IQM3003

LEVEL 3 · CONTROLLED ASSESSMENT

INTO QUALIFICATIONS

Mathematics and Data Handling

Component 3: Paper 2 examination

Candidate question paper

Duration
2 hours 50 minutes

Total marks
150

Assessment window
_____

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

- Answer every question.
- Write all answers in the separate answer booklet and identify each question clearly.
- Show all working. Unsupported answers may not receive full credit.
- Only a non-programmable, non-graphing scientific calculator is permitted. No additional 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.

Question paper

Q	Question	Marks
1	A college has 600 students on science courses and 400 on business courses. It plans a stratified random sample of 50 students. (a) State how many students should be selected from each group. [2] (b) Explain how to select the students randomly within each group. [1]	3
2	Simplify $\frac{12a^5b^{-2}}{3a^2b^{-5}}$, where a and b are non-zero. Give your answer with positive indices.	3
3	The distance s metres travelled after t seconds is $s = 2t^3 - 3t^2 + 4t$, for t ≥ 0. (a) Find $\frac{ds}{dt}$. [3] (b) Find the velocity at t = 2 seconds, including units. [2]	5
4	Waiting times in minutes have minimum 2, lower quartile 5, median 8, upper quartile 11 and maximum 20. (a) Draw a box plot on a labelled scale. [3] (b) Find the interquartile range. [1]	4
5	A population is modelled by $N = 800\,e^{0.12t}$, with t in years. Find the time at which the model first reaches 1,600, giving your answer to 2 decimal places.	3
6	For five test sessions, study time x hours and score y are (1, 42), (2, 48), (3, 54), (4, 60), (5, 66). Use $S_{xx} = \sum (x - \bar{x})^2$, $S_{yy} = \sum (y - \bar{y})^2$ and $S_{xy} = \sum (x - \bar{x})(y - \bar{y})$. (a) Draw a labelled scatter diagram. [2] (b) Calculate $\bar{x}$, $\bar{y}$, S_{xx} and S_{xy}. [3] (c) Find the least-squares regression line $y = a + bx$. [2] (d) Calculate Pearson's correlation coefficient, using $r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$. [2] (e) Explain why the line should not be used to predict a score for x = 20, or to prove that study time causes higher scores. [2]	11

Q	Question	Marks
7	Journey times t minutes are grouped as $0 \le t < 10$, $10 \le t < 20$ and $20 \le t < 40$, with frequencies 8, 12 and 10. (a) Calculate the frequency density for each class. [3] (b) Explain why frequency, rather than frequency density, is unsuitable as the height of each histogram bar. [1]	4
8	Parcel masses m kg are grouped as $0 \le m < 2$, $2 \le m < 4$, $4 \le m < 6$ and $6 \le m < 8$. Frequencies are 4, 10, 12 and 4 respectively. (a) Estimate the mean using class midpoints. [3] (b) Estimate the population standard deviation using $\sqrt{\frac{\sum f m^2}{\sum f} - \left(\frac{\sum f m}{\sum f}\right)^2}$, where m now denotes a midpoint. [3] (c) Give the cumulative frequencies at the four upper class boundaries. [1] (d) Estimate the median by linear interpolation. [2]	9
9	A factory uses machine A for 60% of its items and machine B for 40%. The probability an item is defective is 0.02 for A and 0.05 for B. (a) Draw a fully labelled probability tree. [4] (b) Find the probability a randomly chosen item is defective. [3] (c) Given that an item is defective, find the probability it came from B. [3] (d) Two items are selected independently from production. Find the probability both are non-defective. [2]	12
10	In a group of 80 students, 45 study French, 32 study Spanish and 18 study both. (a) Draw a Venn diagram showing all four regions, including neither language. [3] (b) Find the probability a randomly chosen student studies exactly one language. [1] (c) Find P(French | Spanish). [2]	6
11	P(A) = 0.4, P(B) = 0.3 and $P(A \cap B) = 0.12$. (a) Determine, with a calculation, whether A and B are independent. [2] (b) Determine whether they are mutually exclusive. Explain. [1] (c) Find $P(A \cup B)$. [1]	4
12	A discrete random variable X takes values 0, 1, 2 and 3 with probabilities 0.2, 0.3, k and 0.1 respectively. (a) Find k. [1] (b) Find E(X). [2] (c) Find P(X ≥ 2). [1]	4
13	A seed germinates with probability 0.7 independently of other seeds. Ten seeds are planted. Let X be the number germinating. (a) State the distribution of X and its parameters. [1] (b) Find P(X = 8), to 3 significant figures. [3] (c) Find the probability that at least one seed germinates, to 6 decimal places. [2]	6

