

Semester One Examination, 2022

Question/Answer booklet

MATHEMATICS  
METHODS  
UNIT 1

**SOLUTIONS**

Section One:  
Calculator-free

**Student Name**

**Teacher 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 | 7 | 7 | 50 | 52 | 35 |
| Section Two: Calculator-assumed | 12 | 12 | 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**seven** questions. Answer **all** questions. Write your answers in the spaces provided.

Working time: 50 minutes.

Question 1 (6 marks)

Solve each of the following equations.

(a) . (2 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ simplifies equation   obtains correct solution |

(b) . (2 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ factorises   both correct solutions |

(c) . (2 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ arranges equation into form   both correct solutions |

Question 2 (6 marks)

(a) Solve the equation . (2 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ equates to zero and factorises   correct solutions |

(b) Sketch the graphs of and on the axis below, showing the coordinates of all axes intercepts of the parabola and any points of intersection of the graphs. (4 marks)

<EFOFEX>
id:fxd{0eb64c3f-6c68-4a8d-8e82-fbef641b46c3}

FXData:

</EFOFEX>

|  |
| --- |
| Solution |
| See graph |
| Specific behaviours |
| ✓ symmetrical parabola, correct turning point   labels roots of parabola   correct straight line   labels both points of intersection |

Question 3 (8 marks)

The graphs of the function and two relations are shown below.

<EFOFEX>
id:fxd{5d9e1aab-4658-4689-8116-b6e2238a12e7}

FXData:

</EFOFEX>

(a) Explain how the vertical line test can be used to distinguish a function from a relation.

(2 marks)

|  |
| --- |
| Solution |
| The test concludes that a relation is a function if **any** vertical line intersects at one point only (if there is any intersection). Otherwise, the graph is simply a relation. |
| Specific behaviours |
| ✓ includes reference to **any** vertical line   includes reference to **number of** **intersections** |

(b) State the equation of the parabolic relationship. (1 mark)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ correct equation |

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

(c) Determine . (1 mark)

(d) Solve . (1 mark)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
|  all correct solutions |

(e) The equation of the circle is , where and are constants. Determine the value of each constant. (3 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ correct factored form of circle   expands and simplifies   uses expanded form to state each value |

Question 4 (6 marks)

(a) Expand . (2 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ expands any pair of binomials   correct expansion |

(b) Let .

(i) Calculate . (1 mark)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ correct sum |

(ii) Solve . (3 marks)

|  |  |
| --- | --- |
| Solution | Alternative Solution |
| Since then is a factor of .  By inspection,  Hence when . | Since then is a factor of .   |  |  | | --- | --- | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  | |  |  |   Hence when . |
| Specific behaviours | Specific behaviours |
| ✓ obtains factor using (i) or any one factor   expresses as linear and quadratic factors   factors quadratic and states solutions | ✓ obtains factor using (i) or any one factor   performs polynomial division and obtains the quadratic factor   factors quadratic and states solutions |

Question 5 (7 marks)

(a) The graph of is shown. State the value of the constant and the value of the constant . (2 marks)

<EFOFEX>
id:fxd{dcaa166f-761e-472a-b298-342258fc40df}

FXData:

</EFOFEX>

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ correct value of   correct value of |

(b) Point lies on the unit circle with centre so that the anticlockwise angle measured from the positive -axis to the line is , . Determine the size of when has coordinates . (2 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ indicates method (reasoning or sketch of unit circle)   correct angle |

(c) Solve the equation when . (3 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ indicates reference angle   one correct solution   both correct solutions |

Question 6 (11 marks)

<EFOFEX>
id:fxd{43489872-082e-405e-ba9b-90a4877f410a}

FXData:
</EFOFEX>In the diagram, is a right  
triangle, and points and   
lie on sides and   
respectively to form right  
triangles and .

The length of is unit,  
 and ,  
from which it can be shown  
that ,   
and .

(a) Use triangle to show that and hence explain why .

|  |
| --- |
| Solution |
| Hence |
| Specific behaviours |
| ✓ uses properties of to obtain expression for   explains as required |

(2 marks)

(b) Use triangle to explain why . (1 mark)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ correctly uses properties of to obtain equation |

(c) Use the equation from part (b) to derive the identity .

(2 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ cross multiplies   shows step to simplify into required form |

(d) Determine an exact value for . (3 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ expands using sum formula   substitutes exact values   simplifies and rationalise |

(e) Solve for . (3 marks)

|  |
| --- |
| Solution |
|  |
| Specific behaviours |
| ✓ expands using difference formula   substitutes exact values and simplifies   correct solution |

Question 7 (8 marks)

The binomial coefficients in the ninth row of Pascal's triangle are and so on.

(a) Deduce the value of

|  |
| --- |
| Solution |
| Using symmetry property then . |
| Specific behaviours |
| ✓ correct coefficient |

(i) . (1 mark)

(ii) . (2 marks)

|  |
| --- |
| Solution |
| Using next row property  or |
| Specific behaviours |
| ✓ indicates use of property or formula   correct coefficient |

(b) The sum of all but one of the binomial coefficients in the ninth row of Pascal's triangle  
is . Determine, with justification, the value of the missing coefficient. (2 marks)

|  |
| --- |
| Solution |
| Sum of row is  Hence missing coefficient is . |
| Specific behaviours |
| ✓ indicates sum of row   correct coefficient |

(c) Determine the coefficient of the term in the expansion of . (3 marks)

|  |
| --- |
| Solution |
| Using the binomial expansion, required term will be  or  Hence coefficient will be |
| Specific behaviours |
| ✓ indicates how to obtain term of expansion   simplifies the three components of coefficient   correct coefficient |

Supplementary page

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

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