $2p - p + 12 + 2k = 16$
	A second correct equation obtained by substituting a value for x in the identity	M1	oe could go back to equating coefficients at this stage
	$p = -2$	A1	
	$k = 3$	A1	may come from one equation by substituting $x = 1$
	Additional Guidance		
	Correct expansion, then $p + 6 = 4$ followed by $p = 2$ (incorrect) would give $k = 5$ on ft ... allow ft mark for k		M1, A0 M1, A1ft
	In Alt 2 substituting $x = 1$ leads to $k = 3$ (a second equation would be needed to gain further marks)		M1, A1

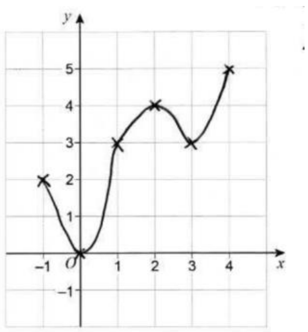
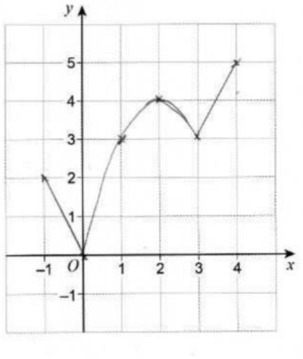
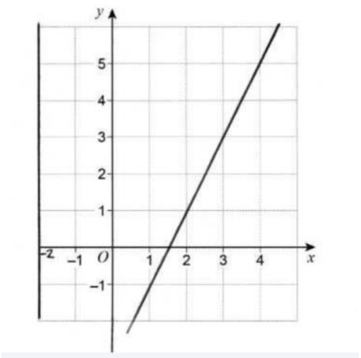
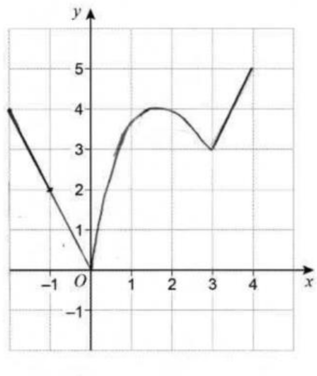
Q	Answer	Mark	Comments
5	$2\sqrt{x} - 10 = 2^3$ or $2\sqrt{x} - 10 = 8$ or $2\sqrt{x} = 18$	M1	
	$\sqrt{x} = \dfrac{2^3 + 10}{2}$ or $\sqrt{x} = \dfrac{8 + 10}{2}$ or $\sqrt{x} = 9$ or $4x = 18^2$ or $x = 9^2$	M1dep	
	$x = 81$	A1	± 81 scores A0
	Additional Guidance		

Q	Answer	Mark	Comments
6	$\begin{pmatrix} 2a & b \\ -b & -a \end{pmatrix} \begin{pmatrix} 3 \\ 4 \end{pmatrix} = \begin{pmatrix} 8 \\ -7 \end{pmatrix}$	M1	
	$6a + 4b = 8$ and $-3b - 4a = -7$	M1dep	oe allow these to be written as a matrix equation in all likelihood this will imply M2 as the matrices may not be seen
	Solve eg $12a + 8b = 16$ and $-12a - 9b = -21$ **or** $18a + 12b = 24$ and $-16a - 12b = -28$ or substitution eg $a = \frac{8 - 4b}{6}$ and $\frac{-4(8 - 4b)}{6} - 3b = -7$ **or** $b = \frac{4 - 3a}{2}$ and $-4a - \frac{3(4 - 3a)}{2} = -7$	M1dep	oe for making coefficients of a or b equal dependent on first M1 only oe
	$a = -2$ **or** $b = 5$	A1	
	$a = -2$ **and** $b = 5$	A1	
	Additional Guidance		
	Matrices wrong way round can be recovered by correct equations in second M		
	Point written as coordinates rather than a matrix can be recovered by correct equations in second M		
	a **or** b correct with no incorrect working		M1, M1, M1, A1, A0

Q	Answer	Mark	Comments
7		B4	B1 for a straight line from (−1, 2) to (0, 0). This should be drawn with a ruler (give BOD) B1 for a quadratic style curve through (0, 0), (1, 3), (2, 4) and (3, 3) within tolerance. Condone one straight line between only one of the sections between (0, 0) and (1, 3), (1, 3) and (2, 4) or (2, 4) and (3, 3) B1 for any quadratic graph drawn with correct curvature and no straight lines (see examples) with clear vertices at (0,0) and (3,3) and within tolerance for these points. There needs to be evidence of a maximum turning point drawn. B1 for a straight line from (3, 3) to (4, 5). This should be drawn with a ruler (give BOD) SC1 for all six stated points plotted correctly and clearly defined (don't need to be joined up or could be joined up incorrectly). If any incorrect points plotted then no marks can be awarded