Q	Question	Marks
14	A supplier claims that 10% of its components fail a test. An engineer suspects the failure rate has increased. In a random sample of 20 components, 5 fail. Let X be the number of failures. Use a 5% significance level. Under X ~ Bin(20, 0.10), P(X ≥ 4) = 0.13295, P(X ≥ 5) = 0.04317 and P(X ≥ 6) = 0.01125. (a) State the null and alternative hypotheses. [2] (b) State two assumptions needed for the binomial model, in context. [2] (c) Give the p-value and the test decision, with justification. [3] (d) State the critical region and explain why its lower boundary is 5 rather than 4. [2] (e) Explain what a Type I error means here and give the actual significance level of this test. [2]	11
15	Package mass X is modelled as normal with mean 500 g and standard deviation 8 g. For a standard normal Z, Φ(−1.5) = 0.0668, Φ(1) = 0.8413 and Φ(1.5) = 0.9332, where Φ(z) = P(Z ≤ z). (a) Find P(X < 488). [2] (b) Find P(492 < X < 512). [3] (c) Estimate how many packages in a batch of 2,000 exceed 512 g. [2]	7
16	Battery life X hours follows a normal model with mean 40 and standard deviation 6. The manufacturer wants a warranty life w such that only 5% of batteries fail before w. Use Φ(−1.645) = 0.05. (a) Calculate w. [3] (b) Explain one reason the normal model may be unsuitable for a population containing two substantially different battery types. [2]	5
17	The curve is $y = x^2 + 2x - 3$. Find the equations of the tangent and the normal at x = 1.	6
18	For $f(x) = x^3 - 6x^2 + 9x + 2$, find the coordinates of both stationary points and determine their nature.	6
19	(a) Find $\int (6x^2 - 4x + 3)\ dx$. [4] (b) Evaluate $\int_1^3 (2x + 1)\ dx$. [3] (c) The curve $y = x(4 - x)$ meets the x-axis at x = 0 and x = 4. Find the area enclosed by the curve and the x-axis. [3]	10
20	An open-topped box is made by cutting squares of side x cm from each corner of a 30 cm by 20 cm rectangle and folding up the sides. Take 0 < x < 10. (a) Show that the volume is $V = 4x^3 - 100x^2 + 600x$. [3] (b) Find the value of x that maximises the volume, giving x to 3 significant figures. [5] (c) Calculate the maximum volume to the nearest cm³. [2] (d) State one physical assumption and explain its effect on the model. [2]	12
21	A triangular plot has two sides of 12 m and 15 m enclosing an angle of 40°. (a) Calculate the third side to 3 significant figures. [3] (b) Calculate the plot's area to 3 significant figures. [2] (c) A circular path has radius 12 m and central angle 40°. Find the arc length to 3 significant figures. [2]	7
22	Solve $\log_{10}(x - 1) + \log_{10}(x + 2) = 1$. Explain why one algebraic solution must be rejected.	4

Q	Question	Marks
23	(a) Simplify $\dfrac{x^2-9}{x^2+x-6}$, stating all exclusions from the original domain. [4] (b) Solve $x^2-5x+6>0$. [2] (c) A dataset has lower quartile 12 and upper quartile 20. Using the 1.5 × IQR rule, decide whether 34 is an outlier. Show your calculation. [2]	8