ADDITIONAL SAMPLE
ASSESSMENT MATERIAL

LEVEL 2 CERTIFICATE
FURTHER MATHEMATICS (8365/1)

Paper 1 – Non-Calculator

Mark scheme

Version 1.0

Lead Examiners have prepared these mark schemes for specimen papers. These mark schemes have not, therefore, been through the normal process of standardising that would take place for live papers.

Further copies of this Mark Scheme are available from aqa.org.uk

Glossary for Mark Schemes

AQA exams are marked in such a way as to award positive achievement wherever possible. Thus, for these 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.

M	Method marks are awarded for a correct method which could lead to a correct answer.
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.
ft	Follow through marks. Marks awarded for correct working following a mistake in an earlier step.
SC	Special case. Marks awarded within the scheme for a common misinterpretation which has some mathematical worth.
M dep	A method mark dependent on a previous method mark being awarded.
B dep	A mark that can only be awarded if a previous independent mark has been awarded.
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.
[*a*, *b*)	Accept values $a \leq$ value $< b$
3.14 …	Allow answers which begin 3.14 eg 3.14, 3.142, 3.1416
Use of brackets	It is not necessary to see the bracketed work to award the marks.

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

Questions which ask students to show working

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

Questions which do not ask students to show working

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

Misread or miscopy

Students often copy values from a question incorrectly. If the examiner thinks that the student 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	$\sqrt{\frac{130-49}{130+39}}$ or $\sqrt{\frac{81}{169}}$	M1	
	$\frac{9}{13}$	A1	condone $\pm\frac{9}{13}$
	Additional Guidance		
2	$\frac{1}{5} \times 3a = \frac{35}{100} \times (a + 6)$	M1	oe
	$60a = 35a + 210$ or $\frac{3a}{5} - \frac{35a}{100} = \frac{210}{100}$	M1dep	oe eg $25a = 210$ expands brackets and eliminates fractions or expands brackets and collects terms
	$\frac{42}{5}$ or 8.4	A1	oe value
	Additional Guidance		
3	$\left(\frac{-4+6}{2}, \frac{5+1}{2}\right)$ or (1, 3)	M1	
	$\frac{-2+x}{2}$ = their 1 or $\frac{-1+y}{2}$ = their 3	M1dep	oe eg their 1 + their 1 – – 2 or their 3 + their 3 – – 1
	(4, 7)	A1	
	Additional Guidance		

Q	Answer	Mark	Comments
4(a)	$x^2y(x^2 + 3y^2)$	B2	B1 correct partial factorisation eg $x^2(x^2y + 3y^3)$ or $xy(x^3 + 3xy^2)$ or $y(x^4 + 3xy^3)$ or $x(x^3y + 3xy^3)$
	Additional Guidance		
	Only common factor removed is 1		B0
4(b)	$2(5x - y)$ or $-2(y - 5x)$ or $3(y - 5x)$ or $-3(5x - y)$	M1	
	$-\frac{2}{3}$	A1	
	Additional Guidance		
5	$2^2 + 3^2$ or $4 + 9$ or 13	M1	oe eg $\sqrt{2^2 + 3^2}$
	$x^2 + y^2 = 13$	A1	
	$(x - 2)^2 + (y - 3)^2 = 13$	A1	
	Additional Guidance		

Q	Answer	Mark	Comments
6(a)	$32n > 11(3n - 7)$	M1	allow $32n = 11(3n - 7)$
	$32n > 33n - 77$ or $77 > n$	M1dep	oe must be correct inequality unless recovered
	76	A1	
	Additional Guidance		
	$n = 77$ with final answer 76		M2A1
	$n = 77$ with final answer not 76		M1M0A0
6(b)	$\frac{32}{3}$	B1	oe value
	Additional Guidance		
	Ignore conversion to decimal if $\frac{32}{3}$ seen		
7	$a = 1$	B1	
	$b = 2$	B1	
	$\frac{4-3}{5-2}$ or $\frac{1}{3}$	M1dep	oe eg $\frac{3-4}{2-5}$ or $\frac{-1}{-3}$
	$c = \frac{1}{3}$ and $d = \frac{7}{3}$	A1	
	Additional Guidance		
	$(x-1)^2 + 2$		B2
	$\frac{1}{3}x + \frac{7}{3}$		M1A1

Q	Answer	Mark	Comments
8(a)	$\sqrt[3]{x}$ … or $\sqrt[3]{-8}$	M1	oe eg $\sqrt[3]{y}$ …
	–6	A1	
	Additional Guidance		
8(b)	$\frac{6}{x-5}$	B1	
	$6 = x(x-5)$	M1	oe eg $x^2 - 5x - 6 (= 0)$ ft their $\frac{6}{x-5} = x$ with fractions eliminated
	$(x+1)(x-6)$ or $\frac{--5 \pm \sqrt{(-5)^2 - 4\times1\times-6}}{2\times1}$ or $\frac{5}{2} \pm \sqrt{\frac{49}{4}}$	M1	oe correct factorisation or correct formula for their 3-term quadratic
	–1 and 6	A1	
	Additional Guidance		
	$\frac{6}{x} - 5 = x$		B0
	$6 - 5x = x^2$		M1
	$x^2 + 5x - 6 = 0$		
	$(x+6)(x-1)$		M1
	–6 and 1		A0

