



AS FURTHER MATHEMATICS 7366/1

Paper 1

Mark scheme

June 2026

Version: 1.0 Final

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 Examiner.

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.

No student should be disadvantaged on the basis of their gender identity and/or how they refer to the gender identity of others in their exam responses.

A consistent use of 'they/them' as a singular and pronouns beyond 'she/her' or 'he/him' will be credited in exam responses in line with existing mark scheme criteria.

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

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Mark scheme instructions to examiners

General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- marking instructions that indicate when marks should be awarded or withheld including the principle on which each mark is awarded. Information is included to help the examiner make his or her judgement and to delineate what is creditworthy from that not worthy of credit
- a typical solution. This response is one we expect to see frequently. However credit must be given on the basis of the marking instructions.

If a student uses a method which is not explicitly covered by the marking instructions 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.

Key to mark types

M	mark is for method
R	mark is for reasoning
A	mark is dependent on M marks and is for accuracy
B	mark is independent of M marks and is for method and accuracy
E	mark is for explanation
F	follow through from previous incorrect result

Key to mark scheme abbreviations

CAO	correct answer only
CSO	correct solution only
ft	follow through from previous incorrect result
'their'	indicates that credit can be given from previous incorrect result
AWFW	anything which falls within
AWRT	anything which rounds to
ACF	any correct form
AG	answer given
SC	special case
OE	or equivalent
NMS	no method shown
PI	possibly implied
sf	significant figure(s)
dp	decimal place(s)
ISW	Ignore Subsequent Workings

Examiners should consistently apply the following general marking principles:

No Method Shown

Where the question specifically requires a particular method to be used, we must usually see evidence of use of this method for any marks to be awarded.

Where the answer can be reasonably obtained without showing working and it is very unlikely that the correct answer can be obtained by using an incorrect method, we must award **full marks**. However, the obvious penalty to candidates showing no working is that incorrect answers, however close, earn **no marks**.

Where a question asks the candidate to state or write down a result, no method need be shown for full marks.

Where the permitted calculator has functions which reasonably allow the solution of the question directly,

the correct answer without working earns **full marks**, unless it is given to less than the degree of accuracy accepted in the mark scheme, when it gains **no marks**.

Otherwise we require evidence of a correct method for any marks to be awarded.

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.

Work erased or crossed out

Erased or crossed out work that is still legible and has not been replaced should be marked. Erased or crossed out work that has been replaced can be ignored.

Choice

When a choice of answers and/or methods is given and the student has not clearly indicated which answer they want to be marked, mark positively, awarding marks for all of the student's best attempts. Withhold marks for final accuracy and conclusions if there are conflicting complete answers or when an incorrect solution (or part thereof) is referred to in the final answer.

AS/A-level Maths/Further Maths assessment objectives

AO		Description
AO1	AO1.1a	Select routine procedures
	AO1.1b	Correctly carry out routine procedures
	AO1.2	Accurately recall facts, terminology and definitions
AO2	AO2.1	Construct rigorous mathematical arguments (including proofs)
	AO2.2a	Make deductions
	AO2.2b	Make inferences
	AO2.3	Assess the validity of mathematical arguments
	AO2.4	Explain their reasoning
	AO2.5	Use mathematical language and notation correctly
AO3	AO3.1a	Translate problems in mathematical contexts into mathematical processes
	AO3.1b	Translate problems in non-mathematical contexts into mathematical processes
	AO3.2a	Interpret solutions to problems in their original context
	AO3.2b	Where appropriate, evaluate the accuracy and limitations of solutions to problems
	AO3.3	Translate situations in context into mathematical models
	AO3.4	Use mathematical models
	AO3.5a	Evaluate the outcomes of modelling in context
	AO3.5b	Recognise the limitations of models
	AO3.5c	Where appropriate, explain how to refine models

Q	Marking instructions	AO	Marks	Typical solution
1	Circles the 1st answer.	1.1b	B1	AB
	Question total		1	

Q	Marking instructions	AO	Marks	Typical solution
2	Circles the 4th answer.	1.1b	B1	65°
	Question total		1	

