

MATHEMATICS METHODS

Section One: Calculator-free

Student Name/Number: \_\_\_\_\_

Teacher Name: \_\_\_\_\_

Time allowed for this section

Reading time before commencing work: five minutes  
Working time for this section: fifty minutes

**Materials required/recommended for this section**  
To be provided by the supervisor: This Question/Answer Booklet  
Formula Sheet

To be provided by the candidate:

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters  
Special items: nil

Important note to candidates

No other items may be taken into the examination room. It is **your** responsibility to ensure that you do not have any unauthorised notes or other items of a non-personal nature in the examination room. If you have any unauthorised material with you, hand it to the supervisor **before** reading any further.

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## Structure of this paper

Section	Number of questions available	Number of questions to be answered	Working time (minutes)	Marks available	Percentage of exam
Section One: Calculator-free	7	7	50	50	35
Section Two: Calculator-assumed	11	11	100	100	65
					100

## Instructions to candidates

- The rules for the conduct of School exams are detailed in the \_\_\_\_\_ *School/College assessment policy*.  
Sitting this examination implies that you agree to abide by these rules.
- Write your answers in this Question/Answer Booklet.
- You must be careful to confine your responses to the specific questions asked and to follow any instructions that are specific to a particular question.
- Spare pages are included at the end of this booklet. They can be used for planning your responses and/or as additional space if required to continue an answer.
  - Planning: If you use the spare pages for planning, indicate this clearly at the top of the page.
  - Continuing an answer: If you need to use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.
- Show all working clearly.** Your working should be in sufficient detail to allow your answers to be checked readily and for marks to be awarded for reasoning. Incorrect answers given without supporting reasoning cannot be allocated any marks. For any question or part question worth more than two marks, valid working or justification is required to receive full marks. If you repeat any question, ensure that you cancel the answer you do not wish to have marked.
- It is recommended that you **do not use pencil**, except in diagrams.
- The Formula Sheet is **not** to be handed in with your Question/Answer Booklet.

(6 marks)

Determine the following

(a) 
$$\int_{\frac{\pi}{2}}^{-\pi} \cos(\pi - x) dx$$

(2 marks)

(b) 
$$\frac{d}{dx} \left[ \int_4^x \sqrt{4t^2 - 3} dt \right]$$

(2 marks)

(c) 
$$\int_{\frac{\pi}{2}}^0 \frac{dx}{x} [\sin(2x)]$$

(2 marks)

**Section One: Calculator-free** (50 Marks) Weighing 35%

This section has 7 (seven) questions. Answer all questions. Write your answers in the spaces provided.

Suggested working time: 50 minutes.

Question 1

(a) Determine  $f'(x)$  given that

(i) 
$$f(x) = \sqrt{5 + x^2}$$

(2 marks)

(ii) 
$$f(x) = \frac{e^{\frac{1}{3}x} + 5}{x}$$

(2 marks)

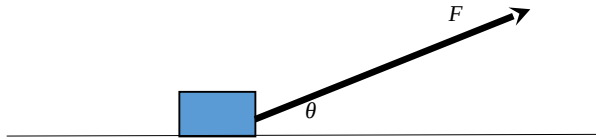
(b) Evaluate  $\left( \frac{dy}{dx} \right)_z + 9y_z$  given that  $y = 5 \cos(3x + 1)$ .

(3 marks)

Question 2

(6 marks)

A heavy container is being dragged along a horizontal surface by a chain which makes an angle  $\theta$  with the horizontal ( $0 < \theta < 90^\circ$ ).



The force,  $F$  Newtons, exerted on the chain is given by

$$F = \frac{1200}{3\sin\theta + 4\cos\theta}$$

Determine the minimum possible value of the force  $F$ .

Question 6

Using the trigonometric identities  $\sin^2\theta + \cos^2\theta = 1$  and  $\cos 2x = \cos^2 x - \sin^2 x$ ,  
determine  $\int \sin^2 x \, dx$

(8 marks)

Question 5

Determine the following indefinite integrals.

(a)  $\int (e^{x^2-1} + 5x^2) dx$

(2 marks)

(b)  $\int \frac{4x^3 + 3}{x^2} dx$

(2 marks)

(c)  $\int 5(2x - 3)^2 dx$

(2 marks)

(d)  $\int [\sin(2x + 3) - 2 \cos(\pi x)] dx$

(2 marks)

(8 marks)

Question 3

A particle is undergoing rectilinear motion where the velocity  $v(t)$  m s<sup>-1</sup> at time  $t$  seconds is given by

$$v(t) = 30 \left( 1 + \cos \frac{\pi t}{5} \right) \text{ for } t \geq 0.$$

(a) When is the particle first at rest?

(2 marks)

(b) What is the initial acceleration of the particle?

(2 marks)

(c) Will the particle ever return to its starting point? Justify your answer.

(2 marks)

(d) How far does the particle travel in the first 10 seconds?

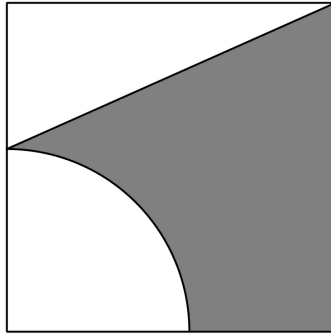
(2 marks)

**Question 4**

**(11 marks)**

Jamie is a keen darts player. For a competition, the dart board consists of a square of side length  $k$  cm and is partitioned as shown below.

Note: the quarter circle and the triangle meet at the mid-way point of the square.



A dart is considered equally likely to hit any part of the square board, and all darts are assumed to land within the square.

- (a) Show that the probability of a dart landing in the shaded area is  $p = \frac{12 - \pi}{16}$  (5 marks)

Jamie throws three darts.

Determine, in terms of  $p$ , the probability that:

- (b) Jamie's first and third throws land within the shaded area and the second throw outside the shaded area. (2 marks)

- (c) Jamie hits the shaded region only once in three throws. (2 marks)

- (d) hits the shaded region at least once with his three throws. (2 marks)