Q	Answer	Mark	Comments
9	**Alternative method 1**		
	$a^{\frac{16}{12}}$ or $a^{\frac{4}{3}}$	M1	oe eg $a^{\frac{8}{6}}$
	$a^{\frac{10}{12}}$ or $a^{\frac{5}{6}}$	A1	
	a^5	A1	
	Alternative method 2		
	$a^{\frac{18}{4}} \times a^{\frac{42}{12}}$ or $a^{\frac{96}{12}}$ or a^8	M1	oe eg $a^{\frac{9}{2}} \times a^{\frac{7}{2}}$
	$\frac{a^8}{a^3}$	A1	oe eg $\frac{a^{\frac{96}{12}}}{a^3}$
	a^5	A1	
	Additional Guidance		
10	$n^3 + 2n^2 + 2n^2 + 4n + 2n^2 + 4n + 4n + 8$ or $n^3 + 4n^2 + 2n^2 + 4n + 8n + 8$ or $n^3 + 6n^2 + 12n + 8$	B2	oe eg $n^3 + 3 \times 2n^2 + 3 \times 2^2n + 8$ B1 $n^2 + 2n + 2n + 4$ or $n^2 + 4n + 4$
	their $n^3 + 6n^2 + 12n + 8$ $- n^3 + 5n^2$	M1	
	$11n^2 + 12n + 8$	A1	
	Additional Guidance		
	$n^3 + 8 - n^3 + 5n^2$		B0M1A0

Q	Answer	Mark	Comments
11	$10\sqrt{6}$ or $3\sqrt{6}$ or $2\sqrt{6}$ or $\frac{\sqrt{100\times6}-\sqrt{9\times6}}{\sqrt{4\times6}}$	M1	
	Two of $10\sqrt{6}$ and $3\sqrt{6}$ and $2\sqrt{6}$	M1dep	
	$\frac{7}{2}$ or 3.5	A1	oe value
	Additional Guidance		
12	$\frac{3a}{2a+9}=\frac{3}{5}$	M1	
	$15a = 6a + 27$	M1dep	oe eg $9a = 27$
	$a = 3$	A1	
	$15^2 - 9^2$ or $225 - 81$ or 144	M1	ft their 3 if less than 9
	12	A1ft	ft their 3 if less than 9
	Additional Guidance		
	ft answer must be exact or to 1 dp or better		

Q	Answer	Mark	Comments
13	$\frac{1}{3}\pi r^2 \times \frac{5r}{3} = \frac{320}{9}\pi$	M1	oe eg $\frac{5}{9}\pi r^3 = \frac{320}{9}\pi$
	$r^3 = \frac{320}{5}$ or $r^3 = 64$ or $\sqrt[3]{64}$	M1dep	oe eg $r^3 = \frac{\frac{320\pi}{9}}{\frac{5\pi}{9}}$
	4	A1	SC2 [5.6, 5.623]
	Additional Guidance		

14(a)	30 and 150 with no other solutions [0, 360]	B2	B1 30 with no other solutions [0, 360] or 150 with no other solutions [0, 360] SC1 30 and 150 with one other solution [0, 360]
	Additional Guidance		

14(b)	300°	B1	
	Additional Guidance		

Q	Answer	Mark	Comments
15	Any 3 of angle $ABC = 100$ or angle $ABE = 2x$ or angle $BCF = 180 - 4x$ or angle $CBF = 80 - 2x$ or angle $CBF = 8x - 180$ or angle BCF = $50 + x$	B3	oe eg angle $BCF = 180 - 2x - 2x$ or angle $CBF = 180 - 100 - 2x$ or angle $CBF = 180 - 2(180 - 4x)$ or angle $BCF = \frac{180 - (80 - 2x)}{2}$ B2 any two angles correct B1 any one angle correct angles may be seen on the diagram
	$180 - 4x = 50 + x$ or $2x + 2x + 50 + x = 180$ or $8x - 180 + 100 + 2x = 180$	M1	oe eg $180 - 4x = \frac{180 - (80 - 2x)}{2}$ or $2x + 2x + \frac{180 - (80 - 2x)}{2} = 180$
	26	A1	
	Additional Guidance		
	M1 implies B3		

