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### Semester One Examination, 2020

### Question/Answer booklet

# MATHEMATICS

**SOLUTIONS**

**SPECIALIST**

**UNIT 1**

## Section One:

## Calculator-free

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WA student number: In figures |  |  |  |  |  |  |  |  |  |  |

In words

Your name

|  |  |
| --- | --- |
| Number of additional answer booklets used (if applicable): |  |

## 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 examinations are detailed in the school handbook. 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 answers to the specific question asked and to follow any instructions that are specific 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.

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

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

Working time: 50 minutes.

Question 1 (5 marks)

(a) Without prefacing the statement with 'It is not ...' or similar, write the negation of the following statements:

(i) Polygon is a rhombus or a square. (1 mark)

|  |
| --- |
| **Solution** |
| Polygon is **not** a rhombus **and** **not** a square. |
| **Specific behaviours** |
| ✓ correct negation |

(ii) obtuse angles , the angle is acute. (2 marks)

|  |
| --- |
| **Solution** |
| an obtuse angle such that is not an acute angle. |
| **Specific behaviours** |
| ✓ replaces 'for all' with 'there exists'   correct negation |

(b) If a true statement is negated, explain whether the contrapositive of the negated statement will also be true. (2 marks)

|  |
| --- |
| **Solution** |
| No. If a statement is true then the contrapositive will always be true and if a true statement is negated, the negated statement will always be false. |
| **Specific behaviours** |
| ✓ states no, explaining truth of negated statement   explains truth of contrapositive statement |

Question 2 (7 marks)

Two forces are given by N and N.

(a) Determine

(i) . (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ correct vector |

(ii) . (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ one correct multiple  ✓ correct vector |

(iii) . (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ correct value |

(b) The resultant of , and a third force is N. Determine the magnitude of the third force. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
|  correct vector equation   correct third force  ✓ correct magnitude |

Question 3 (6 marks)

(a) Consider the statement: .

(i) Write the inverse statement. (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ correct statement |

(ii) Write the converse statement. (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ correct statement |

(b) State whether each of the following statements are true or false, supporting each answer with an example or counterexample.

(i) positive integer . (2 marks)

|  |
| --- |
| **Solution** |
| True.  If and . |
| **Specific behaviours** |
| ✓ states true, with counterexample   counterexample using positive integer |

(ii) such that . (2 marks)

|  |
| --- |
| **Solution** |
| False.  If then no value for exists so that . |
| **Specific behaviours** |
| ✓ states false, with counterexample   counterexample with |

Question 4 (6 marks)

The position vectors of points and are and .

(a) Determine the position vector of point that divides internally in the ratio .

(3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ vector   indicates appropriate method   correct position vector |

(b) A small body leaves and moves with a constant velocity in a direction parallel to . Determine, with reasons, whether the body will pass through point with position vector . (3 marks)

|  |
| --- |
| **Solution** |
| But and so body will not pass through as is not parallel to . |
| **Specific behaviours** |
| ✓ vector   indicates not parallel to velocity   states will not pass through |

Question 5 (7 marks)

(a) different letters are chosen from the in the word PAYMENT and then arranged to form a password. Determine how many different passwords are possible that

(i) end in T. (1 mark)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ correct number |

(ii) end in T or start with P. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ number for P and T   uses inclusion-exclusion principal  ✓ correct number |

(b) Determine the number of two letter permutations that can be made using letters from the word REPAYMENT. (3 marks)

|  |
| --- |
| **Solution** |
| letters - singles and double (E).  Both different:  Both the same:  Total permutations: . |
| **Specific behaviours** |
| ✓ breaks into exclusive cases   correct calculation for each case   correct number |

Question 6 (7 marks)

Trapezium is such that .

The midpoints of sides and are and .

Let and . Use a vector method to prove that is a parallelogram.

|  |
| --- |
| **Solution** |
| Then , .  Hence .  Note that .  Also .  Hence .  Hence is a parallelogram as (has a pair of equal length, parallel sides). |
| **Specific behaviours** |
| ✓ diagram of trapezium, roughly to scale   uses correct vector notation throughout   vectors ,   vector   vectors ,   vector   conclusion |

Question 7 (7 marks)

Consider the vectors and .

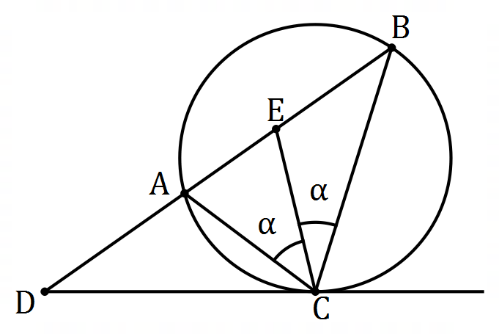
(a) Determine the vector projection of onto . (3 marks)

|  |
| --- |
| **Solution** |
| Hence required vector is |
| **Specific behaviours** |
| ✓ unit vector for   scalar product   correct vector |

(b) Given that , determine the value of and the value of . (4 marks)

|  |
| --- |
| **Solution** |
| Equating and coefficients:  Hence |
| **Specific behaviours** |
| ✓ equation using -coefficients  ✓ equation using -coefficients   value of   value of |

Question 8 (7 marks)

In the diagram shown, and lie on a circle.

The tangent at and secant intersect at .

Point lies on so that bisects .

(a) Show that . (3 marks)

|  |
| --- |
| **Solution** |
| Given .  Let , so that .  (alternate segment)  (sum of opposite interior angles)  Hence as required. |
| **Specific behaviours** |
| ✓ uses alternate segment theorem   uses triangle properties   logical explanation |

(b) Given that cm and cm, determine the length of . (4 marks)

|  |
| --- |
| **Solution** |
| (intersecting secants)  Let (isosceles triangle) so that and .  Then |
| **Specific behaviours** |
| ✓ uses intersecting secants theorem   uses isosceles triangles to express required lengths   forms equation   correct length |

Supplementary page

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

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