



Semester One Examination, 2019

Question/Answer booklet

**MATHEMATICS
SPECIALIST
UNIT 1**

**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: 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 examination
Section One: Calculator-free	8	8	50	52	35
Section Two: Calculator-assumed	13	13	100	98	65
Total					100

Instructions to candidates

- 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.
- Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
- You must be careful to confine your answer to the specific question asked and to follow any instructions that are specified to a particular question.
- 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.
- 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.
- The Formula sheet is not to be handed in with your Question/Answer booklet.

Markers use only		
Question	Maximum	Mark
1	4	
2	8	
3	6	
4	7	
5	6	
6	7	
7	6	
8	8	
S1 Total	52	
S1 Wt ($\times 0.6731$)	35%	
S2 Wt	65%	
Total	100%	

Section One: Calculator-free**35% (52 Marks)**

This section has **eight (8)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 50 minutes.

Question 1**(4 marks)**

Determine the truth of the following statements, using an example or counter-example to support each answer.

(i) If $z \in \mathbb{R}$ and z^3 is an even number then z is an even number. (2 marks)

(ii) If $x, y \in \mathbb{Z}$ and $x > y$ then $x^2 > y^2$. (2 marks)

Question 2

(8 marks)

Let $\mathbf{a} = 4\mathbf{i} - 8\mathbf{j}$, $\mathbf{b} = -3\mathbf{i} + 6\mathbf{j}$ and $\mathbf{c} = 2\mathbf{i} + 3\mathbf{j}$.

(a) Determine

(i) $\mathbf{b} - \mathbf{c}$.

(1 mark)

(ii) $3\mathbf{b} + 4\mathbf{a}$.

(2 marks)

(iii) $|\mathbf{a} + \mathbf{c}|$.

(2 marks)

(b) Determine a unit vector that is parallel to $\mathbf{a} + \mathbf{b}$ but in the opposite direction.

(3 marks)

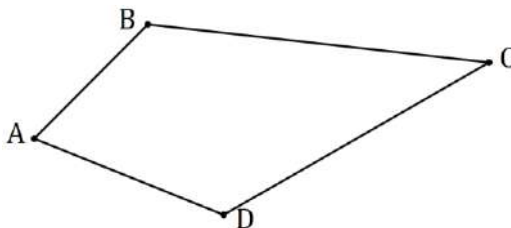
Question 3**(6 marks)**

- (a) Body A moves 40 m on a bearing of 315° . Express this displacement in component form using unit vectors \mathbf{i} and \mathbf{j} . (3 marks)

- (b) Body B moves with a velocity of $4\sqrt{3}\mathbf{i} - 4\mathbf{j} \text{ ms}^{-1}$. Determine the speed of this body and the bearing it is travelling in. (3 marks)

Question 4**(7 marks)**

Quadrilateral $ABCD$ is shown below. The midpoints of sides AB , BC , CD and DA are P , Q , R and S respectively. Let $\overrightarrow{AB} = 2\mathbf{b}$, $\overrightarrow{AC} = 2\mathbf{c}$ and $\overrightarrow{AD} = 2\mathbf{d}$.



- (a) Sketch quadrilateral $PQRS$ on the diagram above. (1 mark)
- (b) Determine expressions for \overrightarrow{AQ} , \overrightarrow{AR} and \overrightarrow{QR} in terms of \mathbf{b} , \mathbf{c} and \mathbf{d} . (3 marks)
- (c) Prove that $\overrightarrow{PQ} = \overrightarrow{SR}$ and $\overrightarrow{PS} = \overrightarrow{QR}$. (3 marks)

Question 5**(6 marks)**

Consider the following statement that refers to two **isosceles** triangles.

If the triangles have the same area, then the triangles are congruent.

(a) Write the inverse statement and state whether it is true or false. (2 marks)

(b) Write the converse statement and state whether it is true or false. (2 marks)

(c) Write the contrapositive statement and use a counter-example to explain why it is false. (2 marks)

Question 6**(7 marks)**

- (a) The work done, in joules, by a force of \mathbf{F} Newtons in changing the displacement of an object by \mathbf{s} metres, is given by the scalar product of \mathbf{F} and \mathbf{s} . Determine the work done by
- (i) force $\mathbf{F} = (10\mathbf{i} + 8\mathbf{j})$ N that moves a small body from $(2\mathbf{i} - 8\mathbf{j})$ m to $(15\mathbf{i} + 12\mathbf{j})$ m. (2 marks)
- (ii) a horizontal force of 30 N that pushes a small body 1.8 m up a slope inclined at 30° to the horizontal. (2 marks)
- (b) Determine the vector projection of $(2\mathbf{i} + 4\mathbf{j})$ on $(-3\mathbf{i} + 4\mathbf{j})$. (3 marks)

Question 7**(6 marks)**

The position vectors of points P and Q are $\mathbf{p} = \begin{bmatrix} 3 \\ 1 \end{bmatrix}$ and $\mathbf{q} = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$ respectively.

(a) Determine the magnitude of the displacement vector \overrightarrow{PQ} . (2 marks)

(b) Determine the values of λ so that $|\mathbf{p} - \lambda\mathbf{q}| = 4$. (4 marks)

Question 8

(8 marks)

(a) Evaluate $\frac{{}^{2020}P_2}{101 \times {}^{20}P_1}$.

(3 marks)

(b) Given that ${}^{n+1}P_r = k \times {}^nP_r$, determine the constant k in terms of n and/or r . (3 marks)

(c) Given that ${}^{14}P_{12} = 43\,589\,145\,600$, determine ${}^{16}P_{12}$. (2 marks)

Supplementary page

Question number: _____

