

FREE
TRIAL

SEQUOIA
— EDUCATION —

Write your **full name** in the space above.

Specialist Mathematics Examination 1

Question and Answer Book

VCE Trial Examination – Free

- Reading time is **15 minutes**
- Writing time is **1 hour**

Materials supplied

- Question and Answer Book of 12 pages
- Formula Sheet

Instructions

Students are **not** permitted to bring any technology (calculators or software) or notes of any kind into the examination room.

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

Contents

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9 questions (40 marks)	2–11

Instructions

- Answer **all** questions in the spaces provided.
 - Write your responses in English.
 - 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 (3 marks)

Consider the relation $e^{xy} = y^2 - 3$.

Find $\frac{dy}{dx}$ at the point $(0, 2)$.

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Question 2 (4 marks)

Consider the hyperbola specified parametrically by

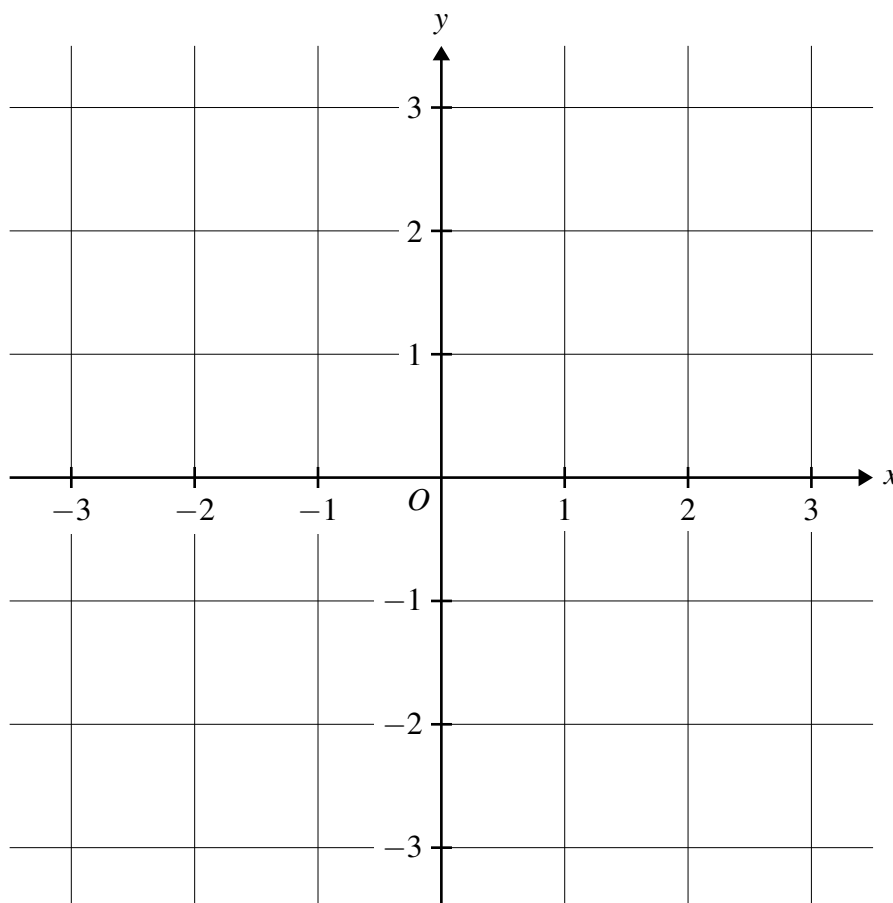
$$x = \frac{1}{2} \cot(t), \quad y = \csc(t) - 2, \quad 0 < t < \pi.$$

- a.** Find the Cartesian equation of the hyperbola.

1 mark

- b.** Sketch the hyperbola on the axes below, labelling asymptotes with their equations and axial intercepts with their coordinates.

3 marks



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Question 3 (3 marks)

- a. Show that $\sqrt{3} - i = 2 \operatorname{cis}\left(-\frac{\pi}{6}\right)$. 1 mark

- b. Find the integers n for which $(\sqrt{3} - i)^n$ is a real number. 2 marks

Question 4 (4 marks)

The energy consumption, in kilowatt-hours (kW h), per Australian household over a three-month period is normally distributed with a standard deviation of 72 kW h.

A random sample of 256 Australian households was taken, and the mean energy consumption per household over a three-month period was found to be 350 kW h.

- a. Calculate an approximate 95% confidence interval for the mean energy consumption of an Australian household over a three-month period. Use $z = 2$.

2 marks

- b. Find the smallest sample size n required for a 95% confidence interval to have a margin of error no greater than 4 kW h. Use $z = 2$.

2 marks

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Question 6 (6 marks)

From a helicopter hovering high above the ground, a skydiver falls from rest and, for the first second, falls freely under gravity to negligible air resistance.

- a.** Show that the speed of the skydiver after one second is g metres per second. 1 mark

After one second, air resistance is significant and the skydiver experiences a downward acceleration, in m s^{-2} , of $a = g - 0.2v$, where v is the speed of the skydiver, in m s^{-1} .

- b.** Find the speed of the skydiver six seconds after falling from the helicopter. Give your answer in m s^{-1} , expressed in the form kg , where k is a real constant. 4 marks

- c.** Find the terminal speed of the skydiver, in m s^{-1} . 1 mark

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c. Hence, evaluate $\int_0^{\frac{\pi}{2}} \frac{1}{2 + \cos(x)} dx$.

2 marks

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