



INSIGHT
Trial Exam Paper

2009

SPECIALIST MATHEMATICS

Written examination 1

STUDENT NAME:

QUESTION AND ANSWER BOOK

Reading time: 15 minutes

Writing time: 1 hour

Structure of book

<i>Number of questions</i>	<i>Number of questions to be answered</i>	<i>Number of marks</i>
10	10	40

- Students are permitted to bring the following items into the examination: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring sheets of paper, notes of any kind or white out liquid/tape into the examination.
- Calculators are not permitted in this examination.

Materials provided

- The question and answer book of 13 pages with a separate sheet of miscellaneous formulas.
- Working space is provided throughout this book.

Instructions

- Write your **name** in the box provided.
- Remove the formula sheet during reading time.
- You must answer the questions in English.

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

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Instructions

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

A decimal approximation **will not** be accepted if an exact answer is required.

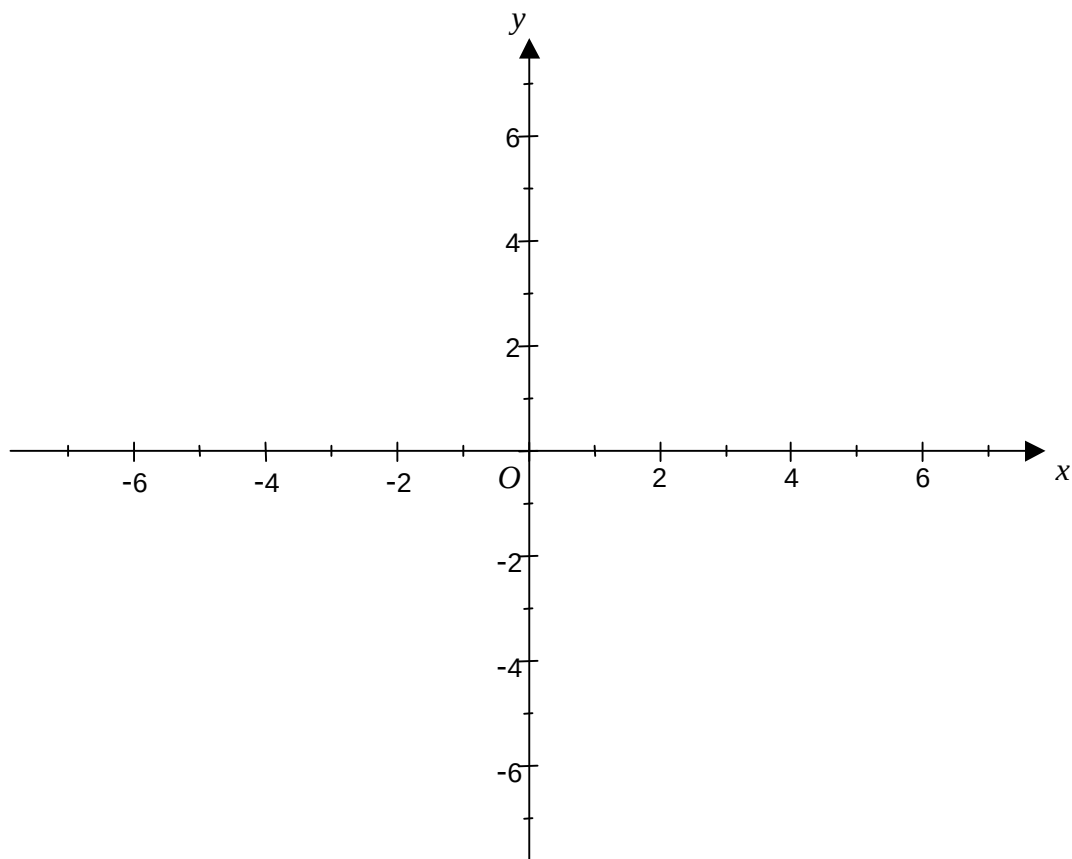
In questions where more than one mark is available, appropriate working **must** be shown.

Unless otherwise indicated, 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

Sketch the graph of $y = \frac{1}{2-x} - x$ on the axes below. Give the exact coordinates of any stationary points and intercepts and the equations of any straight line asymptotes.



4 marks

Question 2

Find all solutions of $z^3 + z + 10 = 0$, $z \in \mathbb{C}$.

3 marks

Question 3

Find the cube roots of $4i - 4\sqrt{3}$ in polar form.

This image shows a blank 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.

3 marks

Question 4

Find the point of intersection of the normals to the curve $x^2y + y^2 = 5$ at $y = 1$.

[illegible]

5 marks

Question 5

Given $\frac{d}{dx}\left(\arctan\left(\frac{2x}{x^2-1}\right)\right) = \frac{a}{x^2+b}, |x| \neq 1$

Find the real numbers a and b .

