

## WAEP Semester One Examination, 2016

### Question/Answer booklet

# MATHEMATICS SPECIALIST UNIT 3

## Section One: Calculator-free

If required by your examination administrator, please  
place your student identification label in this box

Student number: In figures

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In words

\_\_\_\_\_

Your name

\_\_\_\_\_

### Time allowed for this section

Reading time before commencing work: five minutes

Working time for 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 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 exam
Section One: Calculator-free	7	7	50	53	35
Section Two: Calculator-assumed	12	12	100	98	65
<b>Total</b>					100

**Instructions to candidates**

1. The rules for the conduct of examinations are detailed in the school handbook. 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 response to the specific question asked and to follow any instructions that are specified to a particular question.
4. Additional working space pages at the end of this Question/Answer booklet are for planning or continuing an answer. If you use these pages, indicate at the original answer, the page number it is planned/continued on and write the question number being planned/continued on the additional working space page.
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.

**Section One: Calculator-free****35% (53 Marks)**

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

Working time for this section is 50 minutes.

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**Question 1****(6 marks)**

Consider  $f(z) = z^4 + 3z^3 + 7z^2 - 21z - 26$ ,  $z \in \mathbb{C}$ . Solve  $f(z) = 0$  over  $\mathbb{C}$ .

**Question 2****(7 marks)**

A sphere has equation  $x^2 + y^2 + z^2 - 2x + 4y + 3z + 1 = 0$ .

- (a) Determine the coordinates of the centre and the radius of the sphere. (4 marks)

- (b) Determine the vector equation of the straight line that passes through the points on the sphere where  $y = -2$  and  $z = 0$ . (3 marks)

Question 3

(8 marks)

(a) Let  $z = 2 \cos\left(\frac{2\pi}{3}\right) + 2i \sin\left(\frac{2\pi}{3}\right)$ .

(i) Express  $z$  in Cartesian form.

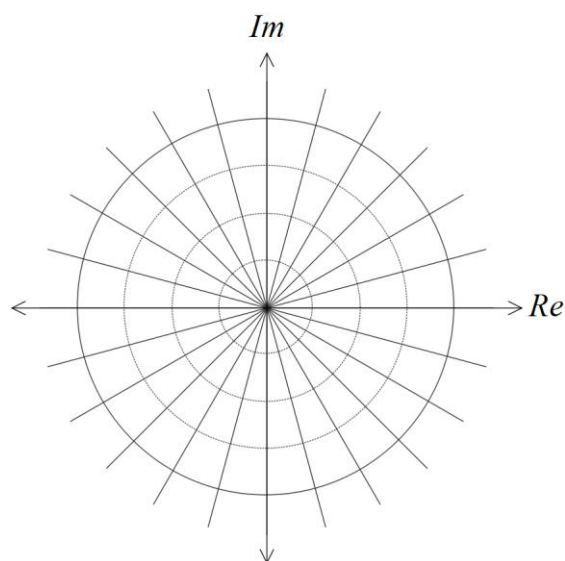
(2 marks)

(ii) Determine  $z^5$  in Cartesian form.

(3 marks)

(b) If  $w^3 + 1 = 0$ , sketch the location of all roots of this equation on the axes below.

(3 marks)



**Question 4****(7 marks)**

Consider the following system of equations, where  $k$  is a real constant.

$$x + 2y + z = 3$$

$$2x - y - 3z = k$$

$$x + 3y + kz = 6$$

- (a) Solve the system of equations when  $k = 1$ .

**(3 marks)**

- (b) Show that no value of  $k$  exists for the system of equations to represent three planes intersecting in a single straight line.

**(4 marks)**

**Question 5****(8 marks)**

- (a) Determine the vector equation of the plane that contains the points  $A(1, -1, 2)$ ,  $B(2, 1, 0)$  and  $C(3, -1, 1)$ . (4 marks)

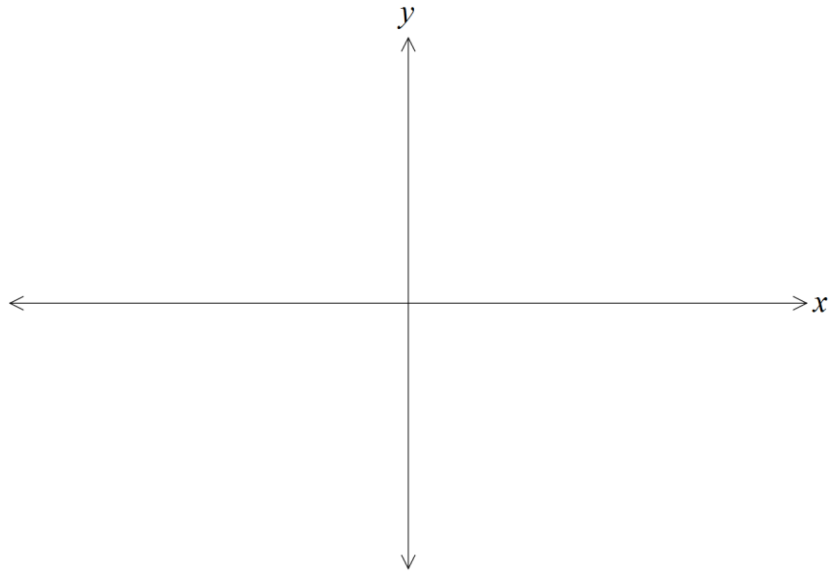
- (b) Plane  $\Pi$  has equation  $x + 2y - z = 3$ . Line  $L$  is perpendicular to  $\Pi$  and passes through the point  $(1, -6, 4)$ . Determine where line  $L$  intersects plane  $\Pi$ . (4 marks)

## Question 6

(7 marks)

- (a) Sketch the graph of  $y = \frac{|x-2|}{2}$  on the axes below.

(2 marks)



- (b) Solve the equation  $4|x-8| = 38 - x$ .

(3 marks)

- (c) Solve the inequality  $\frac{1}{|x+2|} \leq 1$ .

(2 marks)



**Question 7****(10 marks)**

Particle A has position vector given by  $\mathbf{r} = 3\cos(t)\mathbf{i} + 3\sin(t)\mathbf{j}$ , where  $t$  is the time in seconds.

- (a) Show that the path of the particle is circular. (2 marks)

Particle B is stationary, with position vector  $3\mathbf{i} + 4\mathbf{j} + 5\mathbf{k}$ .

- (b) Determine an expression for the distance between particles A and B in terms of  $t$ . (2 marks)

- (c) Determine the position vector of the A when it is (i) nearest and (ii) furthest from B. (6 marks)

**Additional working space**

Question number: \_\_\_\_\_

**Additional working space**

Question number: \_\_\_\_\_

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