



XAVIER COLLEGE
SAC / Assessment Conditions

PART ONE – TECHNOLOGY FREE

MATHEMATICAL METHODS

MONDAY 2ND AUGUST 3.45 pm – 5.55 pm

- Listen carefully to the supervisor's instructions.
- Permissible items include: pens, pencils, highlighters, erasers, sharpeners, rulers.
- You are not permitted to use white out (liquid paper).
- You have 10 minutes reading (for both papers) and 1 hour writing to complete this part.
- Complete this task in the spaces provided.
- Give answers in exact form unless told otherwise.
- You MAY NOT use your CAS calculator OR a bound set of notes to complete this part of the SAC.
- A number of questions are consequential in nature. You are advised to show all working, even for questions worth one mark. In questions worth more than 1 mark, working is required to gain full marks.
- You must work silently and independently for the duration of the task. Only questions of clarification can be asked of your teacher.
- It is not in your interest to talk about this task with students from other classes.

PLEASE NOTE: *Students are NOT permitted to have mobile phones or any other unauthorised electronic devices in their possession during a SAC/examination*

COMPULSORY STUDENT DECLARATION

I, (print your name neatly) _____ acknowledge that I have read the SAC/examination conditions and understand which items/materials I am permitted to use and have in my possession.

****If you have any doubts as to what is permitted, raise your hand and DO NOT sign this declaration****

Student's Signature: _____

Student's Name: _____

Teacher's Name: _____



MATHEMATICAL METHODS
MODELLING/PROBLEM SOLVING
SAC 2021
(SAC 2)

PART ONE
TECHNOLOGY FREE

37 Marks

Question 1 (4 marks)

- a. If $f: \mathbb{R} \rightarrow \mathbb{R}, f(x) = \frac{5}{(2x-1)^3}$, find $f'(x)$ 2 marks

- b. Evaluate $f'\left(\frac{\pi}{6}\right)$ given $f(x) = -\frac{1}{3}\sin(x)\cos(x)$. 2 marks

Question 2

- Let $g(x) = 3e^{-2x} - x^3 + \frac{1}{\sqrt{2x-1}}$. Find an antiderivative of $g(x)$ 3 marks

Question 3

If the line $y = 4x + 3$ is parallel to the tangent of $y = (x - k)^3 - 8$ at $x = 2$,
what is the value(s) of k ?

3 marks

Express your answer in the form $\frac{a \pm b\sqrt{c}}{d}$, where a, b, c and $d \in \mathbb{Z}$.

Question 4

a. If $y = (1 - 5x)(1 - x)$, find $\frac{dy}{dx}$

2 marks

b. If $f(x) = \frac{x}{\log_e(x)}$, evaluate $f'(e^2)$

2 marks

Question 5 (7 marks)

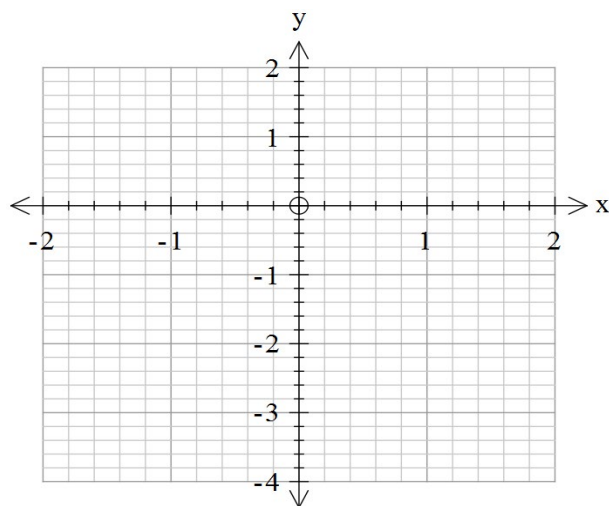
For the graph of $f : [-1, 2] \rightarrow \mathbb{R}, f(x) = x^2(1-x)$

- a.** Find the exact coordinates of the turning points.

3 marks

- b.** Sketch the graph of $y = f(x)$, clearly labelling coordinates of intercepts, turning points and endpoints.

4 marks



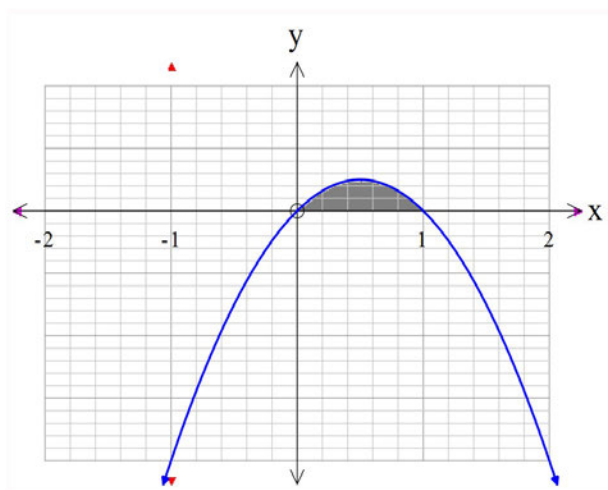
Question 6 (4 marks)

a. Find $\int (x - x^2) dx$

1 mark

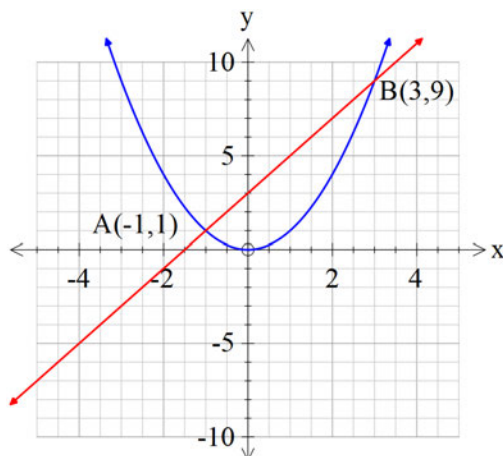
b. Hence evaluate the area of the shaded region of the graph of $y = x(1 - x)$

3 marks



Question 7 (6 marks)

The graphs of $y = x^2$ and $y = 2x + 3$ are shown below.



- a.** Show that the points of intersection of the two graphs are $A(-1,1)$ and $B(3,9)$. 2 marks

- b.** Find the gradient of the line AB. 1 mark

- c.** A line parallel to the line AB is a tangent to the curve $y = x^2$. Find the equation of this tangent and sketch it on the axes above. 3 marks

Question 8 (10 marks)

Let $f: (a, b) \rightarrow \mathbb{R}: f(x) = x \log_e(x)$

- a. i.** Find a , such that $f(x)$ has a maximum domain. 1 mark

- ii.** Find $f'(x)$ 1 mark

- iii.** Hence find the coordinates of the stationary point. 2 marks

- b.** Using your answer for part **a ii.** find an antiderivative of $\log_e(x)$ 2 marks

END OF PART ONE