

Question	Mark	Max	Question	Mark	Max
4	3				
3	9		7	9	
2	10		6	8	
1	6		5	5	

Important note to Candidates

Special items: nil

To be provided by the candidate Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters

Formula sheet

This Question/Answer booklet

To be provided by the supervisor

Materials required/recommended for this section

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

Your Teacher's Name _____

Your Name _____

Calculator-free

Section One:

UNIT 3

SPECIALIST MATHS

Question/Answer booklet

Semester One Examination, 2020



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.

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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 examination
Section One: Calculator-free	7	7	50	50	33
Section Two: Calculator-assumed	10	10	100	100	67
Total					100

Instructions to candidates

1. The rules for the conduct of the Western Australian Certificate of Education ATAR course examinations are detailed in the *Year 12 Information Handbook 2016*. Sitting this examination implies that you agree to abide by these rules.
2. Write your answers in this Question/Answer booklet.
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. Additional pages for the use of planning your answer to a question or continuing your answer to a question have been provided at the end of this Question/Answer booklet. If you use the space to continue an answer, indicate in the original answer space where the answer is continued, i.e. give the page number.
5. **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.
6. It is recommended that you **do not use pencil**, except in diagrams.
7. The Formula sheet is **not** to be handed in with your Question/Answer booklet.

(3 marks)

(c) Determine all the roots to $p(z) = 0$

(2 marks)

(b) Show that $(z - \sqrt{\frac{p}{q}})$ is a factor of $p(z)$

(1 mark)

(a) Determine $p(-1)$

Consider the polynomial $p(z) = z^4 - z^3 + 3z^2 - 5z - 10$

(6 marks)

Question 1

Working time: 50 minutes.

- 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 this clearly at the top of the page. Fill in the original answer space where the answer is continued. i.e. give the page number, indicate in the original answer space where the answer is continued to continue an answer.

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

50 Marks

Section One: Calculator-free

MATHEMATICS METHODS

Question 2

(10 marks)

Consider the functions $g(x) = x^2$ & $f(x) = \frac{1}{\sqrt{x+5}}$.

(a) Determine the natural domain and range of $f(x)$. (2 marks)

(b) Determine the rule for $g \circ f(x)$ and state its natural domain and range. (3 marks)

(c) Determine the rule and natural domain for $f \circ f(x)$. Explain why the composite exists. (3 marks)

(d) Does $g \circ f(x) = \frac{1}{x+5}$? Justify. (2 marks)

(3 marks)

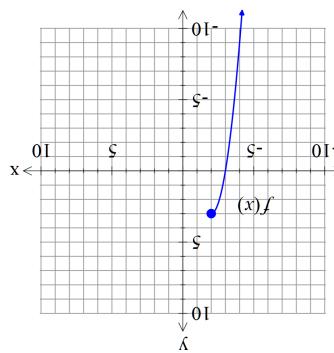
(c) Determine the exact solution(s) to $f(x) = f_{+}(x)$ if any.

(4 marks)

(b) Given that $f(x) = -3x^2 - 12x - 9, x \leq -2$, determine the rule for $y = f_{+}(x)$ and state the domain and range.

(2 marks)

(a) Sketch $y = f_{+}(x)$ on the axes above.



Consider the function $f(x)$ which is drawn below and defined only for $x \leq -2$.

(9 marks)

Question 3

Question 4

(3 marks)

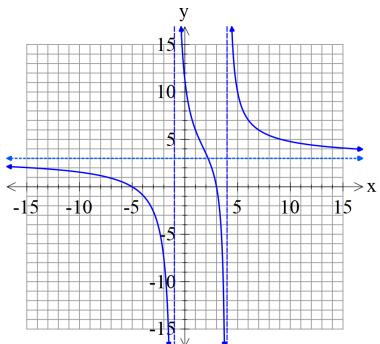
Consider the complex equation $z^n = 1+i$ for any positive integer $n \geq 3$. The n roots are

designated $z_0, z_1, z_2, \dots, z_{n-1}$.