Q	Additional Guidance	
7	Tolerance of plot ± 2mm for each stated point (these are 1cm squares)	
	For $f(x) = -2x$ extending to the left of $x = -1$ or $f(x) = 2x - 3$ extending to the right of $x = 4$ greater than 2mm, award maximum 1 mark from B1 B1 only for a section that would have otherwise scored ie. If both lines extended then B0 B1	
	If more than one line drawn in any section then choice so loss of marks	
	Ignore shading under or over the lines as long as the graph is clear	

Further Additional Guidance on next page

Q	Additional Guidance	
7	 This would score for the second B mark only  Some feathering but close enough to score B4  B0 but had the line stopped at (4,5) it would have gained B1  Straight lines both correct but penalised one mark for the first one extending beyond the domain B1. Quadratic out of tolerance for (1,3) B0. Correct curvature and vertices B1	

Q	Answer	Mark	Comments
8	**Alternative method 1**		
	± (20 − −4) or ± (5 − −7) or ±24 or ±12 seen	M1	allow on diagram
	using $\frac{5}{8}$ or $\frac{3}{8}$ × ± their 24 or ±15 or ±9 or $\frac{5}{8}$ or $\frac{3}{8}$ × ± their 12 or ±7.5 or ±4.5	M1dep	oe
	(11, −2.5)	A2	A1 for each
	Alternative method 2		
	(x =) $\frac{(3(-4) + 5(20))}{8}$ or (y =) $\frac{(3(5) + 5(-7))}{8}$	M1	oe (condone 1 numerical error)
	(x =) $\frac{(3(-4) + 5(20))}{8}$ and (y =) $\frac{(3(5) + 5(-7))}{8}$	M1	oe
	(11, −2.5)	A2	A1 for each
	Additional Guidance		
	(6, 0.5) if no other marks gained (from 3 and 5 reversed)		SC1
	11 **or** −2.5 seen in answer line with no working		M1, M1, A1, A0
	(-2.5, 11) without working can be awarded the method marks		M1, M1, A0, A0
	11 or -2.5 coming from correct working can be awarded one A mark but for A2 these need to be written as coordinates in brackets		

Q	Answer	Mark	Comments
9	$6x^2 - 20x$	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
10	**Alternative method 1**		
	$(6x + ay)(x + by)$	M1	$ab = -20$ or $a + 6b = 26$
	$(6x - 4y)(x + 5y)$	A1	
	$2(3x - 2y)(x + 5y)$	A1	oe but must have 3 correct factors
	Alternative method 2		
	$(3x + ay)(2x + by)$	M1	$ab = -20$ or $2a + 3b = 26$
	$(3x - 2y)(2x + 10y)$	A1	
	$2(3x - 2y)(x + 5y)$	A1	oe but must have 3 correct factors
	Alternative method 3		
	$2(3x^2 + 13xy - 10y^2)$	M1	
	$2(3x - 2y)(x + 5y)$	A2	oe but must have 3 correct factors A1 for correct answer with signs wrong way round ie $2(3x + 2y)(x - 5y)$
	Alternative method 4 using $(3x^2 + 13xy - 10y^2)$		
	$(3x + ay)(x + by)$	M1	$ab = -10$ or $a + 3b = 13$
	$(3x - 2y)(x + 5y)$	A1	
	$2(3x - 2y)(x + 5y)$	A1	oe but must have 3 correct factors
	Additional Guidance		
	Candidates who remove x or y, factorise correctly and then replace the letter to gain correct answer		M1A2
	Candidates who remove x or y, factorise correctly and then **don't** replace the letter		M0A0
	Condone further working in an attempt to solve an equation		

