 **NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**MATHEMATICAL METHODS**

**Practice written examination 1**

**Reading time: 15 minutes**

**Writing time: 1 hour**

**FOR ADJUSTED STUDY DESIGN (2020 ONLY)**

**QUESTION AND ANSWER BOOK**

**Structure of book**

|  |  |  |
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| Number of questions | Number of questions to be answered | Number of marks |
| 9 | 9 | 40 |

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| --- |
| * Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners and rulers. * Students are NOT permitted to bring into the examination room: any technology (calculators or software), notes of any kind, blank sheets of paper and/or correction fluid/tape.   **Materials supplied**   * Question and answer book of 11 pages. * Formula sheet * Working space is provided throughout the book.   **Instructions**   * Write your student number in the space provided above on this page. * Unless otherwise indicated, the diagrams in this book are not drawn to scale. * All written responses must be in English   **At the end of the examination**   * You may keep the formula sheet. |

**Instructions**

Answer **all** questions in the spaces provided.  
In all questions where a numerical answer is required, an exact value must be given, unless otherwise specified.  
In questions where more than one mark is available, appropriate working **must** be shown.  
Unless otherwise indicated, the diagrams in this examination paper are **not** drawn to scale.

**Question 1** (3 marks)

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| **a.** | . | 1 mark |  |  |  | 1 mark |
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| **b.** | . | 2 marks |
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**Question 2** (3 marks)

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**Question 3** (2 marks)

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**Question 4** (3 marks)

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**Question 5** (3 marks)

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| was obtained through transformations of . was dilated by a factor of 2 parallel to the , reflected about the , translated 4 units down and 6 units right. If , what was the equation of |  |
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**Question 6** (9 marks)

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| **a.** | . | 2 marks |
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| **b.** | and hence find their *x*-intercepts. | 2 marks |
|  | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |

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| **c.** | Sketch the graph of *f*(*x*) and *g*(*x*) on the same set of axes, labelling all key points with their coordinates. | 3 marks |
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| **d.** | Determine the exact area enclosed by and | 2 marks |
|  | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |

**Question 7** (2 marks)

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| The normal probability density function, , can be modelled by the equation:  Where and are the mean and standard deviation respectively and are parameters of .  Use calculus to show that the maximum value of occurs when . |  |
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**Question 8** (7 marks)

The heights of students in a school are normally distributed with a mean of 160 cm. Jack’s height is one standard deviation above the mean while Sally’s height is two standard deviations below the mean.

Using the result that and .

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| **a.** | What is the probability that a student selected at random will have a height between that of Jack and Sally? | 1 mark |
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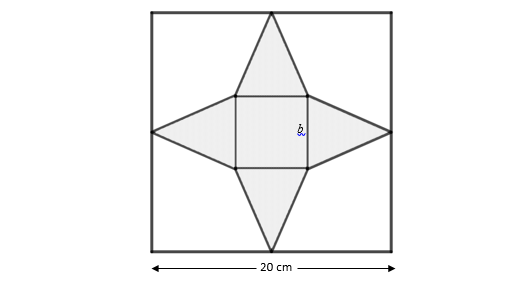
|  |  |  |
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| **b.** | Given that Pepe is taller that Sally, what is the probability that he is also taller than Jack? | 2 marks |
|  | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |

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| **c.** | Three students are selected at random. What is the probability that two of the three will be shorter than Sally? | 2 marks |
|  | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |

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| --- | --- | --- |
| **d.** | At a different school, Agnes’ height is 130 cm, which is 80% of a standard deviation below the school mean. In contrast, Shneevy’s height of 160 cm is 40% of a standard deviation above the school mean. What are the mean and standard deviation of height at this other school? | 2 marks |
|  | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |

**Question 9** (8 marks)

A right square pyramid is to be constructed from a square sheet of thin metal as shown in the diagram below.



The unshaded parts are removed and the triangular sections are then folded upwards to form the pyramid. Finally, the edges are welded is order to seal it. Let the base of the pyramid be *b*.

|  |  |  |
| --- | --- | --- |
| **a.** | Show that the volume, *V*, of the pyramid can expressed as:  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 3 marks |

|  |  |  |
| --- | --- | --- |
| **b.** | What is the feasible domain of *b*?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 1 mark |
| **c.** | What is the value of *b* that results in a pyramid with maximum volume?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | 3 marks |
| **d.** | Hence, what is the maximum volume of the pyramid?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  **END OF QUESTION AND ANSWER BOOK** | 1 mark |

**Mathematical Methods Formulas**

**MATHEMATICAL METHODS**

**Written examinations 1 and 2**

**FORMULA SHEET**

Instructions

|  |
| --- |
| This formula sheet is provided for your reference. |

|  |
| --- |
| **Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic devices into the examination room.** |

**Mensuration**

|  |  |  |  |
| --- | --- | --- | --- |
| area of a trapezium |  | volume of a pyramid |  |
| curved surface area of a cylinder |  | volume of a sphere |  |
| volume of a cylinder |  | area of a triangle |  |
| volume of a cone |  |  | |

**Calculus**

|  |  |  |  |
| --- | --- | --- | --- |
|  | |  | |
|  | |  | |
|  | |  | |
|  | |  | |
|  | |  | |
|  | |  | |
|  | |  | |
| product rule |  | quotient rule |  |
| chain rule |  |  | |

**Probability**

|  |  |  |  |
| --- | --- | --- | --- |
|  | |  | |
|  | |  | |
| mean |  | Variance |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Probability distribution** | | **Mean** | **Variance** |
| discrete |  |  |  |
| continuous |  |  |  |

****

**Solution Pathway**

**NOTE: This task is sold on condition that it is NOT placed on any school network or social media site (such as Facebook, Google Docs etc.) at any time.**

**FOR ADJUSTED STUDY DESIGN (2020 ONLY)**

**NOT FOR PRIVATE TUTOR USE.**

**Question 1** (3 marks)

|  |  |  |
| --- | --- | --- |
| **a.** |  |  |

[1 mark] correct answer

|  |  |  |
| --- | --- | --- |
| **b.** |  |  |
|  |  |  |

[1 mark] correct derivative

[1 mark] correct evaluation at specified *x*-value

**Question 2** (3 marks)

?