Q	Marking instructions	AO	Marks	Typical solution
3	Circles the 1st answer.	1.1b	B1	-1
	Question total		1	

Q	Marking instructions	AO	Marks	Typical solution
4	Circles the 4th answer.	2.2a	B1	11
	Question total		1	

Q	Marking instructions	AO	Marks	Typical solution
5(a)	Obtains $p = 11$ or $q = -5$ or $r = 3$ May be seen in a matrix $\mathbf{M}^2$	1.1a	M1	$\begin{aligned} p &= 11 \\ q &= -5 \\ r &= 3 \end{aligned}$
	Obtains $p = 11$ and $q = -5$ and $r = 3$ May be seen in a matrix $\mathbf{M}^2$	1.1b	A1	
	Subtotal		2	

Q	Marking instructions	AO	Marks	Typical solution
5(b)	Obtains at least one correct coordinate. May be written in vector form.	1.1a	M1	$\begin{bmatrix} 2 & 1 & -3 \\ 0 & 3 & -1 \\ 5 & -2 & 4 \end{bmatrix} \begin{bmatrix} a \\ a+2 \\ 3-a \end{bmatrix} = \begin{bmatrix} 6a-7 \\ 4a+3 \\ -a+8 \end{bmatrix}$ $A' = (6a-7, 4a+3, -a+8)$
	Obtains $(6a-7, 4a+3, -a+8)$	1.1b	A1	
	Subtotal		2	

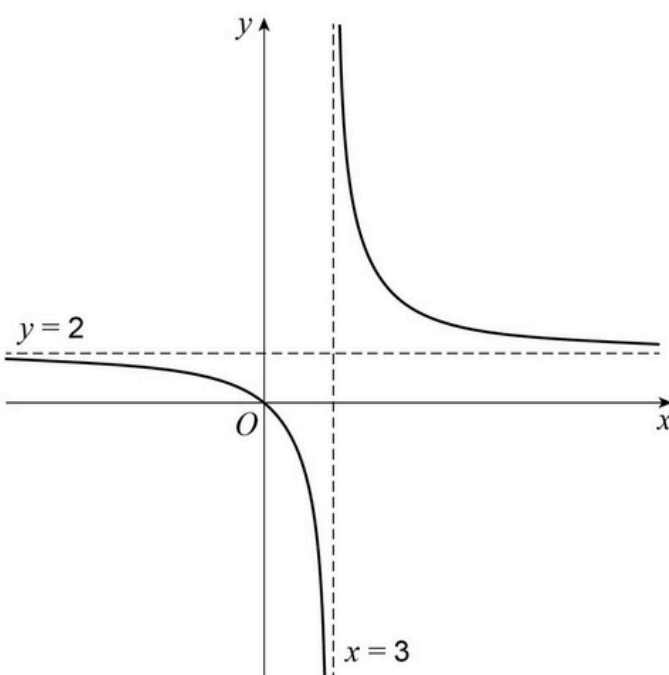
Q	Marking instructions	AO	Marks	Typical solution
5(c)	Writes $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$	1.2	B1	$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
	Subtotal		1	

	Question total		5	
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Q	Marking instructions	AO	Marks	Typical solution
6	Writes the scalar product of a and b as an expression in terms of x Allow one miscopy.	1.1a	M1	$\begin{bmatrix} \sinh x \\ \cosh x \\ -x \end{bmatrix} \cdot \begin{bmatrix} -\sinh x \\ \cosh x \\ 3x \end{bmatrix} = 0$ $-\sinh^2 x + \cosh^2 x - 3x^2 = 0$ $1 = 3x^2$ $x = \pm \frac{1}{\sqrt{3}}$
	Sets the scalar product equal to zero.	1.1a	M1	
	Uses $\cosh^2 x - \sinh^2 x = 1$	1.2	M1	
	Obtains $\pm \frac{1}{\sqrt{3}}$ oe eg $\pm \frac{\sqrt{3}}{3}$ or $\pm \sqrt{\frac{1}{3}}$	1.1b	A1	
Question total			4	

