

 Student Name:………………………………………

### SPECIALIST MATHEMATICS UNITS 3 & 4

### TRIAL EXAMINATION 1

**2021**

#### Reading Time: 15 minutes

Writing time: 1 hour

######  Instructions to students

This exam consists of 10 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 notes or calculators into the exam.

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

An exact answer is required to a question unless otherwise specified.

Unless otherwise indicated, diagrams in this exam are not drawn to scale.

The acceleration due to gravity should be taken to have magnitude where 

Formula sheets can be found on pages 12-14 of this exam.

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**Question 1** (4 marks)

**a.** A 100 kg parcel sits on the floor of a lift, which accelerates upwards at the rate of

.

Find the reaction of the lift floor on the parcel in newtons. 2 marks

**b.** A second lift has a parcel of mass *m* kg sitting on the floor. The lift is accelerating downwards at the rate of . A spring balance in the lift shows the apparent weight of the parcel to be 29 kg wt.

Find the mass of the parcel, *m*, in kilograms. 2 marks

**Question 2** (2 marks)

Find the solutions to the equation , where .

**Question 3** (3 marks)

Consider the vectors ,  and , where *p* and *q* are non-zero real constants.

If  and  are perpendicular vectors, find the values of *p* and *q* such that ,  and  form a linearly dependent set of vectors.

**Question 4** (4 marks)

Find the gradient of the curve  at the point .

Give your answer in the form , where *a*, *b*, and *c* are integers.

**Question 5** (5 marks)

**a.** If  , where , show that the two sets of solutions of this equation are



 2 marks

**b.** Hence, solve the equation , . 3 marks

**Question 6** (6 marks)

**a.** Sketch the graph of  on the axes provided below.

Label any asymptotes with their equations and any stationary points and axis

intercepts with their coordinates. 3 marks



**b.** Find the area enclosed by the graph of , the *x* and *y* - axes and the line

 with equation .

Express your answer in the form , where . 3 marks

**Question 7** (3 marks)

Find a solution to the differential equation  given that .

**Question 8** (3 marks)

Find the volume generated when the region enclosed by the curve  and the

*x*-axis is rotated about the *x*-axis to form a solid of revolution.

**Question 9** (5 marks)

The position of a particle is given by , for , where *t* is in minutes and all distances are measured in metres.

1. State the maximum value of *c*, such that  is defined. 1 mark

1. Find the speed of the particle, in metres per minute, at the point where it is furthest from the *x*-axis. 2 marks

1. Find the magnitude of the initial acceleration of the particle in . 2 marks

**Question 10** (5 marks)

**a.** Show that . 2 marks

Consider the random variable *X* with probability density function



**b.** Find the variance of *X*, giving your answer in the form ,

where . 3 marks

# Specialist Mathematics Formulas

## Mensuration

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

## Circular functions

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## Circular functions – continued

|  |  |  |  |
| --- | --- | --- | --- |
| **Function** |  |  |  |
| **Domain** |  |  |  |
| **Range** |  |  |  |

**Algebra (complex numbers)**

|  |  |
| --- | --- |
|  |  |
|  |  |
|  |  |
|  (de Moivre’s theorem) |  |

**Probability and statistics**

|  |  |
| --- | --- |
| for random variables *X* and *Y* |  |
| for independent random variables *X* and *Y* |  |
| approximate confidence interval for  |  |
| distribution of sample mean  |  |

**Calculus**

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|  |  |
|  |  |
|  |  |
| product rule |  |
| quotient rule |  |
| chain rule |  |
| Euler’s method |  |
| acceleration |  |
| arc length |  |

## Vectors in two and three dimensions Mechanics

|  |  |
| --- | --- |
| momentum |  |
| equation of motion |  |

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