Q	Answer	Mark	Comments
11	**Alternative method 1**		
	$\pi \times r \times 3r = 60\pi$	M1	oe
	$r^2 = 20$ or $r = \sqrt{20}$ or $r = 2\sqrt{5}$	A1	oe
	$(l =)\ 3\sqrt{20}$ or $(l =)\ 6\sqrt{5}$ or $(l =)\sqrt{180}$ or $l^2 = 180$	A1	oe
	$(h^2 =)\ (3\sqrt{20})^2 - (\sqrt{20})^2$ or $(h^2 =)\ (6\sqrt{5})^2 - (2\sqrt{5})^2$ or $(h^2 =)\ (\sqrt{180})^2 - (\sqrt{20})^2$ or $(h^2 =)\ 160$	M1	oe using their l and r (this is independent so l and r can be anything) condone missing brackets
	$(h =)\ 4\sqrt{10}$	A1	
	Alternative method 2		
	$\pi \times \frac{l}{3} \times l = 60\pi$	M1	oe
	$l^2 = 180$ or $l = \sqrt{180}$ or $l = 3\sqrt{20}$ or $l = 6\sqrt{5}$	A1	oe
	$r^2 = 20$ or $(r =)\sqrt{20}$ or $(r =)\ 2\sqrt{5}$	A1	oe
	$(h^2 =)\ (3\sqrt{20})^2 - (\sqrt{20})^2$ or $(h^2 =)\ (6\sqrt{5})^2 - (2\sqrt{5})^2$ or $(h^2 =)\ (\sqrt{180})^2 - (\sqrt{20})^2$ or $(h^2 =)\ 160$	M1	oe using their l and r (this is independent so l and r can be anything) condone missing brackets
	$(h =)\ 4\sqrt{10}$	A1	
	Alternative method 3		
	$\pi \times r \times 3r = 60\pi$ or $\pi \times \frac{l}{3} \times l = 60\pi$	M1	oe
	$r^2 = 20$ or $r = \sqrt{20}$ or $r = 2\sqrt{5}$ or $l = 3\sqrt{20}$ or $l = 6\sqrt{5}$ or $l = \sqrt{180}$ or $l^2 = 180$	A1	oe
	$r^2 + h^2 = (3r)^2$ or $(h^2 =)\ 9r^2 - r^2$ or $\left(\frac{l}{3}\right)^2 + h^2 = l^2$ or $(h^2 =)\ l^2 - \frac{l^2}{9}$	M1	oe to form an equation with only 2 variables using their l or r (this is independent so l and r can be anything)
	$(h =)\ r\sqrt{8}$ or $(h^2 =)\ 160$	A1	oe
	$(h =)\ 4\sqrt{10}$	A1	

Additional Guidance on next page

Q	Answer	Mark	Comments

Q	Additional Guidance	
11	Second M mark is independent of first M mark	
	Answer with no working will not gain any marks	
	Minimum working for full marks would be a correct expression in the second M mark for alt method 1 and alt method 2. In this the candidate would show l and r so the first M mark would be implied. On alt method 3 they would need to show correct evidence in the first A mark and second M mark as a minimum expectation	M1, A1, A1, M1, A1

Q	Answer	Mark	Comments
12	$3x^2 + 2ax$	M1	allow a derivative with at least one term correct and a term in a eg $3x^2 + 2ax + 7$ or $3x^2 + 2a$
	$3(4)^2 + 2a(4)$ or $48 + 8a$	A1ft	
	$3(-1)^2 + 2a(-1)$ or $3 - 2a$	A1ft	
	$48 + 8a = 2(3 - 2a)$	M1dep	oe ft if first M1 earned
	$(a =) -3.5$	A1	oe
	Additional Guidance		
	Minimum expected working is to see the correct derivative in the first M mark. If no working seen then no marks can be awarded		
	If the word "twice" is interpreted the wrong way round ie equation becomes $2(48 + 8a) = 3 - 2a$ this gives an answer of $a = -5\frac{1}{6}$ or −5.1666...		M1, A1, A1, M0, A0

Q	Answer	Mark	Comments
13	**Alternative method 1**		
	$9x^2 + 15x + 15x + 25 - 5x^2 - 50x$ or $9x^2 + 30x + 25 - 5x^2 - 50x$ or $9x^2 + 15x + 15x + 25$ and $-5x^2 - 50x$ or $5x^2 + 50x$	M1	allow only one error in sign, omission or coefficient but not in more than one of these could be written as 2 separate expansions or in a grid
	$4x^2 - 20x + 25$	A1	
	$4x^2 - 20x + 25$ **and** $(2x-5)^2$ or $(2x-5)(2x-5)$ or $4(x-2.5)^2$ or $x = 2.5$ or $b^2 - 4ac = 0$ from quadratic formula	M1dep	factorises or completes the square or uses the quadratic formula correctly. Answer required for M1 dep
	$(2x-5)^2$ or $4(x-2.5)^2$ (are squared terms) and so are always ≥ 0	A1	oe there must be a stated conclusion eg equal roots and positive quadratic so must be greater than or equal to zero
	Alternative method 2		
	$9x^2 + 15x + 15x + 25 - 5x^2 - 50x$ or $9x^2 + 30x + 25 - 5x^2 - 50x$ or $9x^2 + 15x + 15x + 25$ and $-5x^2 - 50x$ or $5x^2 + 50x$	M1	allow only one error in sign, omission or coefficient but not in more than one of these could be written as 2 separate expansions or in a grid
	$4x^2 - 20x + 25$	A1	
	$4x^2 - 20x + 25$ and $\frac{\mathrm{d}}{\mathrm{d}x} = 8x - 20$ and is zero when $x = 2.5$	M1dep	uses calculus to find stationary point
	Tests for minimum by using eg $x = 2$ and $x = 3$ or by using 2nd derivative **or** concludes argument by saying this is a positive quadratic curve with minimum point (2.5, 0), hence always ≥ 0	A1	oe there must be a stated conclusion
	Additional Guidance		

