



2016 TRIAL EXAMINATION 1

UNITS 3 & 4

STUDENT NAME

First Name

Last Name

SPECIALIST MATHEMATICS

Written examination 1

2016

Reading time: 15 minutes

Writing time: 1 hour

QUESTION AND ANSWER BOOK

Structure of book

<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
8	8	40

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the examination room: notes of any kind, blank sheets of paper, correction fluid/tape or a calculator of any type.

Materials supplied

- Question and answer book of 13 pages.
- Working space is provided throughout the book.

Instructions

- Write your **name** in the space provided above on this page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.

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Instructions

Answer **all** questions in the spaces provided.

Unless otherwise specified, an exact answer is required to a question.

In questions where more than one mark is available, appropriate working **must** be shown.

Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Take the **acceleration due to gravity** to have magnitude $g \text{ m/s}^2$, where $g = 9.8$.

Question 1 (4 marks)

Consider the function $f: [0, 3] \rightarrow \mathbb{R}$ defined by the rule $f(x) = |x^2 - 3x + 2|$.

- a. Write $f(x)$ as a hybrid (piecewise) function over the given domain.

2 marks

- b. Hence evaluate $\int_0^3 |x^2 - 3x + 2| dx$.

2 marks

TURN OVER

Question 2 (4 marks)

a. Determine the values of a , b and c such that $\cos^4(x) = a\cos^2(2x) + b\cos(2x) + c$.

2 marks

c. **Hence** determine an antiderivative of $\cos^4(x)$.

2 marks

Consider the two derivative functions $f'(x) = \frac{1}{2x-1}$ and $g'(x) = 5x\sqrt{x}$, with $f(1) = 0$ and $g(1) = 2$.

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- This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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c. Determine an expression for $(f \times g)'(x)$. You do not need to simplify your answer.

2 marks

Question 4 (8 marks)

Consider the four vectors

$$\overrightarrow{OA} = \mathbf{i} + 2\mathbf{j}, \overrightarrow{OB} = -\mathbf{i} + \mathbf{j}, \overrightarrow{OC} = m\mathbf{j} \text{ and } \overrightarrow{OD} = n\mathbf{i} + 4\mathbf{j}, \text{ where } m, n \text{ are non-zero real constants.}$$

- a. Determine vectors $\overrightarrow{AB}$ and $\overrightarrow{DC}$.

2 marks

- b. Determine the values of m and n if $ABCD$ is a rhombus.

2 marks

TURN OVER

c. Calculate the area of the parallelogram $ABCD$.

4 marks

Question 5 (3 marks)

An object of mass 0.4 kg is dropped from a window. The window is 40 metres above the ground. It takes the object 2 seconds to reach the ground level. Calculate the vertical air resistance.

TURN OVER

Question 6 (3 marks)

Let $z = \frac{\tan(a) + i}{\tan(a) - i}$, where $a \in \left(-\frac{\rho}{2}, \frac{\rho}{2}\right)$. Express z in polar form.

Question 7 (5 marks)

Igor is a weightlifter who is training for the upcoming Commonwealth Games. One type of lift is called a snatch lift. Igor has taken a sample of 64 of his most recent snatch lifts. His sample has a mean weight of 120 kg and a standard deviation of 10 kg.

- a.** Determine a 95% confidence interval for the mean weight of all Igor's most recent snatch lifts. 2 marks

- b.** Explain the meaning of the confidence interval obtained in part **a.** 1 mark

- c.** The world record for snatch lifts in Igor's category is 125 kg. Is Igor likely to beat the world record in his category? Justify your answer. 2 marks

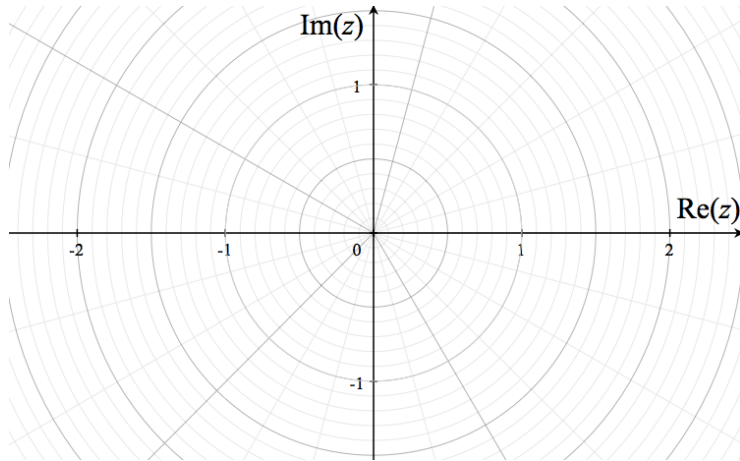
TURN OVER

Question 8 (6 marks)

a. Solve the equation $z^4 = -i$. Give the solutions in polar form.

2 marks

- b.** On the Argand diagram below plot all solutions calculated in **part a**. 2 marks



Consider the equation with complex coefficients $(a + ib - 1)^4 = -i$, where a and b are non-zero real values.

- c. Determine one possible set of values for a and b . 2 marks