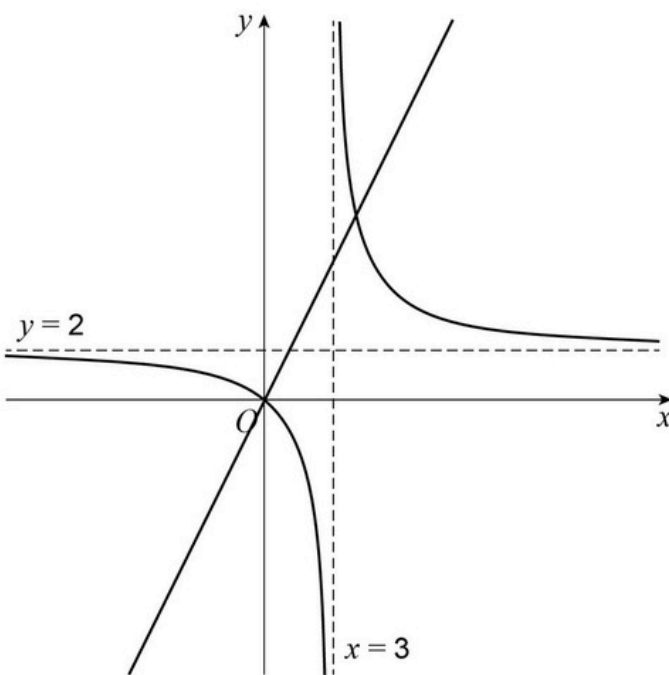
Q	Marking instructions	AO	Marks	Typical solution
7	Integrates $f(x)$ to obtain an expression of the form $ax^3 + bx^2$ PI by one correct value of c	1.1a	M1	$\frac{1}{2} \int_{c-1}^{c+1} (3x^2 + x) dx = 25$ $\left[x^3 + \frac{x^2}{2} \right]_{c-1}^{c+1} = 50$ $\left((c+1)^3 + \frac{(c+1)^2}{2} \right) - \left((c-1)^3 + \frac{(c-1)^2}{2} \right) = 50$ $6c^2 + 2 + 2c = 50$ $3c^2 + c - 24 = 0$ $c = -3 \quad \text{or} \quad c = \frac{8}{3}$
	Divides their integral by 2 or Multiplies the mean by 2 PI by one correct value of c	1.1a	M1	
	Substitutes the correct limits and subtracts and forms a simplified quadratic equation after equating to 25 PI by one correct value of c	1.1a	M1	
	Obtains -3 and $\frac{8}{3}$ Condone AWRT 2.67	1.1b	A1	
Question total			4	

Q	Marking instructions	AO	Marks	Typical solution
8	Identifies at least two of $-4, 1$ and k as roots (of the cubic equation) by listing the roots or sketching a graph with x -intercepts indicated PI by substituting at least two roots in the equation $x^3 + mx + n = 0$ or PI by using at least one formula linking the roots of the equation $x^3 + mx + n = 0$ with at least two correct roots or PI by using at least two of the factors $(x - 1), (x + 4), (x - k)$ Obtains $k = 3$	2.2a	M1	Roots are $-4, 1$ and k $-4 + 1 + k = 0$ $k = 3$ $-4 \times 1 \times 3 = -n$ $n = 12$ $(-4 \times 1) + (-4 \times 3) + (1 \times 3) = m$ $m = -13$
	Obtains $k = 3$	1.1b	B1	
	Selects a method to determine the value of m or n For example: Forms two linear equations in m and n at least one of which is correct eg $1 + m + n = 0$ and $-64 - 4m + n = 0$ or Obtains $-4 \times 1 \times k = -n$ oe or Obtains $(-4 \times 1) + (-4 \times k) + (1 \times k) = m$ oe PI by a correct ft value of m or n for their k	3.1a	M1	
	Obtains $m = -13$ or $n = 12$ PI by a cubic with a correct constant term or x -coefficient	1.1b	A1	
	Obtains $m = -13$ and $n = 12$	1.1b	A1	
Question total			5	

