External assessment 2025

Multiple choice question book

Specialist Mathematics

Paper 1 — Technology-free

General instruction

- Work in this book will not be marked.

Queensland Government | QCAA Queensland Curriculum & Assessment Authority

Section 1

Instruction

- Respond to these questions in the question and response book.

QUESTION 1

Use the substitution $u = x^2$ to express $\int 2x e^{x^2}\, dx$ in terms of u.

(A) $\int e^u\, du$

(B) $\int \frac{1}{2} e^u\, du$

(C) $\int u e^u\, du$

(D) $\int 2\sqrt{u}\, e^u\, du$

QUESTION 2

The position vector of a particle at time t is given by $r = \sin(t)\hat{i} + \cos(t)\hat{j}$.

The path of the particle is

(A) hyperbolic.

(B) parabolic.

(C) elliptical.

(D) circular.

QUESTION 3

The polynomial $P(z) = z^3 + pz^2 + qz + 1$ has complex conjugate roots when

(A) $p = 1$ and $q = 1$

(B) $p = 1$ and $q = i$

(C) $p = i$ and $q = 1$

(D) $p = i$ and $q = i$

QUESTION 4

X is a random variable with mean μ and standard deviation σ.

From random samples of X values, each of size n, the sample mean is calculated. This sampling and calculation is repeated a large number of times.

The mean of the distribution of the sample means would be approximately

(A) $\dfrac{\overline{x}}{n}$

(B) $\dfrac{\mu}{\sqrt{n}}$

(C) $\overline{x}$

(D) μ

QUESTION 5

Within the method of proof using mathematical induction, for which sum is the initial statement true?

(A) $\displaystyle\sum_{i=1}^{n} i^3 = n^2(n+1)^2$

(B) $\displaystyle\sum_{i=1}^{n} i^3 = 2n^2(n+1)^2$

(C) $\displaystyle\sum_{i=1}^{n} i^3 = \frac{n^2(n+1)^2}{2}$

(D) $\displaystyle\sum_{i=1}^{n} i^3 = \frac{n^2(n+1)^2}{4}$

QUESTION 6

At time *t*, a particle travels with a velocity of $v = \left(\frac{2}{1+t^2}\right)\hat{i} - 2t\,\hat{j}.$

Determine a general expression for the position vector, ***r***, of the particle during this motion.

(A) $r = 2\tan^{-1}(t)\,\hat{i} - 2\,\hat{j} + c$

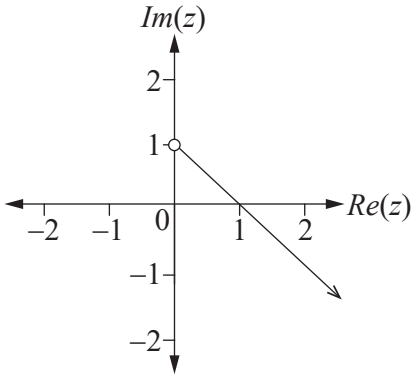
(B) $r = 2\tan^{-1}(t)\,\hat{i} - t^2\,\hat{j} + c$

(C) $r = \frac{1}{2}\tan^{-1}(t)\,\hat{i} - 2\,\hat{j} + c$

(D) $r = \frac{1}{2}\tan^{-1}(t)\,\hat{i} - t^2\,\hat{j} + c$

QUESTION 7

For $z \in C,$ a subset of the complex plane of the form $Arg(z - z_1) = \theta$ is shown.



The values of z_1 and θ respectively are

(A) $-i$ and $-\frac{\pi}{4}$

(B) $-i$ and $\frac{\pi}{4}$

(C) i and $-\frac{\pi}{4}$

(D) i and $\frac{\pi}{4}$

QUESTION 8

The position vectors of two objects over time, t, where $t \geq 0$, are given by

$$r_1(t) = -2\hat{i} + t^2\hat{j}$$
$$r_2(t) = at\hat{i} + 4\hat{j} \quad (\text{where } a \in R)$$

Given that the two objects collide, the value of a is

(A) 2

(B) 1

(C) –1

(D) –2

QUESTION 9

An approximate confidence interval for a population mean is calculated based on a sample size of 16 and is found to have width, w.

A second confidence interval is calculated from another sample with the same sample standard deviation.

Given that the same z-value was used for both intervals and the width of the second interval is $2w$, what is the size of the second sample?

(A) 2

(B) 4

(C) 8

(D) 64

QUESTION 10

Given z_1 and z_2 are complex numbers, which statement is **always** true?

(A) $|z_1 + z_2| = |z_1| + |z_2|$

(B) $|z_1 + z_2| \neq |z_1| + |z_2|$

(C) $|z_1 + z_2| \leq |z_1| + |z_2|$

(D) $|z_1 + z_2| \geq |z_1| + |z_2|$

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