Full name: _____

Teacher: _____

Due date: _____

Orange High School

Year 12 Standard 1 Mathematics

Task 3 Investigative Assignment 2019

Outcomes Assessed
MS1-12-8: applies network techniques to solve network problems MS1-12-9: chooses and uses appropriate technology effectively and recognises appropriate times for such use MS1-12-10: uses mathematical argument and reasoning to evaluate conclusions, communicating a position clearly to others

Weighting 25%	Due: This assignment is due to your classroom teacher 2 weeks from the date received (Term 2 Week 5).

Penalties as per assessment booklet
Failure to submit the assignment within the negotiated timeframe may result in an N-award in Standard 1 Mathematics.

Year 12 Standard 1 Mathematics Investigative Assignment

Nature of the task

This assignment involves the use of network theory to solve a real-world problem.
All parts of the task are to be completed individually. When working during class time, students can access all class notes and practise questions. You will then need to propose a problem and solve it using your network. Knowledge of all terminology used in this topic will be needed to assist you.

Hand-in components of this task

Students will be handing in the following item:

- A hard copy of your typed report with network diagrams (either hand drawn or created using technology) which addresses all of the criteria outlined in this booklet.

Marking criteria

A marking rubric is provided at the back of this booklet.

You will be assessed on how well you:

- Accurately solve a variety of problems based on the scenario.

- Select and use appropriate mathematical processes, technologies and language to investigate, organise and interpret networks.

- Provide reasoning and justification related to the problems.

Feed forward provided by your teachers

You may seek feed forward from your teacher to aid in your understanding of Networks terminology and to outline areas for improvement before submitting your final product.

Computer Cable Analysis

Task Outline:

Our Orange High School is already full to bursting point due to a baby boom between 2006 and 2009 and these children are now reaching our schools. The extra portable classrooms brought in to accommodate the student overflow are draining too much power from the school's current substation. Within five years, the school is on track to reach up to 1,600 students. As a result, the government has approved to build a new school Mathmore High School in Orange, NSW. Here is the proposed plan showing buildings and paths:
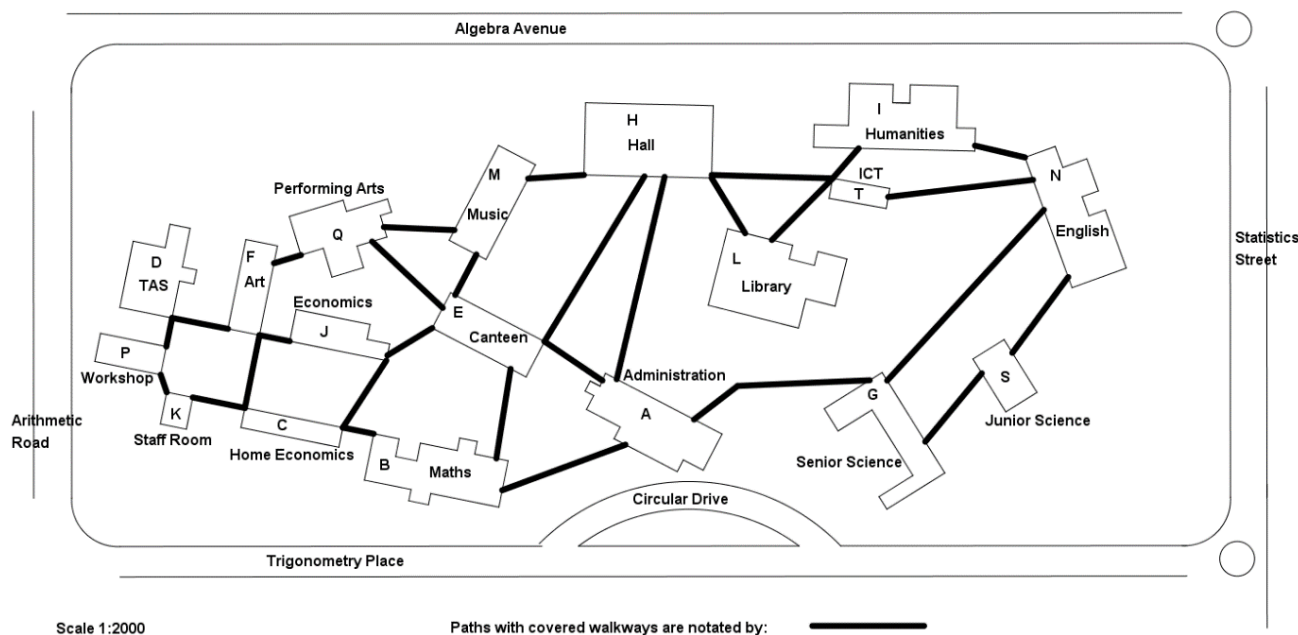
You will be using this plan to solve a variety of network problems.

Throughout your working, always round all distances off to the nearest whole metre, where 1 cm = 2000 cm.

Your mathematical investigations will be recorded in a report. The suggested format for the report is provided on page 6 in Part 7 of the assignment.

Draw a Network - Understanding, Fluency and Communication (13 marks):

1. Using the plan, draw a network diagram of all the buildings connected by covered walkways. You will need to show the actual distances (to the nearest metre) on your diagram.

   - Each vertex will represent a building and should be labelled with the appropriate letter.
   - Each edge will represent a covered walkway and should be labelled with the weighted distances.