Let $p = z_0 \times z_1 \times z_2 \dots \times z_{n-1}$, determine $|p|$ for any positive integer $n \geq 3$. Explain.

Question 5

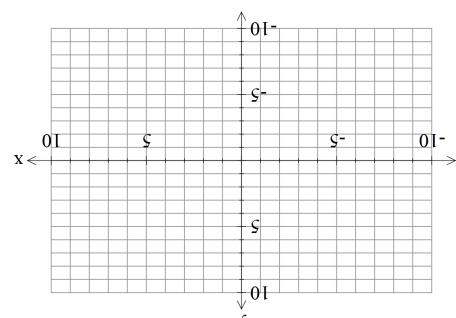
(5 marks)



The function $f(x) = \frac{ax^2 + bx + c}{x^2 + px + q}$ is drawn to the left where $a, b, c, p & q$ are all integers.

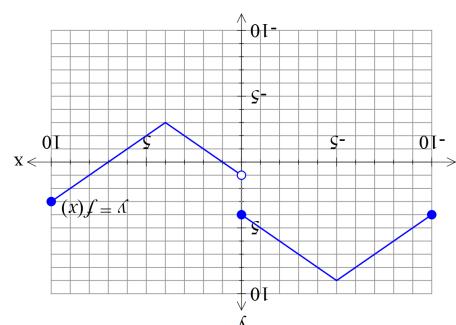
Complete the following table.

a	b	c	p	q



(2 marks)

- (a) Sketch $y = f(-|x|)$ on the axes below.



(8 marks)

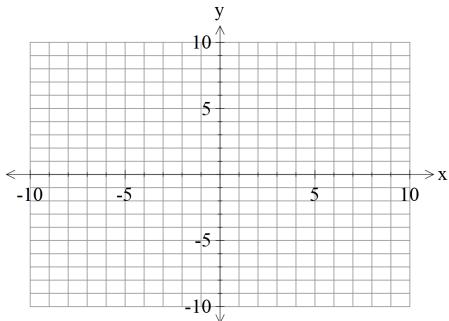
- Q7 cont
c) Given that $V = \sqrt{5} \text{ & } g = 10$ derive the following equation.

(3 marks)

$$\tan^2 \alpha - x \tan \alpha + x^2 + y = 0$$

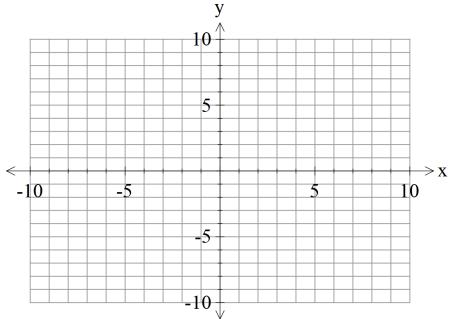
- (b) Sketch $y = |f(|x|)|$ on the axes below.

(3 marks)



- (c) Sketch $y = \frac{1}{f(x)}$ on the axes below.

(3 marks)

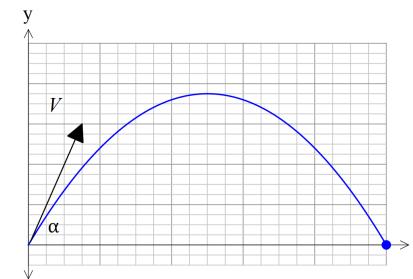
**Question 7**

(9 marks)

Consider a projectile that has an initial speed, $V \text{ m/s}$, at an angle of α with the horizontal

$$\vec{r} = \begin{pmatrix} 0 \\ -gt \end{pmatrix} \text{ m/s}^2$$

that moves with an acceleration of \vec{g} where g is a constant.



- a) If the projectile begins at the origin, show that a time, $t \text{ s}$, and using vector calculus that the velocity vector is given by:

$$\vec{v} = \begin{pmatrix} V \cos \alpha \\ V \sin \alpha - gt \end{pmatrix} \text{ m/s}$$

- b) In terms of V, g & α derive the cartesian equation of the projectile.

(4 marks)