IQM3004

LEVEL 3 · CONTROLLED STAFF DOCUMENT

INTO QUALIFICATIONS

Mathematics

Component 1: Paper 1 written examination

STAFF ONLY · Mark scheme

Duration
1 hour 30 minutes

Total marks
75

Assessment window
Sample assessment

Assessment set
Set S of 2026

Audience
Staff only

Release timing
exam release

Exam date
_____

Assessment set ID
2026-S

STAFF ONLY · Use only this assessment-specific scheme and approved standardisation decisions.	
Assessment window Sample assessment	**Exam date** _____
Paper P1	**Assessment set** Sample 2026 · ID 2026-S

General marking principles

- Record every awarded mark in the corresponding OCR-readable annotation on the candidate response document.
- Credit equivalent valid answers only where the approved item-specific scheme permits them.
- Do not infer grade boundaries from raw marks; award boundaries are held in programme specifications.

Each M1 is one method mark, A1 one accuracy mark dependent on the associated method, and B1 one independent mark. Accept equivalent valid methods and exact forms. Correct answers can imply method. Use 3 significant figures for non-exact numerical answers unless another accuracy is specified. No follow-through unless stated. AO labels support assessment mapping.

Item ID	Question / requirement	Solution and allocation	Alternatives / notes	Max
A1(a)	Simplify $x^{3/2}x^{5/2}$, where $x>0$.	B1 (AO1): x^4.	General principles apply.	1
A1(b)	Rationalise the denominator of $6/(\sqrt{5}-1)$.	M1 (AO1): Multiply numerator and denominator by $\sqrt{5}+1$. A1 (AO1): $3(\sqrt{5}+1)/2$.	General principles apply.	2
A1(c)	Express $(5x+1)/[(x+1)(x-2)]$ in partial fractions.	M1 (AO1): Use $A/(x+1)+B/(x-2)$ and equate $5x+1=A(x-2)+B(x+1)$. A1 (AO1): $4/[3(x+1)]+11/[3(x-2)]$.	General principles apply.	2
A2(a)	Find the gradient of the line through $(-2,1)$ and $(4,13)$.	B1 (AO1): 2.	General principles apply.	1
A2(b)	Find the equation of the line through $(-2,1)$ and $(4,13)$.	M1 (AO1): Use $y-1=2(x+2)$. A1 (AO1): $y=2x+5$.	General principles apply.	2
A2(c)	Find the intersection of $y=2x+5$ and $3x+y=15$.	M1 (AO1): Substitute to obtain $5x+5=15$. A1 (AO1): $(2,9)$.	General principles apply.	2

A3(a)	For $f(x)=x^2-6x+5$, find $f(0)$.	B1 (AO1): 5.	General principles apply.	1
A3(b)	Write x^2-6x+5 in completed-square form and state the minimum value.	B1 (AO1): $(x-3)^2-4$. B1 (AO2): Minimum -4, since a real square is non-negative.	General principles apply.	2
A3(c)	Solve $x^2-6x+5<0$.	M1 (AO1): Factorise $(x-1)(x-5)$ or find roots 1 and 5 by another valid method. A1 (AO2): $1<x<5$; strict endpoints excluded.	General principles apply.	2
A4(a)	Convert 150° to radians, giving an exact answer.	B1 (AO1): $5\pi/6$.	General principles apply.	1
A4(b)	Two sides of a triangle are 6 cm and 8 cm, enclosing an angle of 60°. Find the exact length of the third side.	M1 (AO1): $c^2=6^2+8^2-2(6)(8)\cos 60^\circ$. A1 (AO1): $2\sqrt{13}$ cm.	General principles apply.	2
A4(c)	A circle has radius 6 cm. Find the exact area of the minor segment subtended by an angle of $\pi/3$ radians at the centre.	M1 (AO3): Subtract triangle area from sector area: $\frac{1}{2}(6^2)(\pi/3)-\frac{1}{2}(6^2)\sin(\pi/3)$. A1 (AO1): $(6\pi-9\sqrt{3})$ cm².	General principles apply.	2
A5(a)	Find dy/dx for $y=3x^4-5x+2$.	B1 (AO1): $12x^3-5$.	General principles apply.	1
A5(b)	Find $f(x)$ given $f'(x)=6x-4$ and $f(1)=5$.	M1 (AO1): $f(x)=3x^2-4x+C$; use the given point. A1 (AO1): $f(x)=3x^2-4x+6$.	General principles apply.	2
A5(c)	Evaluate $\int_0^2(3x^2-4x)\,dx$.	M1 (AO1): Antiderivative x^3-2x^2 and substitute both limits. A1 (AO1): 0.	General principles apply.	2