Q	Marking instructions	AO	Marks	Typical solution
9(a)	Sketches an arc with the correct behaviour as it approaches the asymptotes.	1.1b	B1	
	Sketches an arc through (0,0) with approximately the correct behaviour as it approaches the asymptotes.	1.1b	B1	
Subtotal			2	

Q	Marking instructions	AO	Marks	Typical solution
9(b)	Obtains 2	1.1b	B1	$a = 2$
Subtotal			1	

Q	Marking instructions	AO	Marks	Typical solution
9(c)	Obtains – 3	1.1b	B1	$b = -3$
Subtotal			1	

Q	Marking instructions	AO	Marks	Typical solution
9(d)	Solves the inequality to obtain a critical value (excluding 3) eg Solves $\frac{2x}{x-3} = 2x$ to find a value of x from their a and b	1.1a	M1	 $\frac{2x}{x-3} = 2x$ $x = 0 \text{ or } x - 3 = 1$ $x = 0 \text{ or } x = 4$ $x \leq 0, 3 < x \leq 4$
	Obtains a correct positive critical value from their a and b	1.1b	A1F	
	Obtains at least one of $x \leq 0$ or $3 < x \leq 4$ Condone $x < 0$, $3 \leq x \leq 4$, $3 \leq x < 4$, $3 < x < 4$	1.1b	A1	
	Obtains $x \leq 0$ and $3 < x \leq 4$ and no others.	2.2a	A1	
	Subtotal		4	
	Question total		8	

Q	Marking instructions	AO	Marks	Typical solution
10(a)	Forms an equation in A (or B) only. Allow a miscopy of one element.	1.1a	M1	$3\mathbf{A} + 2\mathbf{A} = \begin{bmatrix} 19 & 3 \\ 5 & -7 \end{bmatrix} + \begin{bmatrix} 1 & 2 \\ 5 & -8 \end{bmatrix}$ $\mathbf{A} = \begin{bmatrix} 4 & 1 \\ 2 & -3 \end{bmatrix}$ $2\begin{bmatrix} 4 & 1 \\ 2 & -3 \end{bmatrix} - \mathbf{B} = \begin{bmatrix} 1 & 2 \\ 5 & -8 \end{bmatrix}$ $\mathbf{B} = \begin{bmatrix} 7 & 0 \\ -1 & 2 \end{bmatrix}$
	Obtains at least three correct elements for at least one of the required matrices.	1.1b	A1	
	Obtains $\mathbf{A} = \begin{bmatrix} 4 & 1 \\ 2 & -3 \end{bmatrix}$ and $\mathbf{B} = \begin{bmatrix} 7 & 0 \\ -1 & 2 \end{bmatrix}$	1.1b	A1	
Subtotal			3	

Q	Marking instructions	AO	Marks	Typical solution
10(b)	Explains that the " 2AB " should be 2BA	2.3	E1	2AB should be 2BA
Subtotal			1	

Question total			4	
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Q	Marking instructions	AO	Marks	Typical solution
11(a)	Writes the expression in the form $x \sum r^2 + \sum r + \sum z$ or Substitutes one value of n to form an equation in a and b	1.1a	M1	$\sum_{r=1}^n (r)^3 - \sum_{r=1}^n (r-1)^3$ $= \sum_{r=1}^n 8r^3 - \sum_{r=1}^n (8r^3 - 12r^2 + 6r - 1)$ $= 12 \sum_{r=1}^n r^2 - 6 \sum_{r=1}^n r + \sum_{r=1}^n 1$ $= \frac{12}{6} n(n+1)(2n+1) - \frac{6}{2} n(n+1) + n$ $= n(4n^2 + 6n + 2 - 3n - 3 + 1)$ $= n^2(4n + 3)$ $a = 4, b = 3$
	Replaces $\sum r^2$ with $\frac{1}{6} n(n+1)(2n+1)$ or $\sum r$ with $\frac{1}{2} n(n+1)$ or $\sum k$ with kn or $\sum r^3$ with $\frac{1}{4} n^2(n+1)^2$ or Substitutes two values of n to form two simultaneous equations in a and b	1.1a	M1	
	Replaces $\sum r^2$ with $\frac{1}{6} n(n+1)(2n+1)$ and $\sum r$ with $\frac{1}{2} n(n+1)$ and $\sum k$ with kn or Solves their simultaneous equations in a and b	1.1a	M1	
	Obtains the correct values of a and b Accept $n^2(4n + 3)$	1.1b	A1	
Subtotal			4	

