IQM3004

LEVEL 3 · CONTROLLED ASSESSMENT

INTO QUALIFICATIONS

Mathematics

Component 2: Paper 2 written examination

Candidate question paper

Duration
3 hours

Total marks
150

Assessment window
Sample assessment

Assessment set
Set S of 2026

Response instruction
Write all answers in the separate answer booklet.

Release timing
exam release

Paper
P2

Assessment set ID
2026-S

INTO QUALIFICATIONS LEARNER ID

DELIVERY CENTRE ID (OPTIONAL)

EXAM DATE
_____

ASSESSMENT SET
Set S of 2026

Do not open this paper until instructed. Record every answer in the separate answer booklet.

FOR MARKER USE ONLY

Marker initials	**Mark / 150**

Instructions

- Follow the answer route stated at the start of each section.
- Write all answers in the separate answer booklet and identify each question clearly.
- Show all working where relevant.
- Use the supplied controlled formula sheet. A permitted calculator is non-programmable and non-graphing; calculators with CAS, text/image/document storage or internet capability are not permitted. Phones, tablets and smart watches are not permitted. No candidate-provided materials or AI are permitted.
- The mark allocation is shown beside each question.

All questions are compulsory. Give non-exact numerical answers to 3 significant figures unless another accuracy is stated.

Section A · Short answer questions

Answer all nine questions. 60 marks.

Question A1 · 5 marks

(a) Expand $(1+2x)^5$ through the term in x^3. 3

(b) Find the coefficient of x^4 in $(2-x)^6$. 2

Question A2 · 6 marks

(a) Expand $(1-2x)^{-1/2}$ through the term in x^2. 3

(b) Use your expansion of $(1-2x)^{-1/2}$ through x^2 to approximate $1/\sqrt{0.96}$. 2

(c) State the strict inequality in x required by the standard binomial expansion condition for $(1-2x)^{-1/2}$. 1

Question A3 · 7 marks

(a) An arithmetic progression has third term 11 and eighth term 31. Find the first term and common difference. 3

(b) Find the least positive integer n for which $\sum_{k=1}^{n}(4k-1)>1000$. 4

Question A4 · 7 marks

(a) A sequence satisfies $u_1=100$ and $u_{n+1}=0.8u_n+10$. Find u_2 and u_3. 2

(b) For $u_1=100$, $u_{n+1}=0.8u_n+10$, define $v_n=u_n-50$. Show that v_n is geometric, find a formula for u_n, and find its limit as n increases. 5

Question A5 · 8 marks

(a) Solve $3e^{2x}=15$, giving an exact value of x. 3

(b) Sketch $y=\ln(x-2)$, labelling its vertical asymptote and x-intercept. 2

(c) Solve $\log_2(x-1)+\log_2(x+1)=3$, checking the domain. 3

Question A6 · 11 marks

(a) Prove that $(sec^2\theta-1)/\tan\theta=\tan\theta$ wherever the left-hand expression is defined. 3

(b) Solve $2\sin^2\theta-3\sin\theta+1=0$ for $0\le\theta<2\pi$. 4

(c) Write $3\sin\theta+4\cos\theta$ as $R\sin(\theta+\alpha)$, where $R>0$ and $0<\alpha<\pi/2$. State its maximum value. 4

Question A7 · 6 marks

(a) Let $f(x)=2x+1$ on $\mathbb{R}$ and $g(x)=x^2$ on $\mathbb{R}$. Find $f(g(x))$ and its range. 3

(b) For $h(x)=x^2+3$ restricted to $x\ge0$, find the inverse function, stating its domain and range. 3

Question A8 · 5 marks

(a) Sketch $y=2|x-3|-4$, labelling the vertex and all axis intercepts. 3

(b) Solve $|2x-1|<5$. 2

Question A9 · 5 marks

(a) For small x measured in radians, use small-angle approximations to simplify $\sin(3x)/\tan(2x)$. State the limiting value as $x\to0$. 2

(b) Sketch $y=sec\,x$ for $-\pi<x<\pi$, showing its asymptotes and intercept with the y-axis. 3

Section B · Structured questions

Answer all six questions. 90 marks.

