

Student Name……………………………………

### MATHEMATICAL METHODS UNITS 3 & 4

### TRIAL EXAMINATION 1

**2022**

#### Reading Time: 15 minutes

Writing time: 1 hour

###### Instructions to students

This exam consists of 9 questions.

All questions should be answered in the spaces provided.

There is a total of 40 marks available.

The marks allocated to each of the questions are indicated throughout.

Students may **not** bring any calculators or notes into the exam.

Where a numerical answer is required, an exact value must be given unless otherwise directed.

Where more than one mark is allocated to a question, appropriate working must be shown.

Diagrams in this trial exam are not drawn to scale.

A formula sheet can be found on pages 12 and 13 of this exam.

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**Question 1** (3 marks)

1. Find the derivative of . 1 mark
2. Evaluate . 2 marks

**Question 2** (2 marks)

Let .

Find.

**Question 3** (4 marks)

Let .

1. State the range of *h.* 1 mark
2. Solve . 3 marks

**Question 4** (4 marks)

Saffron is a spice that is sold in very small quantities.

The random variable *X* represents the difference in weight, to the nearest gram, between the actual weight and the advertised weight of packets of saffron being sold.

The distribution of *X* is given in the table below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *x* |  | 0 | 1 | 2 |
|  | *a* | 5*a* | 3*a* | *a* |

1. Show that  1 mark
2. The mean of *X* is 0.4

Find the variance of *X*. 2 marks

1. Random samples of three packets of saffron are taken.

Let  be the random variable that represents the proportion of these three packets for which the actual weight equals the advertised weight.

Find . 1 mark

**Question 5** (7 marks)

The function *h* has a maximal domain and a rule given by .

1. State the domain and range of *h*. 2 marks
2. Explain why the graph of *h* does **not** have a stationary point. 1 mark
3. Sketch the graph of the function *h* on the set of axes below, labelling any asymptote with its equation and axis intercepts with their coordinates. 3 marks



1. The graph of  is transformed to become the graph of *f* after two transformations have been applied in the following order
   * dilation by a factor of three from the *x*-axis
   * translation of two units in the positive direction of the *y*-axis.

State the rule of *f*. 1 mark

**Question 6** (4 marks)

Let .

The acute angle of intersection between the graph of *g* and a tangent to the graph of *f* at the point where , as shown below.



1. Show that the angle that the graph of *g* makes with the positive branch of the *x*-axis

is 60°. 1 mark

1. If , find the value of *a*. 3 marks

**Question 7** (5 marks)

Let *A* and *B* be events from a sample space where  and

.

1. Find in terms of *p*. 1 mark
2. Find in terms of *p*. 2 marks
3. If , find the largest possible interval for the values of *p*. 2 marks

**Question 8** (6 marks)

A function has a gradient given by .

The graph of this function intersects the line  at the point .

1. Find the rule of the function. 2 marks

The line  also intersects a second function, , at the point  as shown on the graph below.



1. Find the area of the region bounded by *f*, the line , the line  and the *x*-axis. 4 marks

**Question 9** (5 marks)

Let . The tangent to *f* at the point where  passes through the point  as shown in the diagram below.



1. Show that the equation of the tangent is given by . 2 marks

Let .

The tangent line found in part **a**. is transformed according to *T* to produce the graph of the function *g*.

1. Find the values of *r* such that the graph of *g* intersects with *f* just once. 3 marks

**END OF EXAMINATION**

**Mathematical Methods formulas**

## 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 |  |  | |

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## Probability

|  |  |  |  |
| --- | --- | --- | --- |
|  | |  | |
|  | |  | |
| mean |  | variance |  |

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

## Sample proportions

|  |  |  |  |
| --- | --- | --- | --- |
|  | | mean |  |
| standard  deviation |  | approximate  confidence  interval |  |