Q	Marking instructions	AO	Marks	Typical solution
11(b)	Obtains $-m^2(am+b) < -250000$ or $-m^2(am+b) = -250000$ with their a and b Condone $-m^2(am+b) > -250000$ PI by AWR 39.4 Condone in terms of n	3.1a	M1	$\sum_{r=1}^m (r-1)^3 = \sum_{r=1}^m r^3 - 3\sum_{r=1}^m r^2 + 3\sum_{r=1}^m r - \sum_{r=1}^m 1$ $= \frac{m^2(m+1)^2}{4} - 3\frac{m(m+1)}{2} + 3\frac{m(m+1)}{2} - m$ $= \frac{m^2(m+1)^2}{4} - m$ $-m^2(4m+3) < -250000$ $4m^3 + 3m^2 - 250000 > 0$ $m > 39.4$ $m = 40$
	Obtains 40	3.2a	A1	
Subtotal			2	
Question total			6	

Q	Marking instructions	AO	Marks	Typical solution
12(a)	Forms a quadratic equation of the form $f(k)x^2 + g(k)x + h(k) = 0$	1.1a	M1	$\text{Let } k = \frac{x^2}{x^2 + 5x - 6}$ $(k-1)x^2 + 5kx - 6k = 0$ There is at least one intersection point, so $(5k)^2 - 4(k-1)(-6k) \geq 0$ $49k^2 - 24k \geq 0$ $24k - 49k^2 \leq 0$
	Obtains the discriminant in terms of k for their $f(k)x^2 + g(k)x + h(k) = 0$	1.1a	M1	
	Sets their discriminant, in terms of k , ≥ 0	1.1a	M1	
	Completes a reasoned argument to show the required result, including a correct reason for setting their discriminant ≥ 0	2.1	R1	
Subtotal			4	

Q	Marking instructions	AO	Marks	Typical solution
12(b)	Obtains 0 and $\frac{24}{49}$	3.1a	B1	The stationary points occur when $24k - 49k^2 = 0$ $k = 0$ or $k = \frac{24}{49}$ $(0,0)$ is a stationary point When $k = \frac{24}{49}$, $-\frac{25x^2}{49} + \frac{120x}{49} - \frac{144}{49} = 0$ $x = 2.4$ $\left(\frac{12}{5}, \frac{24}{49}\right)$ is a stationary point The gradient $= \frac{\frac{24}{49}}{2.4} = \frac{10}{49}$
	Obtains (0,0) Accept $k = 0, x = 0$ or $y = 0, x = 0$ Plby a gradient for PQ of $\frac{y}{x}$ for their second stationary point.	1.1b	B1	
	Substitutes their non-zero root of $24k - 49k^2 = 0$ into their $f(k) = x^2 + g(k)x + h(k) = 0$ oe	1.1a	M1	
	Obtains $x = 2.4$ oe	1.1b	A1	
	Completes a reasoned argument to obtain 10 $\frac{10}{49}$ Must show the quadratic equation $25x^2 - 120x + 144 = 0$ oe	2.1	R1	
Subtotal			5	
Question total			9	