2. From the network diagram you created in Part 1, you are to design a **walk** (subnetwork). At a minimum it must include the following criteria:

   - 8 vertices
   - Minimum 14 edges
   - Minimum of 1 vertex with a degree of 3
   - Connected
   - Weighted edges reflecting real world distances

Additionally, you must:

   - Draw a Weighted Table of your walk

3. The Department of Education wants to link the outside of each building with a computer network. Cable costs **$45 per metre**, and the existing covered walkways are to be used with cable attached to the roof of the walkways. They ask company A to submit a proposal. You are to create a proposal for this scenario. Your proposal should not be longer than an A4 page in length and it must include the following criteria:

   - The cost of this cabling network.

   - A drawing, explaining your reasoning and justifying your working with calculations and network theory.

   - Contains all working out.

   - A network diagram in your explanation.

Propose a Problem in your Network and solve it - Problem Solving, Reasoning and Justification (16 marks):

4. In an effort to reduce the costs of cabling the school, the school executive decides that cable will be from Building P to Building N **connecting only those buildings that are on the shortest path**. Cable cost remains the same. They ask company B to submit a proposal. Create a new proposal, no longer than an A4 page that:

   - Finds the shortest path from P to N.

   - Calculates the cost of this new cable network.

   - Contains all working out.

   - Explains your reasoning with calculations and network theory.

   - Includes a network diagram in your explanation.

5. Some of the executives were not happy with the selected buildings being connected. They came up with another idea of connecting all buildings using a **minimal spanning tree**. Cable costs remain the same. They asked you to submit another proposal. Create an updated proposal, no longer than an A4 page that:

   - Find the minimum spanning tree from P to N.

   - Calculates the cost of this new cabling network.

   - Explains your reasoning with calculations and network theory.

   - Contains all working out

   - Include a network diagram in your explanation.

Conclusion (4 marks)

6. Imagine you are on the school executive. Which of the three proposals would you accept and why? Compare your Part 3, Part 4 and Part 5 results, including how reasonable and practical your prediction is. Your comparison should be no more than one to two paragraphs in length.

Mathematical Report (7 marks)

7. Your report needs to be typed and printed upon submission to your classroom teacher. <u>Digital copies on a USB will not be accepted.</u> Network diagrams can either be hand drawn with a ruler or created using technology. Ensure correct punctuation and grammar are used in your report.

Your report should include:

- Part 1 – network diagram with clearly labelled vertices and weighted edges.

- Part 2 – subnetwork (walk) diagram, weighted table with clearly labelled vertices and weighted edges.

- Part 3 – company A's proposal explaining your reasoning and justifying your working with calculations and network theory to solve the problem.

- Part 4 – company B's proposal explaining your reasoning and justifying your working with calculations and network theory to solve the new problem including a clear answer as the shortest path to your problem.

- Part 5 – company C's proposal explaining your reasoning and justifying your working with calculations and network theory to solve the new problem including a clear answer as the minimal spanning tree to your problem.

- Part 6 – one to two paragraph comparison of your original Part 3 problem to your adjusted Part 4 and Part 5 problem.

Marking Rubric

Outcomes	MS1-12-8	applies network techniques to solve network problems
	MS1-12-9	chooses and uses appropriate technology effectively and recognises appropriate times for such use
	MS1-12-10	uses mathematical argument and reasoning to evaluate conclusions, communicating a position clearly to others

Fluency Communication Understanding	Part 1 Constructs a **network diagram** correctly containing:				
	- Measures and converts actual distances from original diagram	0	1	2	
	- Displays the vertices on network diagram labelled A to T	0	1		
	- Represents all edges correctly	0	1	2	
	Part 2 Constructs a **walk diagram** correctly containing:				
	- 8 Vertices labelled correctly	0	1		
	- Represents all edges correctly	0	1		
	- Min. 1 vertex with deg = 3	0	1		
	- Connected	0	1		
	- Weighted Table	0	1	2	
	Part 3 **Company A's proposal**:				
	- Indicates the correct costing calculation (for example, network diagram redrawn with costings on edges)	0	1	2	
Problem Solving Reasoning Justification	Part 4 **Company B's proposal**:				
	- Indicates the correct costing calculation	0	1	2	
	- Demonstrates a clear attempt at finding the shortest path	0	1		
	- Displays/Draws a correct path	0	1	2	
	- Communicates clearly the process for finding the shortest path	0	1	2	
	- Justifies conclusions using appropriate mathematical language, diagrams, notation and symbols	0	1		
	Part 5 **Company C's proposal**:				
	- Indicates the correct costing calculation	0	1	2	
	- Demonstrates a clear attempt at finding the minimal spanning tree	0	1		
	- Displays/Draws a correct path	0	1	2	
	- Communicates clearly the process for finding the minimal spanning tree	0	1	2	
	- Justifies conclusions using appropriate mathematical language, diagrams, notation and symbols	0	1		
	Part 6 **The conclusion**:				
	- **explanation and comparison** were easy to follow and provided evidence of **deep understanding.**	0	1	2	
	- Makes a correct comment regarding a comparison of meeting the needs of the school	0	1	2	
	Part 7 **The mathematical report**:				
	- **typed** and **well presented**	0	1	2	
	- **diagrams** are **neat** and **drawn with a ruler**	0	1	2	
	- uses **appropriate terminology**	0	1	2	
	- **grammar and punctuation** are correct	0	1		

Teacher's comment:	Total:			out of 40