**Western Australian Certificate of Education**

**Semester One Examination, 2019**

**Question/Answer Booklet**

**MATHEMATICS**

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98

**SPECIALIST**

**UNIT 1&2**

**Section Two:**

**Calculator- assumed Score for this booklet**

**Student’s Name**: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**As shown on your exam timetable.**

**Student’s Teacher Mr Bradbury Mrs Waddell**

(**Circle your teacher’s name**.)

**Time allowed for this section**

Reading time before commencing work: ten minutes

Working time for this section: one hundred minutes

**Materials required/recommended for this section**

***To be provided by the supervisor***

This question /Answer Booklet

Formula Sheet (retained from Section One)

***To be provided by the candidate***

Standard Items: pens (blue/black preferred), pencils (including coloured), sharpener,

correction fluid/tape, eraser, ruler, highlighters.

Special items: drawing instruments, templates, notes on two unfolded sheets of A4 paper,

and up to three calculators approved for use in the WACE examinations.

**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 unauthorized notes or other items of a non-personal nature in the

examination room. If you have any unauthorized material with you, hand it to the supervisor

**before** reading any further.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Section | Number of questions available | Number of questions to be answered | | Working time (minutes) | Marks available | Percentage of exam |
| Section One:  Calculator-free | 8 | 8 | | 50 | 52 | 35 |
| Section Two:  Calculator-assumed | 13 | 13 | | 100 | 98 | 65 |
|  | | | **Total** | | 150 | 100 |

## Instructions to candidates

1. The rules for the conduct of examinations are detailed in the *School Examination Rules* provided with your exam timetable.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 responses to the specific questions asked and to follow any instructions that are specific to a particular question.
4. 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(s) that you are continuing to answer at the top of the page.

1. **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 an answer to any question, ensure that you cancel the answer you do not wish to have marked.
2. It is recommended that you **do not use pencil**, except in diagrams.
3. The formula sheet and your notes are **not to be handed** in with your Question/Answer Booklet.

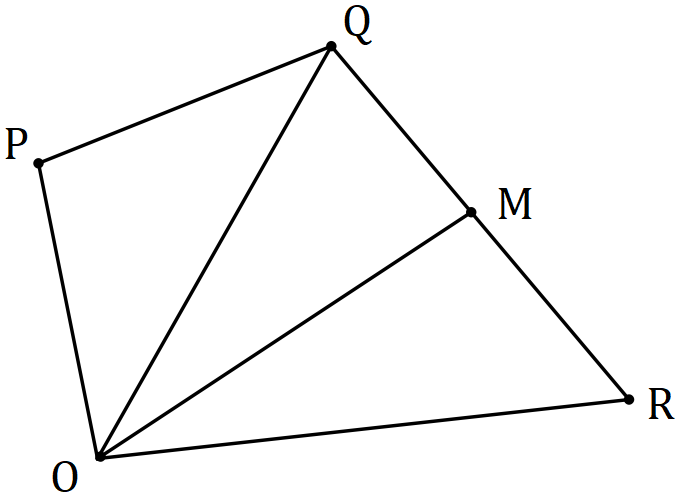
Section Two: Calculator-assumed 65% (98 Marks)

This section has**thirteen (****13)** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 100 minutes.

Question 9 (5 marks)

In the diagram below, is the midpoint of .



If and , express the following in terms of and .

(a) . (1 mark)

(b) . (2 marks)

(c) . (2 marks)

Question 10 (8 marks)

Points and have coordinates and respectively. Determine

(a) . (1 mark)

(b) . (2 marks)

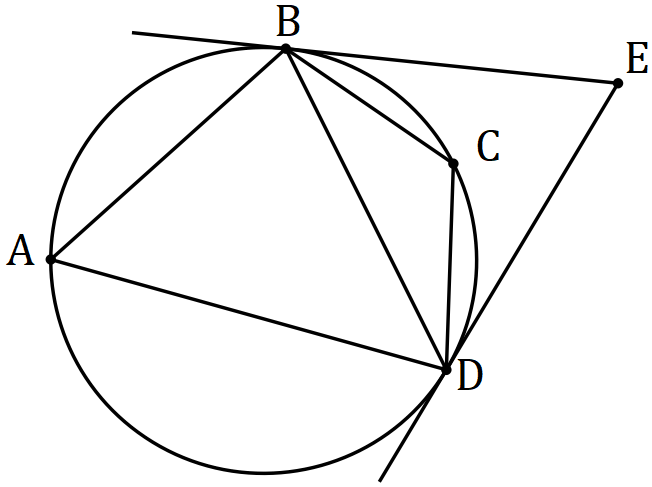
(c) , where is a unit vector in the direction . (3 marks)