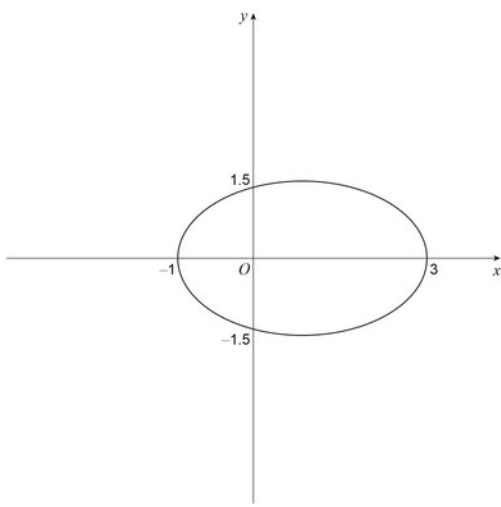
Q	Marking instructions	AO	Marks	Typical solution
13(a)	Substitutes $n = 1$ into LHS and RHS of $\sum_{r=1}^n \frac{1}{r(r+1)} = \frac{n}{n+1}$ and both evaluated to $\frac{1}{2}$	2.2a	B1	When $n = 1$: $\sum_{r=1}^1 \frac{1}{r(r+1)} = \frac{1}{1(1+1)} = \frac{1}{2}$ and $\frac{1}{1+1} = \frac{1}{2}$ so the rule is true for $n = 1$
	Uses $\sum_{r=1}^k \frac{1}{r(r+1)} = \frac{k}{k+1}$ and obtains $\frac{k}{k+1} + \frac{1}{(k+1)(k+2)}$	2.4	M1	Assume the rule is true for $n = k$ $\sum_{r=1}^k \frac{1}{r(r+1)} = \frac{k}{k+1}$
	Completes working to show $\sum_{r=1}^{k+1} \frac{1}{r(r+1)}$ is equivalent to $\frac{k+1}{k+2}$	2.2a	A1	$\sum_{r=1}^{k+1} \frac{1}{r(r+1)} = \frac{k}{k+1} + \frac{1}{(k+1)(k+2)}$ $= \frac{k(k+2)}{(k+1)(k+2)} + \frac{1}{(k+1)(k+2)}$ $= \frac{k^2 + 2k + 1}{(k+1)(k+2)}$ $= \frac{(k+1)^2}{(k+1)(k+2)}$ $= \frac{k+1}{k+2}$
	Completes a reasoned argument by stating that the rule is true for $n = 1$ and if the rule is true for $n = k$ then it is also true for $n = k + 1$ and concludes that (by induction) $\sum_{r=1}^n \frac{1}{r(r+1)} = \frac{n}{n+1}$ is true for all integers $n \geq 1$ This mark is dependent on all previous marks. The algebra must use an alternative letter to n	2.1	R1	so the rule is true for $n = k + 1$ So, by induction, $\sum_{r=1}^n \frac{1}{r(r+1)} = \frac{n}{n+1}$ is true for all integers $n \geq 1$
Subtotal			4	

Q	Marking instructions	AO	Marks	Typical solution
13(b)	Completes a reasoned argument to prove the required result. Must include the LHS, at least one intermediate step and the RHS. Accept the abbreviation LHS.	2.1	R1	$\frac{p}{p+1} - \frac{q}{q+1} = 1 \frac{p(q+1)}{(p+1)(q+1)} - \frac{q(p+1)}{(p+1)(q+1)}$ $= \frac{pq + p - qp - q}{(p+1)(q+1)}$ $= \frac{pq - qp}{(p+1)(q+1)}$
Subtotal			1	

Q	Marking instructions	AO	Marks	Typical solution
13(c)	Substitutes $n = 4999$ or $n = 10\,000$ into $\frac{n}{n+1}$	3.1a	M1	$\sum_{r=1}^{10000} \frac{1}{r(r+1)} - \sum_{r=1}^{4999} \frac{1}{r(r+1)} = \frac{10000}{10001} - \frac{4999}{5000}$ $= \frac{10000 - 4999}{10001 \times 5000}$ $= \frac{5001}{50005000}$
	Obtains $\frac{5001}{50005000}$	2.2a	A1	
Subtotal			2	