[illegible]

3 marks

Question 6

Find $\int e^{6x} \sqrt{e^{2x} + 1} \, dx$.

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4 marks

Question 7

An object in a refrigerator cools according to differential equation $\frac{dT}{dt} = -k(T - 3)$, $k \in R$,

where T °C is the temperature of the object t hours after it being placed in the refrigerator.

A drink with an initial temperature of 18°C is placed in the refrigerator for 1 hour, and it cools to 8°C in that time.

- a.** Show that $T = 15e^{-kt} + 3$ is a solution to this differential equation.

2 marks

- b.** Find the exact value of k .

1 mark

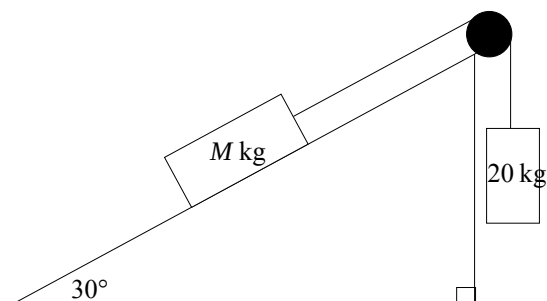
- c. Find the exact temperature of the drink after 2 hours.

1 mark

Total $2 + 1 + 1 = 4$ marks

Question 8

A mass of M kg is connected to a 20 kg mass by a light string passing over a smooth pulley. The rough plane is inclined at 30° to the horizontal level and has coefficient of friction $\mu = \frac{1}{5}$. The tension in the string connecting the two masses is 150 newtons.



- a.** Show that the M kg mass is accelerating up the inclined plane at 2.3 m/s^2 .

2 marks

- b.** Determine the exact value of M .

3 marks

Total 2 + 3 = 5 marks

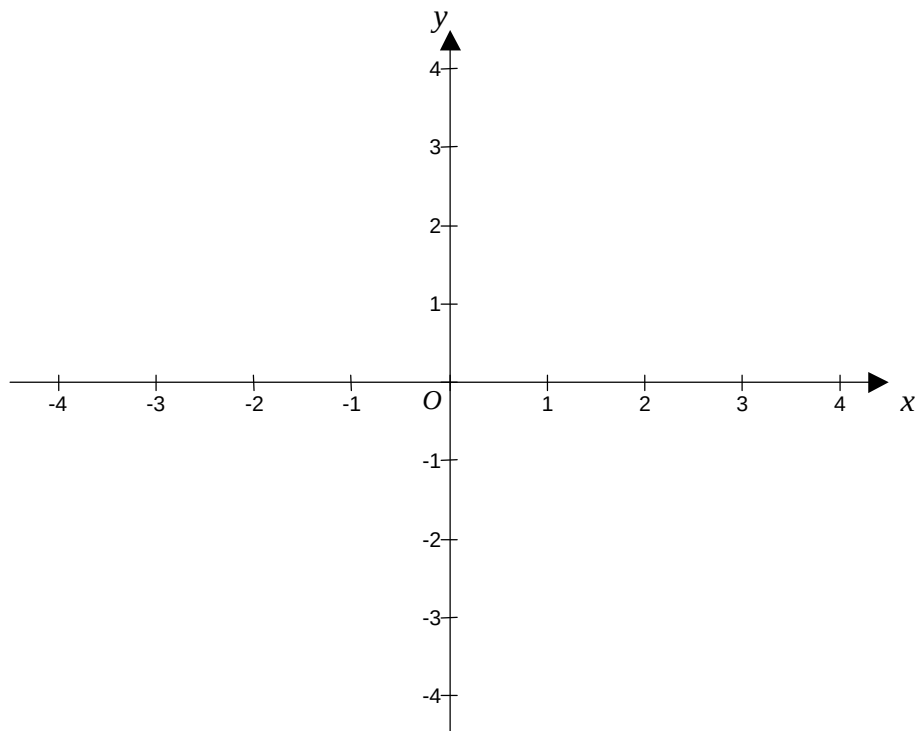
Question 9

The position of a particle at time t is given by $\underline{r} = (1 - 2\sin(\pi t))\underline{i} + (\cos(2\pi t) + 2)\underline{j}$

- a.** Find the Cartesian equation of the path of the particle.

2 marks

- b.** Sketch a graph of the path of the particle for $0 \leq t \leq \frac{1}{2}$ indicating its direction of motion.



2 marks

Question 9 – continued
TURN OVER

- c. Determine the speed at which the particle is travelling when $t = \frac{1}{4}$.

1 mark

Total $2 + 2 + 1 = 5$ marks