(d) The coordinates of point , given that . (2 marks)

Question 11 (7 marks)

(a) In the diagram below (not drawn to scale) and lie on a circle and and are tangents to the circle. If and , determine the size of .

(3 marks)



(b) Quadrilateral is such that , and .

(i) Sketch a diagram to show this information. (1 mark)

(ii) Show that is cyclic and hence determine the size of . (3 marks)

Question 12 (8 marks)

(a) Show that the vectors and are perpendicular. (2 marks)

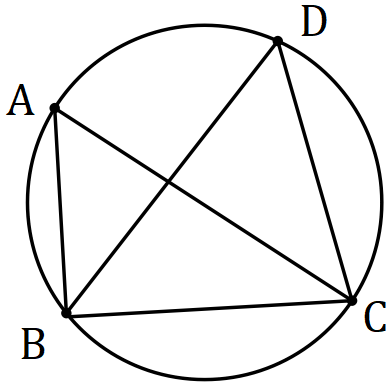
(b) Determine, to the nearest degree, the angle between the vectors and .

(2 marks)

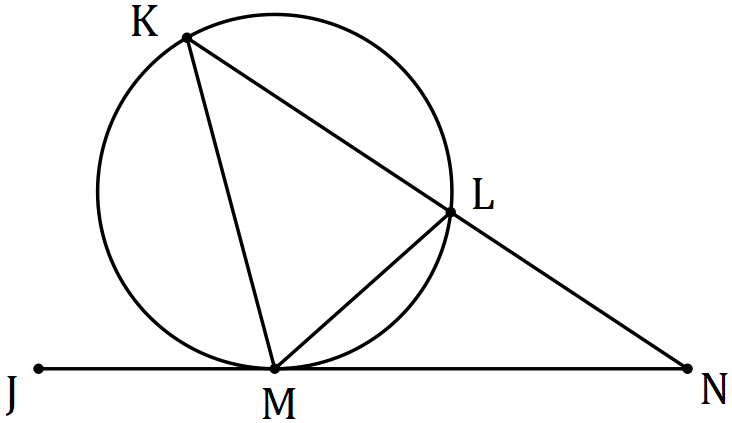
(c) The vectors and are perpendicular, where is a constant. Determine the value(s) of and the corresponding pair(s) of vectors. (4 marks)

Question 13 (8 marks)

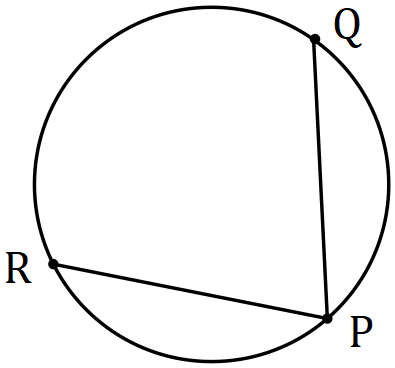
(a) and lie on a circle with diameter (diagram not to scale). Determine the size of when . (2 marks)



(b) and lie on a circle (diagram not to scale). Secant cuts the circle at and is a tangent to the circle at . Given that and , determine the size of and the size of . (3 marks)



(c) and lie on a circle of radius mm (diagram not to scale) and mm. Determine the size of angle , to the nearest degree. (3 marks)



Question 14 (9 marks)

The parts of this question refer to the word AERIFICATION. It has different consonants and vowels, some of which are repeated.

(a) Determine the number of ways that different consonants chosen from the letters of the word can be arranged in a row. (1 mark)

(b) Determine the number of ways that all the letters of the word can be arranged in a row.