Question total			7	
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Q	Marking instructions	AO	Marks	Typical solution
14(a)	Uses one of $x = r \cos \theta$ or $y = r \sin \theta$ or $r^2 = x^2 + y^2$	3.1a	M1	$2r - r \cos \theta = 3$ $2\sqrt{x^2 + y^2} = x + 3$ $2\sqrt{\frac{x^2 + y^2}{2}} = x + 3$ $4(x^2 + y^2) = (x + 3)^2$ $3x^2 - 6x + 4y^2 = 9$ $3(x - 1)^2 + 4y^2 = 12$ $\frac{(x - 1)^2}{4} + \frac{y^2}{3} = 1$
	Uses two of $x = r \cos \theta$ or $y = r \sin \theta$ or $r^2 = x^2 + y^2$	1.1a	M1	
	Correctly squares both sides of the equation.	1.1a	M1	
	Obtains a correct form with r and θ eliminated and square root signs removed eg $4(x^2 + y^2) = (x + 3)^2$	1.1b	A1	
	Obtains $(x - 1)^2$	1.1b	B1	
	Obtains $\frac{(x - 1)^2}{4} + \frac{y^2}{3} = 1$	1.1b	A1	
Subtotal			6	

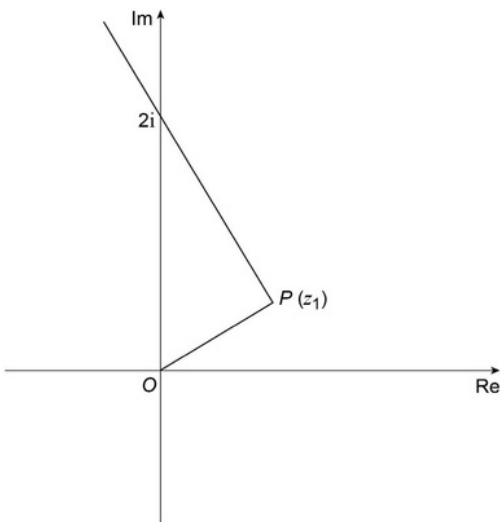
Q	Marking instructions	AO	Marks	Typical solution
14(b)	Draws an ellipse with the maximum and minimum to the right of the y-axis.	1.1b	B1	
	Draws an ellipse with the correct x-axis intercepts.	1.1b	B1	
	Draws an ellipse with the correct y-axis intercepts.	1.1b	B1	
Subtotal			3	

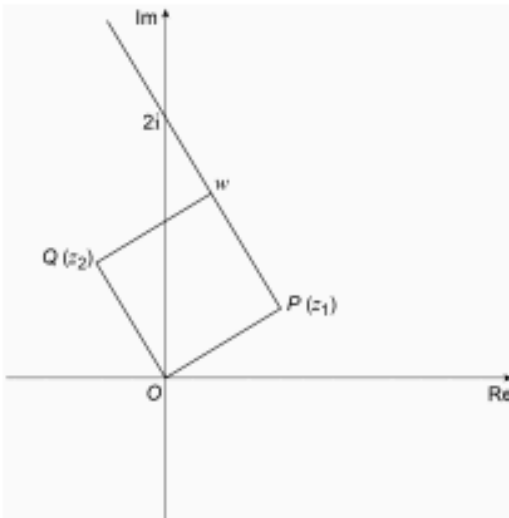
Q	Marking instructions	AO	Marks	Typical solution
14(c)(i)	States translation $\begin{bmatrix} -1 \\ 0 \end{bmatrix}$ ft their k	2.2a	B1F	Translation $\begin{bmatrix} -1 \\ 0 \end{bmatrix}$
	Subtotal		1	

Q	Marking instructions	AO	Marks	Typical solution
14(c)(ii)	Uses two of $x = r \cos \theta$ or $y = r \sin \theta$ or $r^2 = x^2 + y^2$	3.1a	M1	$\frac{x^2}{4} + \frac{y^2}{3} = 1$ $3(r \cos \theta)^2 + 4(r \sin \theta)^2 = 12$ $r^2(3 \cos^2 \theta + 4 \sin^2 \theta) = 12$ $r = \sqrt{\frac{12}{3 \cos^2 \theta + 4 \sin^2 \theta}}$
	Obtains a correct equation for E_1 in the form $r = f(\theta)$ eg $r = \sqrt{\frac{12}{3 \cos^2 \theta + 4 \sin^2 \theta}}$ ISW Accept $r = \pm \sqrt{\frac{12}{3 \cos^2 \theta + 4 \sin^2 \theta}}$	1.1b	A1	
	Subtotal		2	

