TRINITY COLLEGE

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 | | | | | | | | |

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

1. The rules for the conduct of Trinity College examinations are detailed in the *Instructions to Candidates* distributed to students prior to the examinations. Sitting this examination implies that you agree to abide by these rules.

2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.

3. 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.

4. 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.

5. It is recommended that you do not use pencil, except in diagrams.

6. 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.

7. The Formula sheet is not to be handed in with your Question/Answer booklet.

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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 **(8 marks)**

Let $\mathbf{a} = 3\mathbf{i} - 5\mathbf{j}$, $\mathbf{b} = -4\mathbf{i} + 3\mathbf{j}$ and $\mathbf{c} = -\mathbf{i} + 2\mathbf{j}$.

(a) Determine

(i) $\mathbf{b} - \mathbf{c}$. (1 mark)

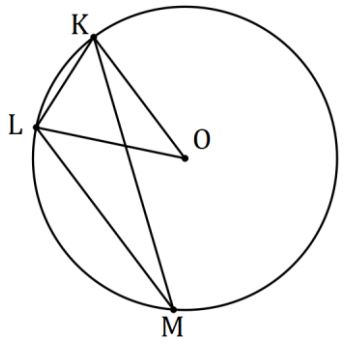
(ii) $5\mathbf{c} + 3\mathbf{a}$. (2 marks)

(iii) $|\mathbf{a} - \mathbf{c}|$. (2 marks)

(b) Determine a unit vector that is parallel to $\mathbf{a} + \mathbf{c}$ but in the opposite direction. (3 marks)

Question 2 **(4 marks)**

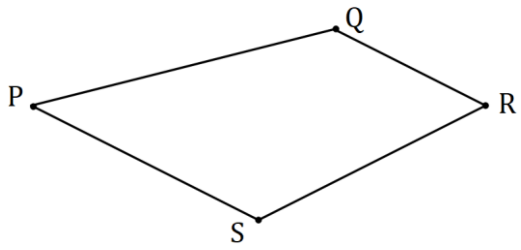
In the diagram below (not drawn to scale) K, L and M lie on the circle with centre O and OK is parallel to ML.



Determine, with reasons, the size of $\angle OLK$ and the size of $\angle KLM$ when $\angle OKM = 14°$.

Question 3 **(7 marks)**

Quadrilateral $PQRS$ is shown below. The midpoints of sides PQ, QR, RS and SP are A, B, C and D respectively. Let $\overrightarrow{PQ} = 2\mathbf{q}, \overrightarrow{PR} = 2\mathbf{r}$ and $\overrightarrow{PS} = 2\mathbf{s}$.



(a) Sketch quadrilateral $ABCD$ on the diagram above. (1 mark)

(b) Determine expressions for $\overrightarrow{PB}, \overrightarrow{PC}$ and $\overrightarrow{BC}$ in terms of $\mathbf{q}, \mathbf{r}$ and $\mathbf{s}$. (3 marks)

(c) Prove that $\overrightarrow{AD} = \overrightarrow{BC}$ and $\overrightarrow{AB} = \overrightarrow{DC}$. (3 marks)

Question 4 **(6 marks)**

(a) Body A moves with a velocity of $6\sqrt{2}\mathbf{i} - 6\sqrt{2}\mathbf{j}$ ms^{-1}. Determine the speed of this body and the bearing it is travelling in. (3 marks)

(b) Body B moves 32 m on a bearing of $300°$. Express this displacement in component form using unit vectors **i** and **j**. (3 marks)

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Question 5 **(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 $\mathbf{F} = (5\mathbf{i} + 10\mathbf{j})$ N that moves a small body from $(16\mathbf{i} - 2\mathbf{j})$ m to $(22\mathbf{i} + 8\mathbf{j})$ m. (2 marks)

(ii) a horizontal force of 45 N that pushes a small body 0.4 m up a slope inclined at $45°$ to the horizontal. (2 marks)

(b) Determine the vector projection of $(-\mathbf{i} - 4.5\mathbf{j})$ on $(3\mathbf{i} - 4\mathbf{j})$. (3 marks)

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Question 6 **(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) Use a counter-example to explain why the statement is false. (2 marks)

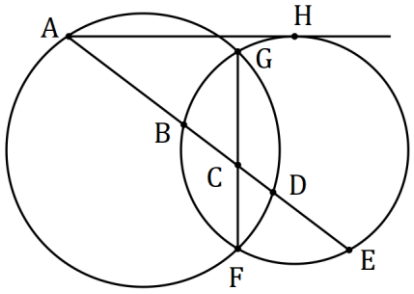
(b) Write the contrapositive statement and state whether it is true or false. (2 marks)

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

See next page

Question 7 **(6 marks)**

In the diagram below (not drawn to scale), two circles intersect at F and G. AH is a tangent to the circle at H. AE is a straight line that cuts the circles at A, B, D and E and intersects chord GF at C. $AB = 4, GC = 5.5, CF = 2$, $AH = 8$ and $BC < CE$.



(a) Deduce that $BE = 12$. (2 marks)

(b) Determine BC and CD, justifying your answers. (4 marks)

Question 8 **(8 marks)**

(a) Evaluate $\frac{^{55}P_2}{^{6}P_3}$. (3 marks)

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

(c) Given that $^{13}P_8 = 51\,891\,840$, determine $^{13}P_{10}$. (2 marks)

End of questions

Supplementary page

Question number: _____