A6(a)	Disprove the claim that n^2+n+11 is prime for every positive integer n.	B1 (AO2): Choose $n=10$ (or another valid counterexample). B1 (AO2): Then the value is $121=11^2$, which is composite; one counterexample disproves the universal claim.	General principles apply.	2
A6(b)	Using exhaustion, prove that for $n\in\{1,2,3,4\}$, n^2 leaves remainder 0 or 1 when divided by 4.	B1 (AO2): Compute squares $1,4,9,16$ for the four permitted integers. B1 (AO2): Remainders are $1,0,1,0$ respectively. B1 (AO2): These exhaust the stated domain, so every permitted case has remainder 0 or 1. A claim about all integers is not required.	General principles apply.	3
B1(a)	Let $f(x)=x^3-3x^2-4x+12$. Use the Factor Theorem to show that $(x-2)$ is a factor.	M1 (AO1): $f(2)=8-12-8+12=0$. A1 (AO2): By the Factor Theorem, $f(2)=0$ implies $(x-2)$ is a factor.	General principles apply.	2
B1(b)	For $f(x)=x^3-3x^2-4x+12$, divide by $(x-2)$ and hence solve $f(x)=0$.	M1 (AO1): Valid polynomial division or coefficient comparison. A1 (AO1): Quotient x^2-x-6 with zero remainder. M1 (AO1): Factorise quotient as $(x-3)(x+2)$. A1 (AO1): $x=-2,2,3$; all three required.	General principles apply.	4
B1(c)	Sketch $y=x^3-3x^2-4x+12$, labelling all intercepts with the coordinate axes.	B1 (AO1): Intercepts $(-2,0),(2,0),(3,0),(0,12)$ correctly labelled. B1 (AO2): Positive-leading cubic shape, crossing at each simple root, tending down left and up right.	General principles apply.	2
B1(d)	Find the equation of the tangent to $y=x^3-3x^2-4x+12$ at $x=0$.	M1 (AO1): $dy/dx=3x^2-6x-4$, giving gradient -4 at 0. A1 (AO1): $y=-4x+12$.	General principles apply.	2

B1(e)	The graph of $y=f(x)$ is translated by vector $\begin{pmatrix}2\\-3\end{pmatrix}$. Write the equation of the new graph in terms of f, and give the image of the point $(0,12)$.	B1 (AO1): $y=f(x-2)-3$. B1 (AO1): $(2,9)$.	General principles apply.	2
B1(f)	For what real values of k does $x^2-3x+k=0$ have two distinct real roots? Justify your answer.	M1 (AO1): Discriminant $9-4k$. M1 (AO2): Two distinct real roots require $9-4k>0$. A1 (AO2): $k<9/4$.	General principles apply.	3
B2(a)	A circular garden has centre $C=(2,-1)$ and passes through $P=(5,3)$. Coordinates are measured in metres. Find its radius and equation.	M1 (AO1): $CP=\sqrt{3^2+4^2}=5$ m. A1 (AO1): $(x-2)^2+(y+1)^2=25$.	General principles apply.	2
B2(b)	Find the equation of the tangent at $P=(5,3)$ to the circle with centre $(2,-1)$ and radius 5.	M1 (AO2): Radius gradient $4/3$, so tangent gradient $-3/4$. A1 (AO1): $y-3=-\frac{3}{4}(x-5)$ or $3x+4y=27$.	General principles apply.	2
B2(c)	Find the points where the line $y=3$ intersects $(x-2)^2+(y+1)^2=25$.	M1 (AO1): $(x-2)^2=9$. A1 (AO1): $(-1,3)$ and $(5,3)$.	General principles apply.	2
B2(d)	For $C=(2,-1)$, $P=(5,3)$ and $Q=(-1,3)$, find the area of triangle CPQ.	M1 (AO3): Use base $PQ=6$ and perpendicular height 4. A1 (AO1): 12 m².	General principles apply.	2
B2(e)	A straight path follows $y=3$ inside the circular garden $(x-2)^2+(y+1)^2\le 25$. State the path length inside the garden and explain how you obtain it.	B1 (AO3): Length 6 m. B1 (AO2): The chord endpoints are $(-1,3)$ and $(5,3)$, so their horizontal separation is $5-(-1)=6$.	General principles apply.	2

