

Year 12 Examination, 2018

Question/Answer Booklet

**MATHEMATICS SPECIALIST**

**Section One: Calculator-free**

Student Name/Number: \_\_\_\_\_

Teacher Name: \_\_\_\_\_

**Time allowed for this section**

Reading time before commencing work: five minutes

Working time for this 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	50	35
Section Two: Calculator-assumed	11	11	100	100	65
					100

### Instructions to candidates

- The rules for the conduct of School exams are detailed in the \_\_\_\_\_ *School/College assessment policy*.  
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 responses to the specific questions asked and to follow any instructions that are specific 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 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% (54 Marks)**

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

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.

Suggested working time: 50 minutes.

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**Question 1**

**(4 marks)**

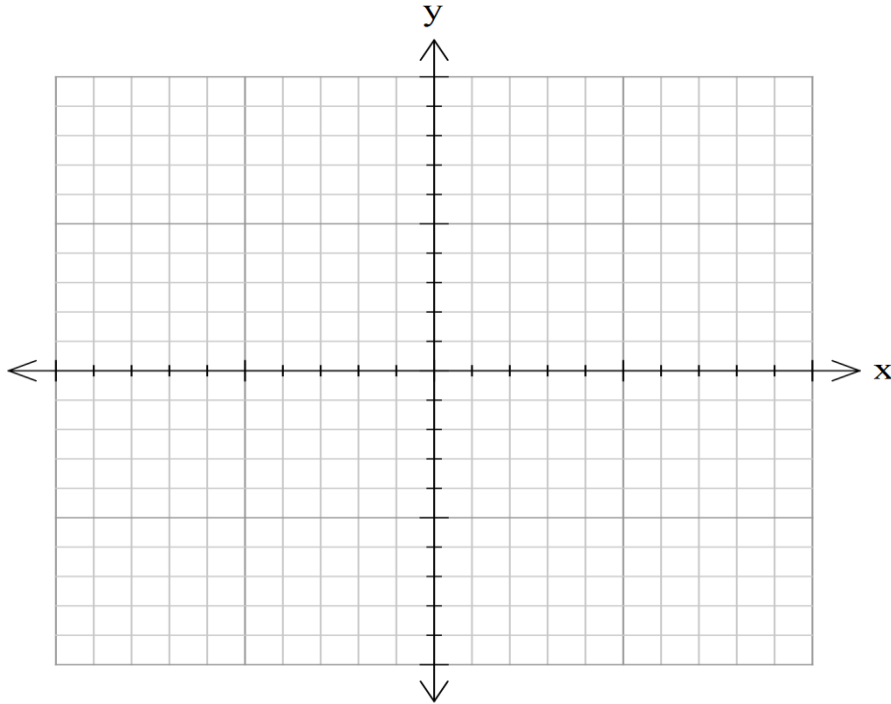
Three collinear points P, Q and R have the position vectors  $2\mathbf{i} + 6\mathbf{j} - 3\mathbf{k}$ ,  $\mathbf{i} + a\mathbf{j} + 2\mathbf{k}$  and  $b\mathbf{i} + 5\mathbf{j}$  respectively.

Determine the values of a and b.

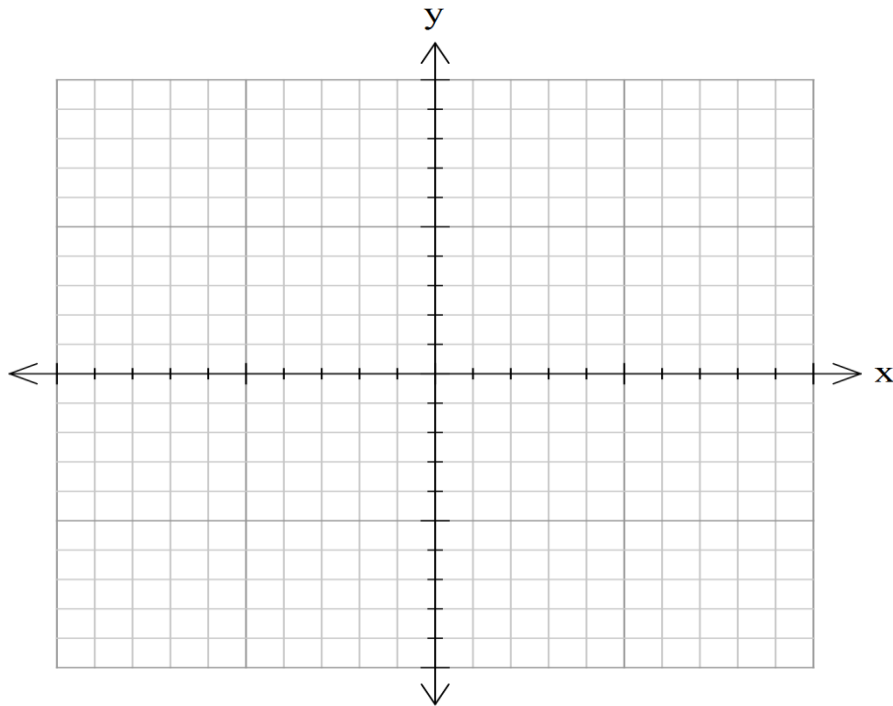
Question 2

(15 marks)