Q	Answer	Mark	Comments
14	(A =) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$	B1	
	(B =) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$	B1	
	(BA =) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$	M1	must be two 2x2 matrices in the correct order
	$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$	A1	only if M1 awarded for correct product
	Additional Guidance		
	Mark positively for the B marks (you may see more than 2 matrices)		
	If both matrices wrong but then in the correct order		B0, B0, M1, A0
	Both matrices correct but in wrong order		B1, B1, M0, A0
	Possible to score B1 B0 M1 A0 if one correct and one not		B1, B0, M1, A0
	Either A or B on answer line but not identified and no other working		B0, B0, M0, A0
	Condone matrices written without brackets throughout		

15	144°	B1	answers should be on answer line but can be accepted if they are the only angles written on the diagram (other than 36° which is the question so fine) condone missing degree sign
	216°	B1	
	Additional Guidance		
	Don't accept cos144°, cos216°, cos x = 144°, cos x = 216° Accept cos144° = −0.8090 and cos216° = −0.8090		B0 B1, B1
	If more than 2 angles offered this is choice 4 or more angles 2 wrong 1 right 1 wrong 2 right 1 wrong 1 right		 B0 B0 B1 B1

Q	Answer	Mark	Comments
16	$\frac{(21-11\sqrt{5})(3+\sqrt{5})}{(3-\sqrt{5})(3+\sqrt{5})}$	M1	could be $-3-\sqrt{5}$ condone missing final bracket of $3+\sqrt{5}$ if written in this form. Brackets not needed if written as two separate fractions
	Denominator of 4	A1	would be –4 if $-3-\sqrt{5}$ used
	Numerator $63-33\sqrt{5}+21\sqrt{5}-55$ or $8-12\sqrt{5}$	M1dep	allow three terms correct in a 4 term expansion. If error appears in 2 or 3 term simplification and 4 term expansion not seen award M0 expansion could be seen in a grid
	$2-3\sqrt{5}$ or $-3\sqrt{5}+2$	A1	penalise further working
	Additional Guidance		
	Correct first A mark and M1dep mark would assume first M mark correct if not seen.		

Q	Answer	Mark	Comments
17	Any angle in terms of x either in working or on diagram. These could include: *CBA* = 3x; *ACB* = x + 23; *OBA* = 3x – 37; *OBA* = $\frac{180-(2x+46)}{2}$ (= 67 – x); *BAC* = *BCE* = 157 – 4x; *BOA* (reflex) = 314 − 2x	M1	oe but this must be an explicit expression for an angle mark positively (look for any correct angle) 67 – x will be awarded M1 if seen on diagram but if in working would need *OBA* stating. Apply to other angles
	A further angle that could be a different expression for one of the angles in the first mark or an angle that doesn't include x: eg *OCE* = 90; *BCP* = 90; *OCB* = 37; *BCE* = 53; *PCD* = 37	M1dep	look for isosceles triangles being formed by inserting a radius from O to C. P is the point on the circumference where BO is extended. could be a further angle that has the same expression as the first
	A correct equation formed for x that would lead to the solution; eg (3x − 37) + (3x − 37) + (2x + 46) = 180 or 3x + (x + 23) + 53 = 180 many of these will lead to 4x = 104	M1	oe
	(x =) 26	A1	
	Additional Guidance		
	Look for angles on diagram		
	(x =) 37.5 could be a common error. Mark as per mark scheme		
	Labelling angle ABO as angle y and then writing 2y + 2x + 46 = 180 would not be enough for the first M mark. If they went on to write y = 67 – x this would gain the first M mark		

