

The Mathematical Association of Victoria

Trial Exam 2014

SPECIALIST MATHEMATICS

Written Examination 1

STUDENT NAME _____

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>
9	9	40

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

Materials supplied

- Question and answer book of 13 pages with a detachable sheet of miscellaneous formulas in the centrefold.

Instructions

- Detach the formula sheet from the centre of this book during reading time.
- 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.

THIS PAGE IS BLANK

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 $g = 9.8$

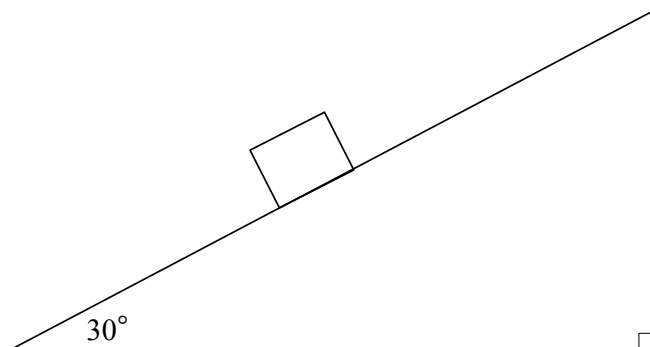
Question 1 (5 marks)

A body of mass 6 kg is projected at a speed of 3 m/s up a **rough** plane inclined at 30° to the horizontal.

The coefficient of friction between the body and the plane is $\frac{2\sqrt{3}}{3}$.

- a. On the diagram below, show all the forces acting on the body while it is moving up the plane and label them.

1 mark



4 marks

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.

Evaluate $\int_{\frac{1}{2}}^1 \frac{x-1}{\sqrt{3-2x}} dx$ and express your answer in the form $\frac{\sqrt{a}-b}{c}$ where a , b and c are positive

integers.

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.

Question 4 (6 marks)

A particle of mass 3 kg is acted on by a variable force so that its velocity v m/s when the particle is x m from the origin is given $v = 1 - x^2$.

- a.** Find the force in newtons acting on the particle when $x = \frac{2}{3}$. 2 marks

- b.** Find the time it takes for the particle to travel from the origin to $x = \frac{2}{3}$. 4 marks

For the curve defined by the relation

$$3(y+1)^2 - 2xy - x^2 = 7,$$

find the equation of all tangents to the curve that are parallel to the x -axis.

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.

Consider the vectors

$$\underset{\sim}{a} = 2\underset{\sim}{i} - \underset{\sim}{j} - 2\underset{\sim}{k} \quad \text{and} \quad \underset{\sim}{b} = -2\underset{\sim}{i} + t\underset{\sim}{j} - \underset{\sim}{k}$$

where $t \in \mathbb{R}$. Let θ be the angle between $\tilde{a}$ and $\tilde{b}$.

Find the values of t such that $\sin(\theta) = \frac{4\sqrt{5}}{9}$.

[illegible]

Question 7 (3 marks)

The path of a particle is given by

$$\mathbf{r}(t) = t^2 \cos(t) \mathbf{i} - t \sin(t) \mathbf{j}, \quad t \geq 0.$$

If the particle leaves the origin at $t = 0$, find the speed of the particle at time $t = \pi$.

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.

Question 9 (5 marks)

Consider the function

$$f : [1, a) \cup (a, b) \rightarrow R, \quad f(x) = 1 - 2\operatorname{cosec}\left(\frac{\pi x}{3}\right).$$

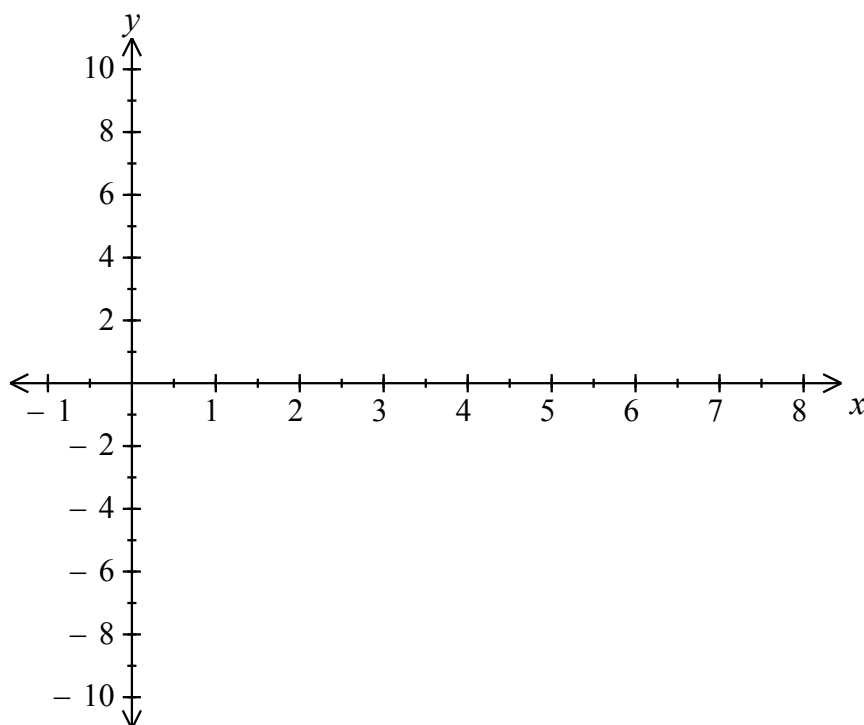
where the values of a and b are the largest for which f is defined.

- a. State the values of a and b .

1 mark

- b. Sketch the graph of $y = f(x)$. Label the turning points and any endpoints with their **coordinates** and the asymptotes with their equations.

4 marks



END OF QUESTION AND ANSWER BOOK