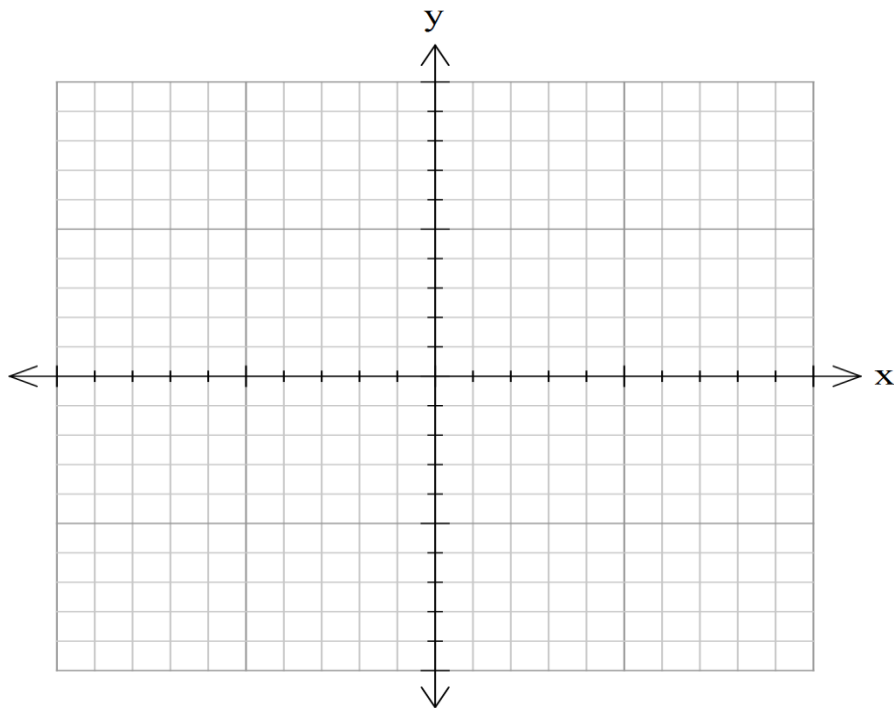
- (a) Sketch the function  $f(x) = \frac{x+1}{x^2+3}$  paying particular attention to the location of its turning point(s) and the behaviour as  $x \rightarrow \pm\infty$ . (9 marks)



(b) Use your graph to sketch the following two functions: (i)  $g(x) = \frac{|x+1|}{x^2+3}$ , (3 marks)



and (ii)  $h(x) = \frac{|x|+1}{x^2+3}$ . (3 marks)



## Question 3

(5 marks)

- (a) Determine the real and imaginary parts of the complex number

$$z = \frac{1+i\sqrt{3}}{1+i} .$$

(2 marks)

- (b) Use your answer to prove that

$$\tan \frac{\pi}{12} = 2 - \sqrt{3} .$$

(3 marks)

Question 4

(7 marks)

Two points A and B have position vectors  $\mathbf{a} = 4\mathbf{i} - 2\mathbf{j} + \mathbf{k}$  and  $\mathbf{b} = -3\mathbf{i} + \mathbf{j} + \mathbf{k}$  respectively.

(a) Determine the vector equation of the line passing through A and B. (2 marks)

(b) If the point  $\mathbf{c} = 18\mathbf{i} + m\mathbf{j} + n\mathbf{k}$  lies on the line determine the values of m and n. (2 marks)

(c) Express the equation of the line in Cartesian form. (2 marks)

(d) Describe geometrically where this line lies relative to the co-ordinate axes. (1 mark)

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

- (a) Calculate the polar form of the complex number

$$z = \frac{-\sqrt{3} + i}{2} .$$

**(2 marks)**

- (b) Deduce the values of the real and imaginary parts of  $z^{2018}$  .

**(3 marks)**



Question 6

(7 marks)

A system of linear equations for the three unknowns is given by

$$\begin{aligned}x - 2y + z &= 7 \\2x + y - 2z &= 1 \\-x + \alpha y + 2z &= \beta\end{aligned}$$

where  $\alpha$  and  $\beta$  are real parameters.