Q	Answer	Mark	Comments
18a	**Alternative method 1**		
	(*AB* =) $\frac{\sqrt{6}}{\tan 60} = \frac{\sqrt{6}}{\sqrt{3}} = \sqrt{2}$	B1	oe must see tan60 oe and some evidence of manipulation with $\sqrt{3}$ oe as well as the final answer to award B1
	Alternative method 2		
	Use of 1 : 2 : $\sqrt{3}$ triangle and showing that our triangle is an enlargement scale factor $\sqrt{2}$	B1	oe must see the triangle drawn and labelled or the ratio clearly seen **and** the scale factor clearly stated
	Additional Guidance		

Q	Answer	Mark	Comments
18b	**Alternative method 1**		
	(*DE* =) $\frac{\sqrt{6}}{\sin 30} = \frac{\sqrt{6}}{0.5} = 2\sqrt{6}$	B1	oe must see sin30 oe and some evidence of manipulation with 0.5 oe as well as the final answer to award B1
	Alternative method 2		
	Use of 1 : 2 : $\sqrt{3}$ triangle and showing that our triangle is an enlargement scale factor $\sqrt{2}$	B1	oe must see the triangle drawn and labelled or the ratio clearly seen **and** the scale factor clearly stated
	Additional Guidance		

18c	$AF = \dfrac{AB}{\cos 60} = \dfrac{\sqrt{2}}{0.5} = 2\sqrt{2}$ or $AF = \dfrac{BF}{\sin 60} = \dfrac{\sqrt{6}}{\frac{\sqrt{3}}{2}} = 2\sqrt{2}$ or $AF^2 = (\sqrt{2})^2 + (\sqrt{6})^2$, so $AF = \sqrt{8}$ or $2\sqrt{2}$	B1	oe allow $2\sqrt{2}$ or $\sqrt{8}$ for this mark seen on the diagram or clearly shown in working
	$CD = \sqrt{6} \times \tan 60 = \sqrt{6} \times \sqrt{3}$ $= \sqrt{18}$ or $3\sqrt{2}$ or $CD = DE \cos 30°$ $= 2\sqrt{6} \times \dfrac{\sqrt{3}}{2} = \sqrt{6} \times \sqrt{3}$ $= \sqrt{18}$ or $3\sqrt{2}$ or $CD^2 = (2\sqrt{6})^2 - (\sqrt{6})^2 = 18$ so $CD = \sqrt{18}$ or $3\sqrt{2}$	B1	oe allow $\sqrt{6} \times \sqrt{3}$ or $\sqrt{18}$ or $3\sqrt{2}$ for this mark seen on the diagram or clearly shown in working
	$6\sqrt{2} + 4\sqrt{6}$	B1dep	dependent on B1, B1 already awarded
	Additional Guidance		
	Condone brackets missed off if recovered		
	AF and *CD* could be seen in part (a) or part (b) so could be awarded B1 in part (c) if used correctly		

Q	Answer	Mark	Comments
19	$\frac{x-2}{2x+2}$ or $\frac{x+1-3}{2(x+1)}$ or $\frac{2x-3}{4x}$	M1	oe substituting correctly in at least one expression
	$4x(x-2)$ and $(2x+2)(2x-3)$ or $4x(x-2)-(2x+2)(2x-3)$ or $4x^2-8x-4x^2+2x+6$ or $6-6x$ or $2x(x-2)$ and $(x+1)(2x-3)$	M1dep	oe (could be from using a different denominator) correct numerators or an expression for both, which need not be simplified do not award any follow through marks from an error in first M mark this one comes from a denominator of $4x(x+1)$
	$4x(x-2)-(2x+2)(2x-3)$ $= 0.5 \times 4x \times 2(x+1)$	M1dep	oe but needs to be the correct equation setting up the quadratic by multiplying the RHS by the product of the denominators could be scored by both sides of the equation still having the same denominator dep on both previous M marks
	$4x^2+10x-6=0$ or $2x^2+5x-3=0$	A1	
	$(4x-2)(x+3)=0$ or $(2x-1)(2x+6)=0$ or $(2x-1)(x+3)=0$	M1dep	correct factors or correct use of quadratic formula oe
	0.5 **and** -3	A1	both answers needed
	Additional Guidance		
	Stop marking as soon as an error is made after first M mark		
	Look out for correct answer from incorrect working ... eg $x+1-2x=0.5$ ... gives $x=0.5$ or $f(2x) = 2 \times \frac{(x-3)}{2x} = \frac{(2x-3)}{4x}$ ie $f(2x)$ written as $2f(x)$ then incorrect multiplication		M0A0