B2(f)	A rectangular flower bed has vertices $(0,0),(3,0),(3,2),(0,2)$. On a labelled coordinate diagram, shade the portion satisfying $x+y\le 3$, and find its area.	B1 (AO1): Draw the rectangle and line $x+y=3$ meeting the bed at $(1,2)$ and $(3,0)$. B1 (AO2): Shade the region containing $(0,0)$, including boundary. B1 (AO3): Area $6-\frac{1}{2}(2)(2)=4$ m². Accept 4 square units; do not withhold the area mark solely for an unstated unit.	General principles apply.	3
B2(g)	The circle $(x-2)^2+(y+1)^2=25$ models the garden boundary. State one assumption of this model and explain how a survey could test it.	B1 (AO3): Assumes a circular boundary of constant radius in a level plane, or another specific valid geometric modelling assumption. B1 (AO3): Measure several distances from proposed centre to boundary and compare with 5 m; accept a relevant test of the stated assumption.	General principles apply.	2
B3(a)	An open rectangular enclosure is built against a straight wall using 40 m of fencing for the other three sides. Let x m be each side perpendicular to the wall. Show that its area is $A=40x-2x^2$, and state the physical range of x.	B1 (AO3): Length parallel to wall is $40-2x$, so $A=x(40-2x)=40x-2x^2$. B1 (AO3): $0<x<20$ for a non-degenerate enclosure.	General principles apply.	2
B3(b)	Use calculus to find the maximum of $A=40x-2x^2$ for $0<x<20$, and justify that it is a maximum.	M1 (AO1): $dA/dx=40-4x$ and set this to zero. A1 (AO1): $x=10$. B1 (AO2): $d^2A/dx^2=-4<0$, so this is a maximum (or valid derivative sign change). A1 (AO3): Maximum area 200 m².	General principles apply.	4
B3(c)	For $A=40x-2x^2$, find the rate of change of area with respect to x at $x=6$, including units.	M1 (AO1): Evaluate $40-4(6)$. A1 (AO3): 16 m² per metre increase in x.	General principles apply.	2

B3(d)	State one practical reason why the enclosure model $A = 40x - 2x^2$ might overestimate usable area.	B1 (AO3): For example, fence-post thickness occupies space, or an internal access strip reduces usable area. Must relate to usable area.	General principles apply.	1
B3(e)	For the separate curve $y = x^2 - 4$, find the intercepts with the x-axis and state where it is below the x-axis.	B1 (AO1): Intercepts $(-2, 0)$ and $(2, 0)$. B1 (AO2): Below for $-2 < x < 2$.	General principles apply.	2
B3(f)	Find the total area between $y = x^2 - 4$ and the x-axis for $-2 \le x \le 2$.	M1 (AO2): Area $\int_{-2}^{2} (4 - x^2)\ dx$; negate the signed integral or use symmetry. M1 (AO1): Use antiderivative $4x - x^3/3$ and limits. A1 (AO1): $32/3$ square units.	General principles apply.	3
B3(g)	The line $y = 0$ and curve $y = x^2 - 4$ bound a region. Explain why their signed integral from -2 to 2 is negative although the area is positive.	B1 (AO2): The curve lies below the line throughout the interior; signed integral counts this negatively, while geometric area is non-negative.	General principles apply.	1