- (a) What are the restrictions on  $\alpha$  and  $\beta$  if this system has no solution? (5 marks)

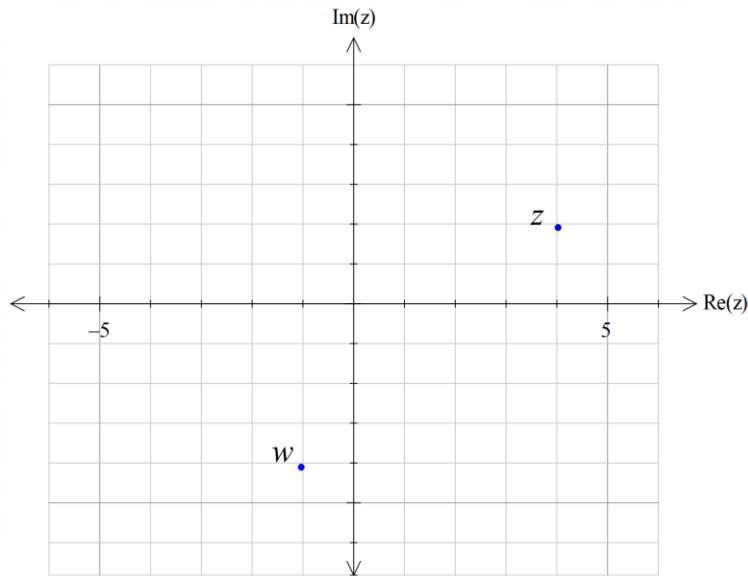
- (b) If the system has the unique solution  $(x, y, z) = (3, -1, 2)$ , determine the relationship between  $\alpha$  and  $\beta$ . (2 marks)

Question 7

(7 marks)

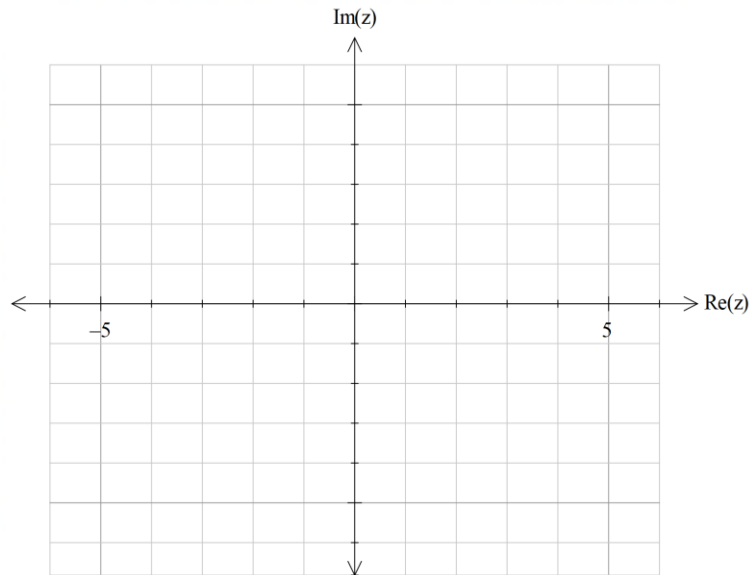
- (a) The diagram below shows the location of complex numbers  $z$  and  $w$ . Show on the same diagram the positions of

$$z_1 = iz, \quad z_2 = \frac{1}{2}(z + w) \text{ and } z_3 = -\bar{w}. \quad (3 \text{ marks})$$



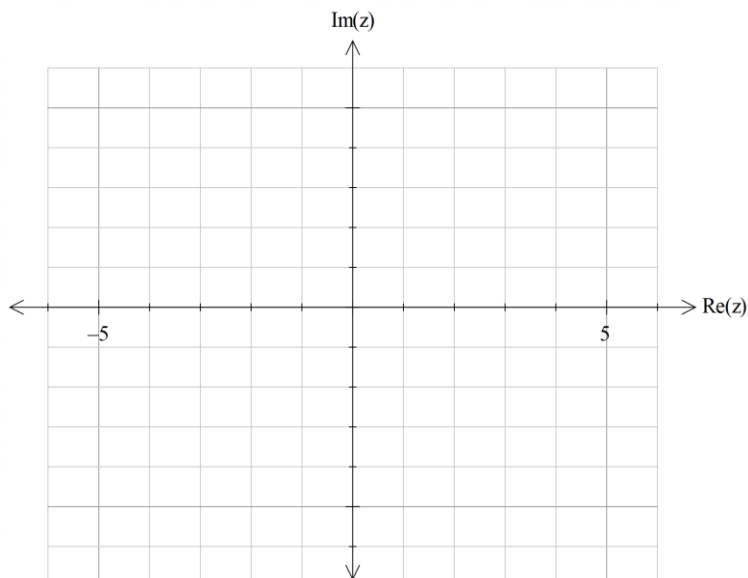
(b) Indicate on the axes below the set of all complex numbers  $z$  which satisfy

$$\arg(z - 3) = \arg(z + 3) + \pi. \quad (2 \text{ marks})$$



(c) Indicate on the axes below the set of all complex numbers  $z$  which satisfy

$$|\arg(z - 3) - \arg(z + 3)| = \frac{\pi}{2}. \quad (2 \text{ marks})$$



**Additional working space**

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

**Additional working space**

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

**Acknowledgements**

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