



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

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 notes or other items of a non-personal nature in the examination room. 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
Total				151	100

Instructions to candidates

- The rules for the conduct of examinations are detailed in the Instructions to Candidates. Sitting this examination implies that you agree to abide by these rules.
- Write your answers in this Question/Answer Booklet.
- 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.
- 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 in the original answer space where the answer is continued, i.e. give the page number. Fill in the number of the question that you are continuing to answer at the top of the page.
- 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.
- It is recommended that you **do not use pencil**, except in diagrams.
- 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.

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} , given
 $f(-1) = f(2) = 0$

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

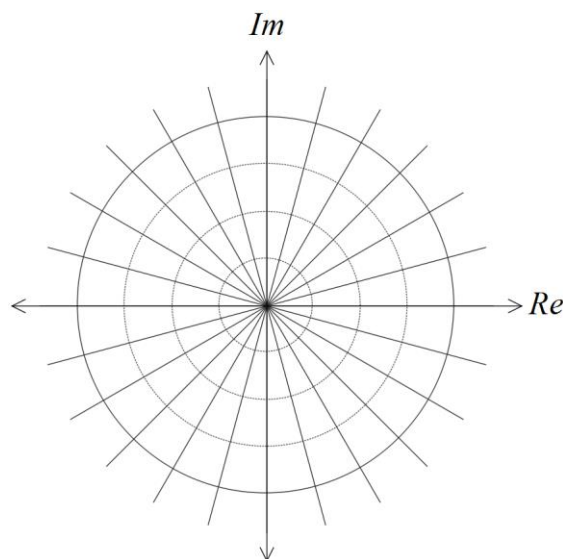
(8 marks)

(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)

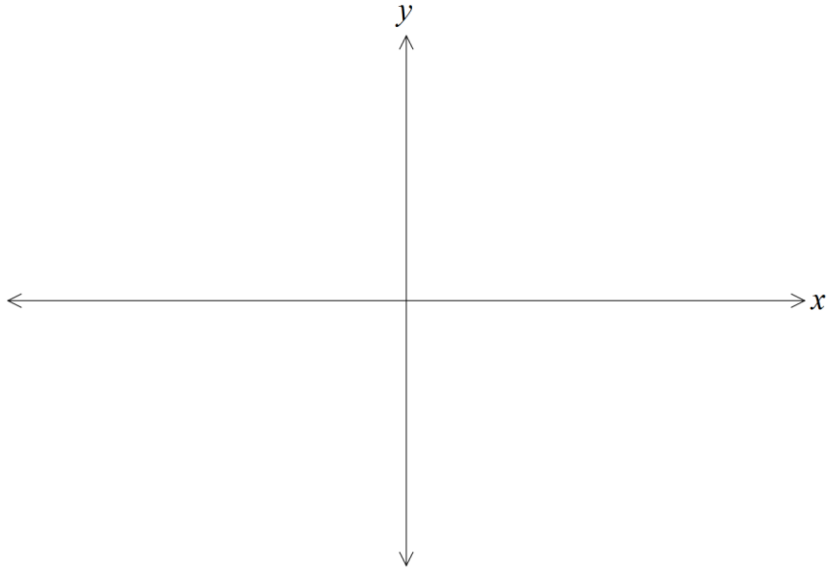
- (b) Plane Π has equation $x + 2y - z = 3$. Line L is perpendicular to Π and passes through the point $(1, -6, 4)$. Determine where line L intersects plane Π . (4 marks)

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 particle A when it is (i) nearest and (ii) furthest from particle B. (6 marks)

Additional working space

Question number: _____

Additional working space

Question number: _____

Additional working space

Question number: _____

