**Name/Registration Number: ……..……………………………..**

**Stage 2 Specialist Mathematics – Skills and Applications Task**

This Skills and Applications Task is divided into two parts. Part 1 is to be completed without a calculator or notes. For Part 2, you may have access to your graphics calculator and one A4 page of handwritten notes. You will commence with both parts of the task but will not have access to your calculator or notes until Part 1 is collected.

**Topic 4: Vectors in Three Dimensions**

**PART 1: NO CACULATOR or NOTES 20 minutes Total: 16 marks**

**QUESTION 1 (5 marks)**

Find *k* such that the angle between the vectors  and  is  .

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 (5 marks)

**QUESTION 2 (8 marks)**

In the following system of equations, *k* is a real constant.



1. Write the system in augmented matrix form and, stating all row operations used, show that this leads to the reduced system: 

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(3 marks)

1. State the value of *k* for which the system has no solution.

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(1 mark)

1. (i) Consider the case where  and solve the system.

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(3 marks)

(ii) Give a geometrical interpretation of the system of equations for the value of *k* found used in part (c) (i).

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(1 mark)

**QUESTION 3 (3 marks)**

Using the formulae  prove that if  then the angle between  must be . The vectors  are non-zero vectors.

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(3 marks)

**END OF PART 1**

**Part 1 will be collected at the end of 20 minutes. Be sure to check your work thoroughly before handing it up at the end of the allocated time.**

 **Name/Registration Number ……………………………..**

**PART 2: CACULATOR AND NOTES MAY BE USED**

 **TIME: 50 minutes TOTAL: 36 marks**

**QUESTION 4 (5 marks)**

(a) Find the equation of the line passing through the point  in the direction of the vector .

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(2 marks)

(b) Find the coordinates of the point where the line intersects the plane

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 (3 marks)

**QUESTION 5 (11 marks)**

1. Points A (1, 3, 0), B (5, -1, 2) and C (-2, 5, -2) are three points on a plane P1.
	1. Find .

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 (3 marks)

* 1. Find the area of triangle ABC.

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(2 marks)

* 1. Find the equation of the plane P1.

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(2 marks)

1. Plane P2 is parallel to plane P1 and passes through D (7, 3, -3).
	1. Find the equation of plane P2.

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(2 marks)

1. Find the distance between the two planes.

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(2 marks)

**QUESTION 6 (15 marks)**

Let A (3, 4, 0), B (-1, 6, 4), C (-5, 2, 2) and D (-1, 0, -2) be four points in space.
(a) Show that A, B, C and D lie in the plane .

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(4 marks)

(b) Show that A, B, C and D form the vertices of a square.

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(3 marks)

(c) Write an equation of the line through P  with direction normal to the plane.

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(2 marks)

(d) Find the point Q of intersection of the plane  and the line found in part (c).

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(3 marks)

(e) Determine whether Q is inside or outside the square.

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(3 marks)

**QUESTION 7 (5 marks)**

Consider the vectors 

1. Find the scalars *a* and *b* if .

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(2 marks)

**END OF PART 2**

Performance Standards for Stage 2 Specialist Mathematics

| - | Concepts and Techniques | Reasoning and Communication |
| --- | --- | --- |
| A | Comprehensive knowledge and understanding of concepts and relationships.Highly effective selection and application of mathematical techniques and algorithms to find efficient and accurate solutions to routine and complex problems in a variety of contexts.Successful development and application of mathematical models to find concise and accurate solutions.Appropriate and effective use of electronic technology to find accurate solutions to routine and complex problems. | Comprehensive interpretation of mathematical results in the context of the problem.Drawing logical conclusions from mathematical results, with a comprehensive understanding of their reasonableness and limitations.Proficient and accurate use of appropriate mathematical notation, representations, and terminology.Highly effective communication of mathematical ideas and reasoning to develop logical and concise arguments.Effective development and testing of valid conjectures, with proof. |
| B | Some depth of knowledge and understanding of concepts and relationships.Mostly effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine and some complex problems in a variety of contexts.Some development and successful application of mathematical models to find mostly accurate solutions.Mostly appropriate and effective use of electronic technology to find mostly accurate solutions to routine and some complex problems. | Mostly appropriate interpretation of mathematical results in the context of the problem.Drawing mostly logical conclusions from mathematical results, with some depth of understanding of their reasonableness and limitations.Mostly accurate use of appropriate mathematical notation, representations, and terminology.Mostly effective communication of mathematical ideas and reasoning to develop mostly logical arguments.Mostly effective development and testing of valid conjectures, with substantial attempt at proof. |
| C | Generally competent knowledge and understanding of concepts and relationships.Generally effective selection and application of mathematical techniques and algorithms to find mostly accurate solutions to routine problems in a variety of contexts.Successful application of mathematical models to find generally accurate solutions.Generally appropriate and effective use of electronic technology to find mostly accurate solutions to routine problems. | Generally appropriate interpretation of mathematical results in the context of the problem.Drawing some logical conclusions from mathematical results, with some understanding of their reasonableness and limitations.Generally appropriate use of mathematical notation, representations, and terminology, with reasonable accuracy.Generally effective communication of mathematical ideas and reasoning to develop some logical arguments.Development and testing of generally valid conjectures, with some attempt at proof. |
| D | Basic knowledge and some understanding of concepts and relationships.Some selection and application of mathematical techniques and algorithms to find some accurate solutions to routine problems in some contexts.Some application of mathematical models to find some accurate or partially accurate solutions.Some appropriate use of electronic technology to find some accurate solutions to routine problems. | Some interpretation of mathematical results.Drawing some conclusions from mathematical results, with some awareness of their reasonableness or limitations.Some appropriate use of mathematical notation, representations, and terminology, with some accuracy.Some communication of mathematical ideas, with attempted reasoning and/or arguments.Attempted development or testing of a reasonable conjecture. |
| E | Limited knowledge or understanding of concepts and relationships.Attempted selection and limited application of mathematical techniques or algorithms, with limited accuracy in solving routine problems.Attempted application of mathematical models, with limited accuracy.Attempted use of electronic technology, with limited accuracy in solving routine problems. | Limited interpretation of mathematical results.Limited understanding of the meaning of mathematical results, their reasonableness, or limitations.Limited use of appropriate mathematical notation, representations, or terminology, with limited accuracy.Attempted communication of mathematical ideas, with limited reasoning.Limited attempt to develop or test a conjecture. |