Government of **Western Australia**
School Curriculum and Standards Authority

ATAR course examination, 2019

Question/Answer booklet

MATHEMATICS METHODS

Section One:
Calculator-free

WA student number:	In figures							

In words _____

_____

Time allowed for this section

Reading time before commencing work: five minutes
Working time: fifty minutes

Number of additional
answer booklets used
(if applicable):

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 material. If you do not have any unauthorised material with you, hand it to the supervisor **before** reading any further.

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Ref: 19-050

MAM-S1

Structure of this paper

Section	Number of questions available	Number of questions to be answered	Working time (minutes)	Marks available	Percentage of examination
Section One: Calculator-free	7	7	50	52	35
Section Two: Calculator-assumed	11	11	100	99	65
				Total	100

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2019*. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.

4. Show all your 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.

5. It is recommended that you do not use pencil, except in diagrams.

6. Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

7. The Formula sheet is not to be handed in with your Question/Answer booklet.

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Supplementary page

Question number: _____

Section One: Calculator-free 35% (52 Marks)

This section has **seven** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answers are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Working time: 50 minutes.

Question 1 **(6 marks)**

Consider the derivative function $f'(x) = xe^{x^2}$.

(a) Determine $\int f''(1)$. (2 marks)

(b) Explain the meaning of your answer to part (a). (1 mark)

(c) Determine the expression for $y = f(x)$, given that it intersects the y-axis at the point $(0,2)$. (3 marks)

See next page

Supplementary page

Question number: _____

Question 2 (6 marks)

The values of the functions $g(x)$ and $h(x)$, and their derivatives $g'(x)$ and $h'(x)$ are provided in the table below for $x = 1$, $x = 2$ and $x = 3$.

	$x = 1$	$x = 2$	$x = 3$
$g(x)$	3	5	−3
$h(x)$	2	−2	6
$g'(x)$	−4	1	4
$h'(x)$	0	−6	−5

(a) Evaluate the derivative of $\dfrac{g(x)}{h(x)}$ at $x = 3$. (2 marks)

(b) Evaluate the derivative of $h(g(x))$ at $x = 1$. (2 marks)

(c) If $h''(1) = -1$, describe with justification, what the graph of $h(x)$ looks like at this point. (2 marks)

Supplementary page

Question number: _____

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Question 3 (7 marks)

Waiting times for patients at a hospital emergency department can be up to four hours. The associated probability density function is shown below.
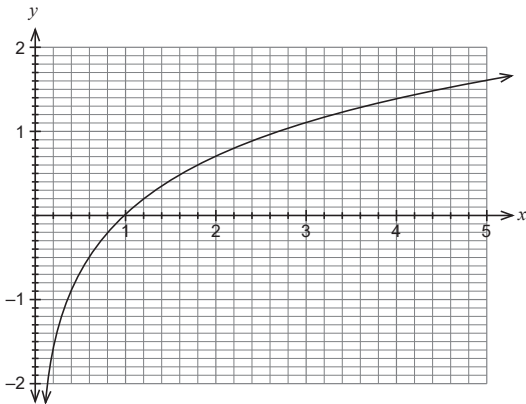

(a) What is the probability a patient will wait less than one hour? (3 marks)
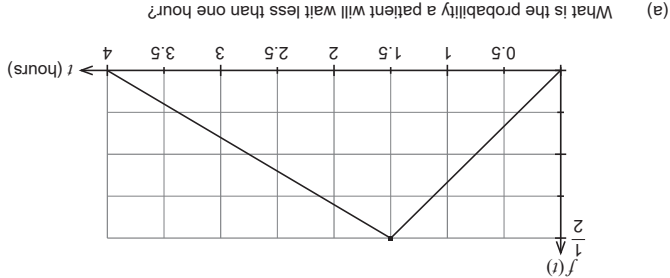
(b) What is the probability a patient will wait between one hour and three hours? (4 marks)

See next page

Supplementary page

Question number: _____

Question 4 (6 marks)

Consider the graph of $y = \ln(x)$ shown below.

(a) Use the graph to estimate the value of p in each of the following.

(i) $1.4 = \ln(p)$ (1 mark)

(ii) $e^{p+1} - 3 = 0$ (2 marks)

Supplementary page

Question number: _____
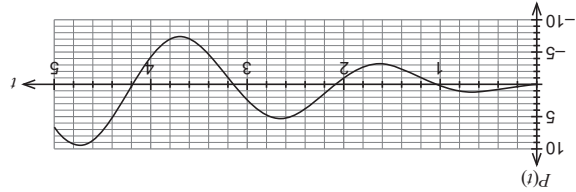
(b) On the axes below, sketch the graph of $y = \ln(x-2) + 1$. (3 marks)

See next page

Question 7 (9 marks)

A company's profit, in millions of dollars, over a five-year period can be modelled by the function:

$$P(t) = 2t\sin(3t) \quad 0 \le t \le 5 \text{ where } t \text{ is measured in years.}$$

The graph of $P(t)$ is shown below.

(a) Differentiate $P(t)$ to determine the marginal profit function, $P'(t)$. (2 marks)

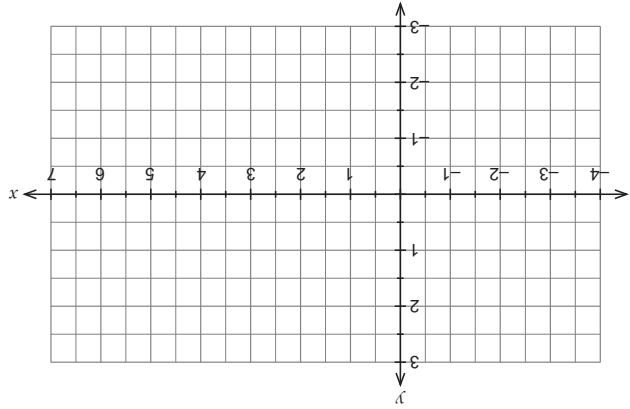(b) Calculate the rate of change of the marginal profit function when $t = \dfrac{\pi}{18}$ years. (4 marks)

(c) Use the increments formula at $t = \dfrac{7\pi}{6}$ to estimate the change in profit for a one month change in time. (3 marks)

End of section

Question 5 (8 marks)

(a) Determine the area bound by the graph of $f(x) = e^x$ and the x-axis between $x = 0$ and $x = \ln 2$. (3 marks)

(b) Hence, determine the area bound by the graph of $f(x) = e^x$, the line $y = 2$ and the y-axis. (2 marks)

(c) Determine the area bound by the graph of $f(x) = e^x$, the line $y = a$ and the y-axis, where a is a positive constant. (3 marks)

Question 6 (10 marks)

The error X in digitising a communication signal has a uniform distribution with probability density function given by

$$f(x) = \begin{cases} 1, & -0.5 < x < 0.5, \\ 0, & \text{otherwise.} \end{cases}$$

(a) Sketch the graph of $f(x)$. (2 marks)

(b) What is the probability that the error is at least 0.35? (1 mark)

(c) If the error is negative, what is the probability that it is less than -0.35? (2 marks)

(d) An engineer is more interested in the square of the error. What is the probability that the square of the error is less than 0.09? (2 marks)

(e) Calculate the variance of the error. (3 marks)