Question B1 · 15 marks

(a) Differentiate $y=x^2e^{3x}$ and factorise your answer. State the two differentiation rules used. 4

(b) For $y = \ln x / x$ with $x > 0$, find $d y / d x$ and determine the interval on which y is increasing. 4

(c) The curve $x^2 + x y + y^2 = 7$ passes through $(1, 2)$. Find $d y / d x$ by implicit differentiation and evaluate it at $(1, 2)$. 3

(d) Find the stationary points of $y = x^2 e^{3x}$ and determine their nature. 4

Question B2 · 15 marks

(a) Use substitution $u = x^2 + 1$ to evaluate $\int_0^1 2x\sqrt{x^2+1}\ \ d x$. 4

(b) Find $\int \cos(3x)\ \ d x$. 2

(c) Find $\int x e^x\ \ d x$ by integration by parts. 3

(d) Find the exact area bounded by $y = e^x$, $y = 1$, $x = 0$ and $x = \ln 2$. 4

(e) Find $\int 3/(3x+2)\ \ d x$, stating the intervals on which your expression is valid. 2

Question B3 · 15 marks

(a) Points A, B, C have position vectors $(1, 2, -1)$, $(5, 0, 3)$ and $(3, 5, 1)$. Find $\overrightarrow{AB}$, its magnitude, and the position vector of the midpoint of AB. 5

(b) $A = (1, 2, -1)$ and $B = (5, 0, 3)$. Point P divides AB internally in the ratio $AP : PB = 1 : 3$. Find P and show that P lies in the plane $z = 0$. 4

(c) Points $A = (1, 2, -1)$, $B = (5, 0, 3)$ and $C = (3, 5, 1)$ are consecutive vertices of parallelogram $ABCD$. Find D and verify that the diagonals have the same midpoint. 4

(d) A displacement in a horizontal plane is $3i + 4j$ km, where i points east and j north. Find its magnitude and bearing to the nearest degree. 2

Question B4 · 15 marks

(a) A vehicle starts from rest. Its velocity increases uniformly to 12 m/s in 6 s, stays at 12 m/s for 10 s, then decreases uniformly to rest in 4 s. Sketch the velocity-time graph and find the total distance travelled. 5

(b) A ball is projected vertically upwards at 19.6 m/s from ground level. Neglect air resistance and use $g = 9.8$ m/s². Find the time to maximum height, the maximum height, and the total time before it returns to ground level. 5

(c) A particle is acted on by forces $F_1=(3,4)$ N and $F_2=(-1,2)$ N in the horizontal plane. Find their resultant. Find the third force required for equilibrium, sketch the three force vectors acting at the particle, and explain what equilibrium implies about its motion. 5

Question B5 · 15 marks

(a) For $f(x)=x^3-x-2$, show that a root lies between 1 and 2, explaining the mathematical condition that makes this argument valid. 3

(b) Use $x_{n+1}=(x_n+2)^{1/3}$ with $x_0=1.5$ to calculate x_1 and x_2, retaining at least six decimal places during working and reporting four decimal places. 3

(c) Write the Newton-Raphson iteration for $f(x)=x^3-x-2$ and calculate one step from $x_0=1.5$. 3

(d) Given $f(1.5213)=-0.000473731403$ and $f(1.5214)=0.000120620344$ for $f(x)=x^3-x-2$, justify the root to three decimal places. 3

(e) A student proposes using Newton-Raphson for $f(x)=x^3-x-2$ with $x_0=1/\sqrt{3}$. Explain why the first step cannot be calculated, and suggest a suitable alternative starting value supported by information in this question. 3

Question B6 · 15 marks

(a) A machine costs £24000. Its resale value is modelled by $V_n=24000(0.85)^n$ pounds after n complete years. Find its value after 3 years and interpret the factor 0.85. 3

(b) For $V_n=24000(0.85)^n$, find the first complete year at which the model predicts a value below £8000. Show your logarithmic working. 4

(c) The machine saves £5000 in year 1, £4500 in year 2 and continues with annual savings multiplied by 0.9. Find the total modelled savings in the first 5 years and the infinite total. Explain why the infinite total may not be a useful prediction. 4

(d) The owner plans to sell after 5 years. Using resale model $V_n=24000(0.85)^n$ and annual savings $5000(0.9)^{n-1}$, calculate total savings plus resale value minus the £24000 purchase cost. Ignore interest and maintenance. State one additional cost or uncertainty needed for a real investment decision. 4