	Question total		12	
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Q	Marking instructions	AO	Marks	Typical solution
15(a)	Uses a complete method to find angle POQ eg subtracts the arguments of z_1 and z_2 eg finds PQ correctly and substitutes triangle OPQ into the cosine rule	3.1a	M1	$\frac{2\pi}{3} - \frac{\pi}{6}$ $= \frac{\pi}{2}$
	Obtains $\frac{\pi}{2}$ Accept 90°	2.2a	A1	
Subtotal			2	

Q	Marking instructions	AO	Marks	Typical solution
15(b)	Forms an expression or equation for the imaginary intercept.	3.1a	M1	$\cos \frac{(\pi - \pi/6)}{2} = \frac{1}{y_1}$ $y_1 = 2$ 
	Obtains the imaginary intercept $2i$ Accept 2 at the imaginary intercept. Condone $(0, 2)$ or $(0, 2i)$	2.2a	A1	
	Draws a half-line from P at an obtuse angle to the positive real axis, that crosses the imaginary axis.	1.1b	B1	
Subtotal			3	

Q	Marking instructions	AO	Marks	Typical solution
15(c)	Identifies the position of w on the diagram. Must appear in the 1st quadrant, above and to the left of P .	3.1a	B1	 $z_1 + z_2 = \cos \frac{\pi}{6} + i \sin \frac{\pi}{6} + \cos \frac{2\pi}{3} + i \sin \frac{2\pi}{3}$ $= \left(\frac{\sqrt{3}}{2} - \frac{1}{2} \right) + \left(\frac{1}{2} + \frac{\sqrt{3}}{2} \right) i$
	Uses a complete method to find w For example: adds z_1 and z_2 or uses $ w = \sqrt{2}$ and $\arg(w) = \frac{\pi}{6} + \frac{1}{2} \times \text{their } \angle POQ$ or finds the Cartesian equations of two lines through w , one of which must be correct, and solves	3.1a	M1	
	Obtains $\left(\frac{\sqrt{3}}{2} - \frac{1}{2} \right) + \left(\frac{1}{2} + \frac{\sqrt{3}}{2} \right) i$	2.2a	A1	
Subtotal			3	

Q	Marking instructions	AO	Marks	Typical solution
15(d)(i)	Selects a method to find the value of α For example: Finds half of their part (c) answer of the form $x + iy$ where x and y are non-zero or Finds half of $z_1 + z_2$	3.1a	M1	$\alpha = \frac{1}{2} \left(\left(\frac{\sqrt{3}}{2} - \frac{1}{2} \right) + \left(\frac{1}{2} + \frac{\sqrt{3}}{2} \right) i \right)$ $= \left(\frac{\sqrt{3}}{4} - \frac{1}{4} \right) + \left(\frac{1}{4} + \frac{\sqrt{3}}{4} \right) i$
	Obtains $\left(\frac{\sqrt{3}}{4} - \frac{1}{4} \right) + \left(\frac{1}{4} + \frac{\sqrt{3}}{4} \right) i$	2.2a	A1	
Subtotal			2	

Q	Marking instructions	AO	Marks	Typical solution
15(d)(ii)	Selects a method to find the value of β For example: Finds half of the modulus of their part (c) answer of the form $x + iy$ where x and y are non-zero or Finds the modulus of their part (d)(i) answer of the form $x + iy$ where x and y are non-zero or Finds half of $ z_1 + z_2 $ or Finds half of $ z_1 - z_2 $	3.1a	M1	$\beta = \frac{1}{2} \sqrt{\left(\frac{\sqrt{3}}{2} - \frac{1}{2}\right)^2 + \left(\frac{1}{2} + \frac{\sqrt{3}}{2}\right)^2}$ $= \frac{1}{2} \sqrt{2}$
	Obtains $\frac{1}{2}\sqrt{2}$ oe	2.2a	A1	
	Subtotal		2	
	Question total		12	
	Question Paper total		80	