# Applecross Senior High School

### Semester One Examination, 2019

### Question/Answer booklet

# MATHEMATICS

**SOLUTIONS**

**SPECIALIST**

**UNIT 1**

## Section One:

## Calculator-free

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 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 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.

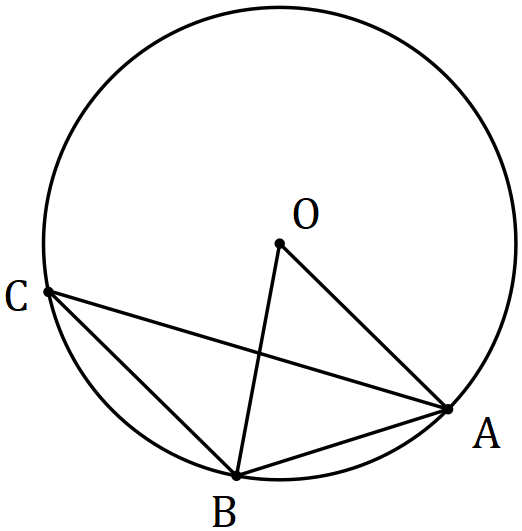
Section One: Calculator-free 35% (52 Marks)

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

Working time: 50 minutes.

Question 1 (4 marks)

In the diagram below (not drawn to scale) and lie on the circle with centre and is parallel to .



Determine, with reasons, the size of and the size of when .

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ with reason   with reason   with reason   |

Question 2 (8 marks)

Let , and .

(a) Determine

(i) . (1 mark)

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

(ii) . (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ determines scalar multiples  ✓ correct vector |

(iii) . (2 marks)

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

(b) Determine a unit vector that is parallel to but in the opposite direction. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ determines  ✓ determines magnitude  ✓ correct unit vector |

Question 3 (6 marks)

(a) Body moves m on a bearing of . Express this displacement in component form using unit vectors and . (3 marks)

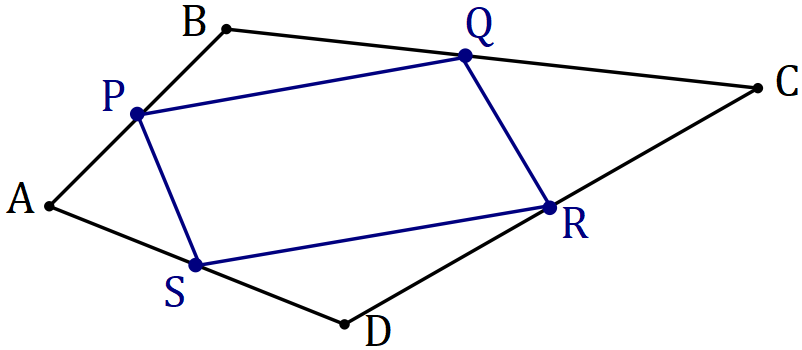
|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ correct angle from -axis   correct -coefficient   correct -coefficient |

(b) Body moves with a velocity of ms-1. Determine the speed of this body and the bearing it is travelling in. (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
|  correct speed   angle with -axis   correct bearing |

Question 4 (7 marks)

Quadrilateral is shown below. The midpoints of sides and are and respectively. Let and .



|  |
| --- |
| **Solution (a)** |
| See diagram |
| **Specific behaviours** |
| ✓ correct quadrilateral |

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

(b) Determine expressions for and in terms of and . (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ derives expression for  ✓ derives expression for  ✓ derives expression for |

(c) Prove that and . (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ derives expression for and equates to   derives expression for   derives expression for and equates to |

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)

|  |
| --- |
| **Solution** |
| If the triangles do not have the same area, then the triangles are not congruent.  This statement is true. |
| **Specific behaviours** |
| ✓ correct inverse statement   states true |

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

|  |
| --- |
| **Solution** |
| If the triangles are congruent, then the triangles have the same area.  This statement is true. |
| **Specific behaviours** |
| ✓ correct inverse statement  ✓ states true |

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

(2 marks)

|  |
| --- |
| **Solution** |
| If the triangles are not congruent, then the triangles do not have the same area.    The isosceles triangles shown are not congruent but have the same area. |
| **Specific behaviours** |
| ✓ correct contrapositive statement   correct example that uses isosceles triangles  Or  shows dimensions that give same area |

Question 6 (7 marks)

(a) The work done, in joules, by a force of Newtons in changing the displacement of an object by metres, is given by the scalar product of and . Determine the work done by

(i) force N that moves a small body from m to m.

(2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ displacement vector   correct work done |

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

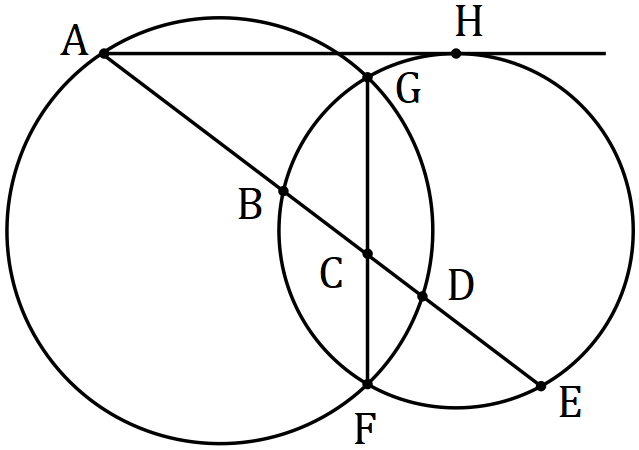
|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ uses correct expression   correct work done |

(b) Determine the vector projection of on . (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ scalar products   substitutes into expression   correct vector projection |

Question 7 (6 marks)

In the diagram below (not drawn to scale), two circles intersect at and . is a tangent to the circle at . is a straight line that cuts the circles at and and intersects chord at . , and .



(a) Deduce that . (2 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ justifies length of   justifies length of |

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

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ justifies equation for   length of   justifies equation for   length of |

Question 8 (8 marks)

(a) Evaluate . (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ expresses as factorials   eliminates factorials   correct value |

(b) Given that , determine the constant in terms of and/or . (3 marks)

|  |
| --- |
| **Solution** |
|  |
| **Specific behaviours** |
| ✓ expresses LHS using factorials   factors out term from denominator   correct expression |

(c) Given that , determine . (2 marks)

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

Supplementary page

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

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