.

[1 mark] correct application of information from tangent line

[1 mark] correct construction of equation solvable for *k*

[1 mark] correct solutions for *k* in required format

**Question 3** (2 marks)

|  |  |
| --- | --- |
|  |  |
| Let  [1 mark] correct quadratic substitution  [1 mark] correct answer  **Question** **4** (3 marks)   |  |  | | --- | --- | |  |  | | Multiply both side by  Check for other solutions in specified domain.  [1 mark] correct transformation of equation to a solvable form  [1 mark] first pair of correct solutions  [1 mark] all other solutions within specified domain | | | |

**Question 5** (3 marks)

|  |  |
| --- | --- |
| was obtained through transformations of . was dilated by a factor of 2 parallel to the , reflected about the , translated 4 units down and 6 units right. If , what was the equation of |  |
| **Method 1**  Complete the square for g’(x)  Apply transformations in reverse order to those specified.  Translate 4 units up and 6 units left.  Reflect about *x*-axis. | |

Dilate by factor of ½ parallel to *y*-axis.

**Method 2**

Set up a matrix equation.

Let

Rearrange to make y the subject and simplify.

[1 mark] valid approach to determining

[1 mark] correct execution of approach used

[1 mark] correct equation for

**Question 6** (9 marks)

|  |  |  |
| --- | --- | --- |
| **a.** | .  Solver  Check for other solutions in specified domain. Period is  [1 mark] valid method for finding points of intersection  [1 mark] correct points of intersection, specified as coordinates | 2 marks |

|  |  |  |
| --- | --- | --- |
| **b.** | . | 2 marks |
|  | Consider  Consider other solutions in specified domain. Period =  Consider  No other solutions in specified domain. |  |

[1 mark] correct solution to

[1 mark] correct solution to

|  |  |  |
| --- | --- | --- |
| **c.** | Sketch the graph of *f*(*x*) and *g*(*x*) on the same set of axes, labelling all key points with their coordinates.    [1 mark] correct graph shapes  [1 mark] key points correctly labelled  [1 mark] end points correctly drawn | 3 marks |

|  |  |  |
| --- | --- | --- |
| **d.** | Determine the exact area enclosed by and | 2 marks |

[1 mark] correct definite integral

[1 mark] correct area

**Question 7** (2 marks)

|  |  |
| --- | --- |
| The normal probability density function, , can be modelled by the equation:  Where and are the mean and standard deviation respectively.  Use calculus to show that the maximum value of occurs when . |  |

Need to solve

Let

By null factor law:

[1 mark] correct derivative

[1 mark] correct solution to derivative equals zero

**Question 8** (7 marks)

The heights of students in a school are normally distributed with a mean of 160 cm. Jack’s heights is one standard deviation above the mean while Sally’s height is two standard deviations below the mean.

Using the result that and

|  |  |  |
| --- | --- | --- |
| **a.** | What is the probability that a student selected at random will have a height between that of Jack and Sally? | 1 mark |

[1 mark] correct probability

|  |  |  |
| --- | --- | --- |
| **b.** | Given that Pepe is taller that Sally, what is the probability that he is also taller than Jack? | 2 marks |

[1 mark] correct conditional probability relationship

[1 mark] correct probability

|  |  |  |
| --- | --- | --- |
| **c.** | Three students are selected at random. What is the probability that two of the three will be shorter than Sally? | 2 marks |

Binomial distribution problem. Need probability of 2 successes from three trials.

[1 mark] correct binomial distribution application

[1 mark] correct evaluation

|  |  |  |
| --- | --- | --- |
| **d.** | At a different school, Agnes’ height is 130 cm, which is 80% of a standard deviation below the school mean. In contrast, Shneevy’s height of 160 cm is 40% of a standard deviation above the school mean. What are the mean and standard deviation of height at this other school? | 2 marks |

Angnes’ *z* score is -0.8

Shneevy’s *z* score is 0.4

For Agnes:

For Shneevy

Solve the simultaneous equations

[1 mark] correct *z*-score equations

[1 mark] correct solution to simultaneous equations

**Question 9**

|  |  |  |
| --- | --- | --- |
| **a.** | Show that the volume, *V*, of the pyramid can expressed as: | 3 marks |

Let

*AA*

*C*

*D*

*B*

Let

*C*

*E*

*D*

[1 mark] using information provided to define dimensions of one of the triangles

[1 mark] expressing pyramid height in terms of base length

[1 mark] substituting information into formula for the volume of a pyramid and simplifying to specific form

|  |  |  |
| --- | --- | --- |
| **b.** | What is the feasible domain of *b*? | 1 mark |

Obviously, .

The maximum value of will be that which causes to be 0. That is, as increases, decreases until at some point .

To determine maximum value. Solve for when in

[1 mark] correct feasible domain

|  |  |  |
| --- | --- | --- |
| **c.** | What is the value of *b* that results in a pyramid with maximum volume? | 3 marks |

Multiply both sides by

But given feasible domain, cm

[1 mark] correct choice and set up of differentiation rule

[1 mark] correct use of rule

[1 mark] correct answer with correct unit.

|  |  |  |
| --- | --- | --- |
| **d.** | Hence, what is the maximum volume of the pyramid? | 1 mark |

Substitute into formula for volume.

[1 mark] correct answer with correct unit