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

ATAR course examination, 2020

Question/Answer booklet

MATHEMATICS SPECIALIST

Place one of your candidate identification labels in this box.

Ensure the label is straight and within the lines of this box.

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 have any unauthorised material with you, hand it to the supervisor **before** reading any further.

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	8	8	50	49	35
Section Two: Calculator-assumed	13	13	100	86	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 2020: Part II Examinations*. 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.

See next page

Section One: Calculator-free **35% (49 Marks)**

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

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.

Working time: 50 minutes.

Question 1 **(3 marks)**

Evaluate exactly $\int_0^{\pi} \left(4\cos^2 x - \sin x\right) dx$.

See next page

Question 2 **(5 marks)**

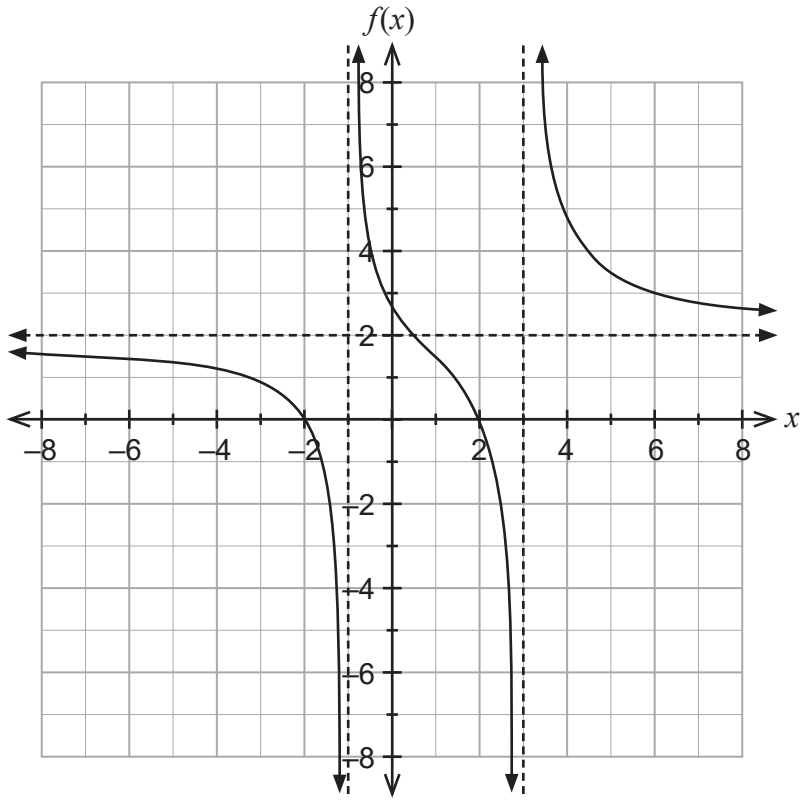
Plane Π has vector equation $\underset{\sim}{r} = \begin{pmatrix} 0 \\ 0 \\ 4 \end{pmatrix} + \lambda \begin{pmatrix} 3 \\ 0 \\ 1 \end{pmatrix} + \mu \begin{pmatrix} 1 \\ -1 \\ 2 \end{pmatrix}$.

(a) Determine the normal vector $\underset{\sim}{n}$ for plane Π. (3 marks)

(b) Determine the Cartesian equation for plane Π. (2 marks)

Question 3 **(6 marks)**

The graph of $y = f(x)$ is shown on the axes below. The defining rule is given by $f(x) = \dfrac{a(x^2 - b)}{(x + c)(x - d)}$ where a, b, c and d are positive constants.



Determine the value of the constants a, b, c and d. Justify your answers.

a	b	c	d

See next page

Question 4 **(7 marks)**

Consider the equations for three planes, each written in Cartesian form:

$\Pi_1 \quad x + y + z = 4$
$\Pi_2 \quad x - y - z = 7$
$\Pi_3 \quad y + z = 1$

(a) Explain whether or not any of these planes are parallel. (2 marks)

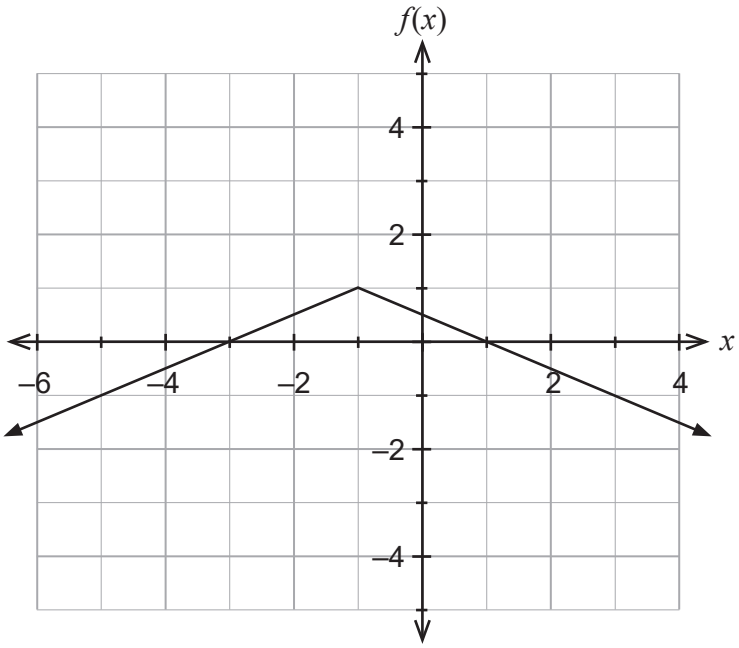
(b) Solve the given system of simultaneous equations. (3 marks)

