**Stage 2 General Mathematics**

**Assessment Type 2: Mathematical Investigation**

**Topic 5: Discrete Models**

You are small business producing one product. Your product must have between 10 and 15 key tasks in its development. You have 11 members of staff available.

**PART 1**

Decide upon your product. Identify all of the individual tasks involved in completing the stage of development of your product. Give a description of each task including an estimated completion time, with sound reasoning.

State the prerequisites for each individual task, with a brief explanation of why they are a precedence task. Following this, produce a precedence network.

**PART 2**

Using the time values for each task, develop an appropriate mathematical method in order to decide which employee will be responsible for each task. Explain why you have chosen the staff members.

\*\**NOTE: If the problem above can be done simply ‘by inspection’ you should change staff members until this is no longer so.*

Construct a network diagram to represent the above information and find:

• the minimum completion time for the task

• the critical path for the task and identify the individual activities that make up the critical path

• the earliest and latest starting times for each individual activity.

**PART 3**

Decide on reasonable changes to the model and predict the possible effect of each change on the minimum completion time and the critical path. Mathematically investigate the effect of the changes and compare it with your prediction. At least two changes should be considered in this manner.

Some examples of changes to consider:

• One of your chosen staffs member is unable to continue to work

• Upskilling employees

• Purchasing pre-made items, rather than producing them within the project

• Having one or more people assist in some of the individual activities

• Identifying individual activities that are not necessary for the successful completion of the task and removing them

**PART 4**

Further extend your investigation to show how your business could operate more effectively? Ideas may include looking at the staff you employ and the roles they undertake.

**THE REPORT**

Produce a report in the appropriate format that introduces the task, shows your mathematical investigation and your discussion of the results and conclusions drawn. Include a discussion of underlying assumptions made and the possible limitations imposed by them on the solutions.

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| **Content** | **Routine** | **Complex** |
| **5.1 Critical Path Analysis** | Interpreting information given in a network or a precedence table (with or without earliest and latest starting times given) | Drawing the network from a given precedence table (with the exception of identifying start and end points and using directed links) |
| Using a forward and backward scan on a given network to find the critical path and minimum completion time for the job and earliest and latest starting times for individual tasks | Interpreting dummy links.  Discussion of leeway (or slack time) over sections of the network not on the critical path |
| Interpreting aspects of the optimum solution in context | Considering the effects of changes to the original conditions |
| **5.2 Assignment Problems** | Solving square arrays of order 4x4 or larger and interpreting the optimum solution(s) in context | Solving non-square arrays larger than order 4x4 and interpreting the optimal solution(s) in context |
|  | Considering the effects of changes to the original conditions |
|  | Interpreting multiple solutions |

The report may take a variety of forms, but would usually include the following:

• an outline of the problem and context

• the method required to find a solution, in terms of the mathematical model or strategy used

• the application of the mathematical model or strategy, including

– relevant data and/or information

– mathematical calculations and results using appropriate representations

– discussion and interpretation of results, including consideration of the reasonableness and limitations of the results

• the results and conclusions in the context of the problem.

A bibliography and appendices, as appropriate, may be used.

The format of an investigation report may be written or multimodal.

Each investigation report, excluding bibliography and appendices if used, must be a maximum of 12 A4 pages if written, or the equivalent in multimodal form. The maximum page limit is for single-sided A4 pages with minimum font size 10. Page reduction, such as two A4 pages reduced to fit on one A4 page, is not acceptable. Conclusions, interpretations and/or arguments that are required for the assessment must be presented in the report, and not in an appendix. Appendices are used only to support the report, and do not form part of the assessment decision.

**Performance Standards for Stage 2 General 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.  Formation and testing of appropriate predictions, using sound mathematical evidence. |
| **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.  Attempted 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.  Formation and testing of mostly appropriate predictions, using some mathematical evidence. |
| **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 different contexts.  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.  Formation of an appropriate prediction and some attempt to test it using mathematical evidence. |
| **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 context.  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.  Some appropriate use of mathematical notation, representations, and terminology, with some accuracy.  Some communication of mathematical ideas, with attempted reasoning and/or arguments.  Attempted formation of a prediction with limited attempt to test it using mathematical evidence. |
| **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 form or test a prediction. |