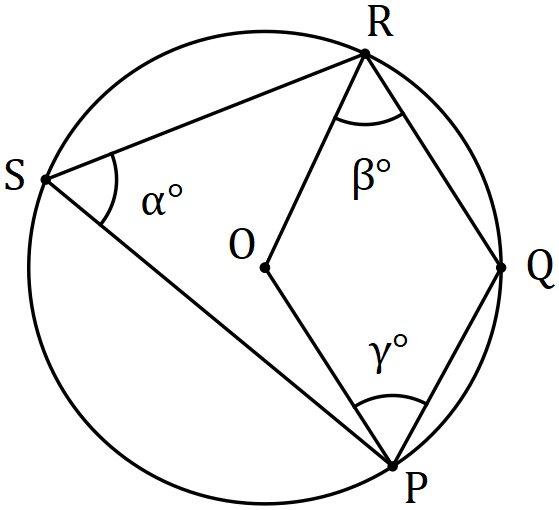
(2 marks)

(c) Determine the number of ways that all the letters of the word can be arranged in a row if the vowels must all be adjacent. (3 marks)

(d) Determine how many letter permutations (e.g. TFI, IRI, etc) can be made using the letters of the word. (3 marks)

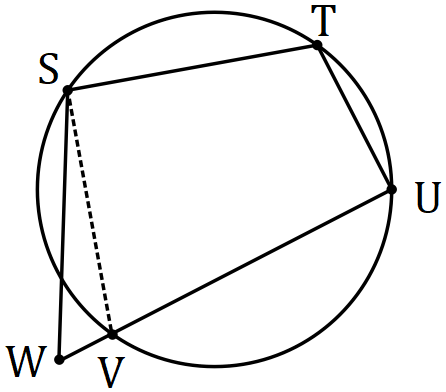
Question 15 (8 marks)

(a) In the diagram below (not drawn to scale) and lie on the circle with centre . Determine the size of angles , and given that and . (4 marks)



(b) Write the converse of the theorem that states the opposite angles of a cyclic quadrilateral are supplementary. (1 mark)

(c) Prove by contradiction that the converse you wrote in (b) is true. Start by assuming that there is a quadrilateral that *does* have supplementary opposite angles but is *not* cyclic, such as shown below. (3 marks)



Question 16 (7 marks)

Three forces and act on a point in a plane.

The forces are, N and .

(a) Determine the magnitude of the resultant force and the direction, to the nearest degree, that the resultant makes with the vector . (3 marks)

When , the forces are in equilibrium.

(b) Determine the values of the scalar constants and for equilibrium to occur. (4 marks)

Question 17 (8 marks)

(a) A set of cards is numbered from to . Determine the minimum number of cards that must be selected to ensure that at least cards in the selection have the same last digit. Justify your answer using the pigeonhole principle. (3 marks)

(b) Eight different books sit on a shelf, one of which has a hardcover and the rest softcovers. A student is told they can take away as many of them as they like but must not leave empty handed. Determine how many different selections can be made

(i) of exactly books. (1 mark)

(ii) altogether. (2 marks)

(iii) that include the hardcover. (2 marks)

Question 18 (8 marks)

Relative to the origin, and have position vectors and respectively.

Particle is initially at and moves with a constant velocity of ms-1.

(a) Calculate

(i) the speed of . (1 mark)

(ii) the position vector of after seconds. (1 mark)

(iii) the distance of from after seconds. (2 marks)

(b) Determine how long after leaving that is m from . (4 marks)

Question 19 (7 marks)

is a trapezium with parallel and in the same direction to .

(a) Sketch a labelled diagram of . (1 mark)

(b) Show that . (2 marks)

(c) lies on and lies on so that . Use a vector method to prove that is a trapezium. (4 marks)

Question 20 (7 marks)

Farm lies km away from farm on a bearing of . A helicopter leaves farm at am to fly to farm . The helicopter can maintain a speed of kmh-1 and there is a steady wind of kmh-1 blowing from the north.

Determine the bearing that the helicopter should steer and the time of its arrival at farm , to the nearest minute.

Question 21 (8 marks)

Determine how many of the integers between and inclusive are

(a) divisible by . (1 mark)

(b) divisible by or . (3 marks)

(c) divisible by or but not both. (1 mark)

(d) divisible by or but not . (3 marks)

**Additional working space.**

**Question Number: \_\_\_\_\_\_\_\_\_**