(c) Give the geometric interpretation of the solution for this system of equations. (2 marks)

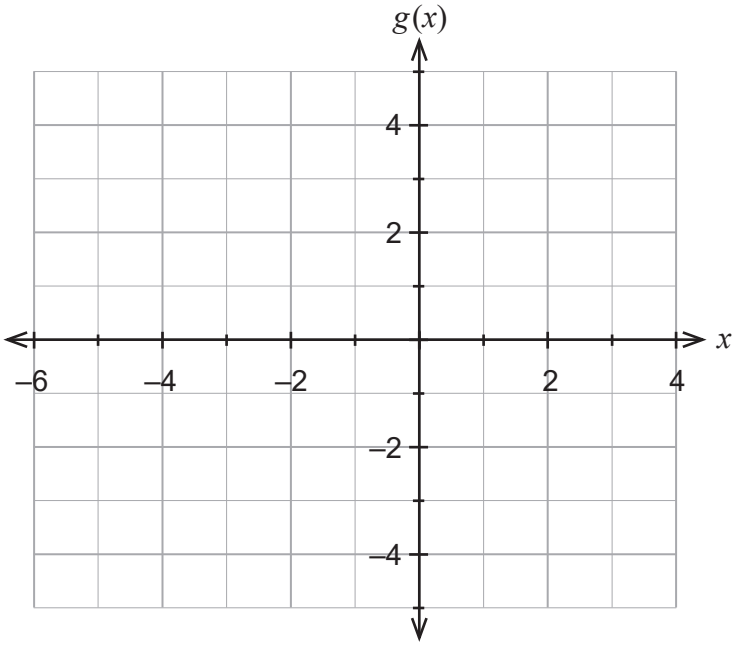
See next page

Question 5 **(7 marks)**

The graph of $f(x) = 1 - \frac{|x+1|}{2}$ is shown below.



(a) Sketch the graph of $g(x) = \frac{1}{f(x)}$ on the axes below. (4 marks)



A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare grid.

See next page

(b) Hence give the domain and range for $h(x) = \dfrac{4}{2 - |x + 1|}$. (3 marks)

See next page

Question 6 **(13 marks)**

Consider $f(x) = 2\tan(x)$ where $-\frac{\pi}{2} < x < \frac{\pi}{2}$.
Let $g(x) = f^{-1}(x)$ be the inverse of function f.

(a) Determine the defining rule for $y = g(x)$. (2 marks)

(b) By using implicit differentiation show that $g'(x)$ can be written in the form $\frac{a}{x^2 + b}$. (4 marks)

See next page

(c) Show that $\frac{3x^2 + 2x + 6}{(x^2 + 4)(x - 3)}$ can be expressed as $\frac{q}{x^2 + 4} + \frac{r}{x - 3}$ and hence determine the values for q and r. (3 marks)

(d) Hence determine $\int \frac{3x^2 + 2x + 6}{(x^2 + 4)(x - 3)}\, dx$. (4 marks)

See next page

Question 7 **(5 marks)**

Evaluate $\int_{-1}^{7} \frac{3x}{\sqrt{x+2}}\,dx$ exactly using the substitution $u = \sqrt{x+2}$.

See next page

Question 8 **(3 marks)**

Consider the complex sum: $\sum_{n=1}^{2020} n i^n = 1i^1 + 2i^2 + 3i^3 + ... + 2020i^{2020}$

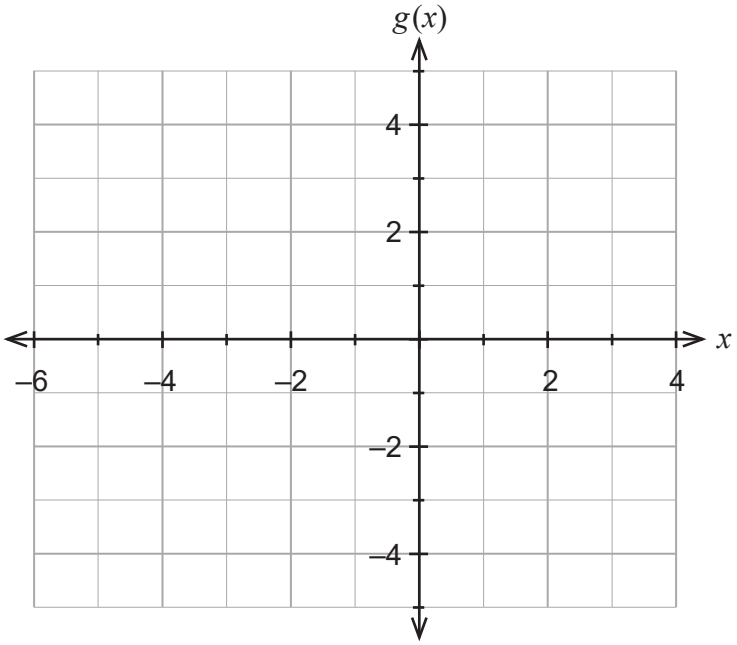
Express the value of this sum in the form $r\,cis\,\theta$ where $-\pi < \theta \leq \pi$.

End of section

Supplementary page

Question number: _____

Spare grid for Question 5.



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