Q	Answer	Mark	Comments
16	$2x^2$ or $7x$	M1	oe eg $3 \times \frac{2}{3}x^{3-1}$
	$2x^2 + 7x$	A1	
	their $2x^2 + 7x < 0$ or their $2x^2 + 7x \leqslant 0$	M1dep	may be implied by final inequality must be a two-term quadratic dep on first M1
	$x(2x + 7)$ or $x = 0$ and $x = -\frac{7}{2}$	M1dep	factorises or solves their two-term quadratic derivative dep on M2
	$-\frac{7}{2} < x < 0$ or $-\frac{7}{2} \leqslant x \leqslant 0$	A1	oe single inequality in x
	Additional Guidance		
	$2x^2 + 7 < 0$		M1A0M1M0A0
	$x^2 + 7x < 0$ $x(x + 7)$ $-7 < x < 0$		M1A0M1 M1 A0

Q	Answer	Mark	Comments
17	(A =) $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$	B1	
	(B =) $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$	B1	
	$\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$	M1	their B × their A allow if their B and their A are 2 by 2 matrices
	$\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$ and states reflection in $y = -x$	A1	
	Additional Guidance		
	Both 2 by 2 matrices incorrect but written in correct order for multiplication		B0M1A0
	One 2 by 2 matrix correct with one 2 by 2 matrix incorrect but written in correct order for multiplication		B1M1A0

Q	Answer	Mark	Comments
18	(cos *CAB* =) $\frac{(3+\sqrt{5})^2+(3-\sqrt{5})^2-(2\sqrt{6})^2}{2(3+\sqrt{5})(3-\sqrt{5})}$	M1	oe eg $(2\sqrt{6})^2 = (3+\sqrt{5})^2 + (3-\sqrt{5})^2$ $-2(3+\sqrt{5})(3-\sqrt{5})\cos CAB$
	$((3+\sqrt{5})^2 =)\ 9+3\sqrt{5}+3\sqrt{5}+5$ or $((3-\sqrt{5})^2 =)\ 9-3\sqrt{5}-3\sqrt{5}+5$ or $((2\sqrt{6})^2 =)\ 4\times 6$ or $((3+\sqrt{5})(3-\sqrt{5}) =)$ $9-3\sqrt{5}+3\sqrt{5}-5$	M1	oe eg $9+6\sqrt{5}+5$ or $9-6\sqrt{5}+5$ or 24 or $9-5$ or 4
	Any three of $((3+\sqrt{5})^2 =)\ 9+3\sqrt{5}+3\sqrt{5}+5$ or $((3-\sqrt{5})^2 =)\ 9-3\sqrt{5}-3\sqrt{5}+5$ or $((2\sqrt{6})^2 =)\ 4\times 6$ or $((3+\sqrt{5})(3-\sqrt{5}) =)$ $9-3\sqrt{5}+3\sqrt{5}-5$	M1dep	
	$\cos CAB = \frac{14+14-24}{8}$	A1	must have cos *CAB* =
	$\cos CAB = \frac{4}{8}$ and 60 or $\cos CAB = \frac{1}{2}$ and 60	A1	
	Additional Guidance		
	2nd M1 is not dependent on the 1st M1		
	Allow cos A or cos x etc		

Q	Answer	Mark	Comments
19	$x + 1 = 6x^2$ or $6x^2 - x - 1\ (= 0)$	M1	oe
	$(3x + 1)(2x - 1)$ or $\frac{--1 \pm \sqrt{(-1)^2 - 4 \times 6 \times -1}}{2 \times 6}$ or $\frac{1}{12} \pm \sqrt{\frac{25}{144}}$	M1dep	
	$-\frac{1}{3}$ and $\frac{1}{2}$	A1	oe values
	Additional Guidance		
	Incorrect quadratic		M0M0A0
20	$14 - 3x^{-3}$	M1	oe
	$14 - 3 \times \left(\frac{1}{2}\right)^{-3}$ or $14 - 24$ or -10	M1	oe substitution of $x = \frac{1}{2}$ into their derivative their derivative must have a negative power of x
	$-1 \div$ their -10 or $\frac{1}{10}$	M1dep	dep on 2nd M1
	$y - 13 =$ their $\frac{1}{10}\left(x - \frac{1}{2}\right)$	M1	oe
	$20y - 2x - 259 = 0$ or $2x - 20y + 259 = 0$	A1	
	Additional Guidance		

Q	Answer	Mark	Comments
21	**Alternative method 1**		
	$-2\left((3x+...)^2...\right)$	M1	from $-2\left(9x^2+6x-\frac{7}{2}\right)$ oe
	$-2\left((3x+1)^2 - 1^2 - \frac{7}{2}\right)$	M1dep	oe
	$9 - 2(3x+1)^2$	A1	
	Alternative method 2		
	$-18\left(\left(x+\frac{1}{3}\right)^2...\right)$	M1	from $-18\left(x^2+\frac{2}{3}x-\frac{7}{18}\right)$ oe
	$-18\left(\left(x+\frac{1}{3}\right)^2 - \left(\frac{1}{3}\right)^2 - \frac{7}{18}.\right)$	M1dep	oe
	$9 - 2(3x+1)^2$	A1	
	Additional Guidance		