Victorian Curriculum
AND ASSESSMENT AUTHORITY

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**Victorian Certificate of Education
2023**

Letter

**STUDENT NUMBER**

# MATHEMATICAL METHODS
## Written examination 1

**Wednesday 1 November 2023**

**Reading time: 9.00 am to 9.15 am (15 minutes)**
**Writing time: 9.15 am to 10.15 am (1 hour)**

## QUESTION AND ANSWER BOOK

**Structure of book**

| Number of questions | Number of questions to be answered | Number of marks |
|---|---|---|
| 9 | 9 | 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: any technology (calculators or software), notes of any kind, blank sheets of paper and/or correction fluid/tape.

**Materials supplied**
- Question and answer book of 14 pages
- Formula sheet
- Working space is provided throughout the book.

**Instructions**
- Write your **student number** in the space provided above on this page.
- Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.
- All written responses must be in English.

**At the end of the examination**
- You may keep the formula sheet.

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

**Instructions**

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

In all questions where a numerical answer is required, an exact value must be given unless otherwise specified.

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.

SAMPLE

Number of questions and mark allocations may vary from the information indicated.

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# MATHEMATICAL METHODS

# Written examination 1

## FORMULA SHEET

### Instructions

This formula sheet is provided for your reference.
A question and answer book is provided with this formula sheet.

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# Mathematical Methods formulas

## Mensuration

| | | | |
|---|---|---|---|
| area of a trapezium | $\dfrac{1}{2}(a+b)h$ | volume of a pyramid | $\dfrac{1}{3}Ah$ |
| curved surface area of a cylinder | $2\pi rh$ | volume of a sphere | $\dfrac{4}{3}\pi r^3$ |
| volume of a cylinder | $\pi r^2 h$ | area of a triangle | $\dfrac{1}{2}bc\sin(A)$ |
| volume of a cone | $\dfrac{1}{3}\pi r^2 h$ | | |

## Calculus

| | |
|---|---|
| $\dfrac{d}{dx}\left(x^n\right)=nx^{n-1}$ | $\displaystyle\int x^n dx=\dfrac{1}{n+1}x^{n+1}+c,\ n\neq-1$ |
| $\dfrac{d}{dx}\left((ax+b)^n\right)=an(ax+b)^{n-1}$ | $\displaystyle\int (ax+b)^n dx=\dfrac{1}{a(n+1)}(ax+b)^{n+1}+c, n\neq-1$ |
| $\dfrac{d}{dx}\left(e^{ax}\right)=ae^{ax}$ | $\displaystyle\int e^{ax}dx=\dfrac{1}{a}e^{ax}+c$ |
| $\dfrac{d}{dx}\left(\log_e(x)\right)=\dfrac{1}{x}$ | $\displaystyle\int \dfrac{1}{x}dx=\log_e(x)+c,\ x>0$ |
| $\dfrac{d}{dx}\left(\sin(ax)\right)=a\cos(ax)$ | $\displaystyle\int \sin(ax)dx=-\dfrac{1}{a}\cos(ax)+c$ |
| $\dfrac{d}{dx}\left(\cos(ax)\right)=-a\sin(ax)$ | $\displaystyle\int \cos(ax)dx=\dfrac{1}{a}\sin(ax)+c$ |
| $\dfrac{d}{dx}\left(\tan(ax)\right)=\dfrac{a}{\cos^2(ax)}=a\sec^2(ax)$ | |

| | | | |
|---|---|---|---|
| product rule | $\dfrac{d}{dx}(uv)=u\dfrac{dv}{dx}+v\dfrac{du}{dx}$ | quotient rule | $\dfrac{d}{dx}\left(\dfrac{u}{v}\right)=\dfrac{v\dfrac{du}{dx}-u\dfrac{dv}{dx}}{v^2}$ |
| chain rule | $\dfrac{dy}{dx}=\dfrac{dy}{du}\dfrac{du}{dx}$ | Newton's method | $x_{n+1}=x_n-\dfrac{f\left(x_n\right)}{f'\left(x_n\right)}$ |
| trapezium rule approximation | $Area\approx\dfrac{x_n-x_0}{2n}\left[f(x_0)+2f(x_1)+2f(x_2)+\ldots+2f(x_{n-2})+2f(x_{n-1})+f(x_n)\right]$ | | |

# Probability

| | |
|---|---|
| $\Pr(A) = 1 - \Pr(A')$ | $\Pr(A \cup B) = \Pr(A) + \Pr(B) - \Pr(A \cap B)$ |
| $\Pr(A\|B) = \dfrac{\Pr(A \cap B)}{\Pr(B)}$ | |

| | | | |
|---|---|---|---|
| mean | $\mu = \mathrm{E}(X)$ | variance | $\mathrm{var}(X) = \sigma^2 = \mathrm{E}((X-\mu)^2) = \mathrm{E}(X^2) - \mu^2$ |
| binomial coefficient | $\dbinom{n}{x} = \dfrac{n!}{x!(n-x)!}$ | | |

| Probability distribution | | Mean | Variance |
|---|---|---|---|
| discrete | $\Pr(X=x) = p(x)$ | $\mu = \sum x\, p(x)$ | $\sigma^2 = \sum (x-\mu)^2\, p(x)$ |
| binomial | $\Pr(X=x) = \dbinom{n}{x} p^x (1-p)^{n-x}$ | $\mu = np$ | $\sigma^2 = np(1-p)$ |
| continuous | $\Pr(a < X < b) = \displaystyle\int_a^b f(x)dx$ | $\mu = \displaystyle\int_{-\infty}^{\infty} x\, f(x)dx$ | $\sigma^2 = \displaystyle\int_{-\infty}^{\infty} (x-\mu)^2 f(x)dx$ |

# Sample proportions

| | | | |
|---|---|---|---|
| $\hat{P} = \dfrac{X}{n}$ | | mean | $\mathrm{E}(\hat{P}) = p$ |
| standard deviation | $\mathrm{sd}(\hat{P}) = \sqrt{\dfrac{p(1-p)}{n}}$ | approximate confidence interval | $\left( \hat{p} - z\sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}},\ \hat{p} + z\sqrt{\dfrac{\hat{p}(1-\hat{p})}{n}} \right)$ |

**END OF FORMULA SHEET**