MATHEMATICS AND STATISTICS MXO2023Y1

INTERNAL ASSESSMENT ACTIVITY

ACHIEVEMENT STANDARD 91257 (VERSION 3) MATHEMATICS AND STATISTICS 2.2

Apply graphical models in solving problems

Level 2, Internal assessment

4 credits

STUDENT INSTRUCTIONS

Overview:

In this assessment activity, you will:

- use graphical models to investigate a situation involving linear and non-linear equations.

Conditions:

- This is an open book assessment activity so you may refer to any related modules or any other resources.
- This must be your own work.
- There is no time limit for the completion of this activity but you should allow up to two hours.
- Any scientific, graphical, CAS calculator may be used.
- Plagiarism detection software may be used to check this is your own work.

You will need:

- quad paper.

Supervisor requirements

- Supervision is not required for this assessment.
- Upload your assessment to the MXO2023Y1 assessment dropbox when you have completed it.

 2019/1

ASSESSMENT CRITERIA

ACHIEVEMENT STANDARD 91257 (VERSION 3) MATHEMATICS AND STATISTICS 2.2

Apply graphical models in solving problems

Achievement	Achievement with Merit	Achievement with Excellence
Apply graphical models in solving problems.	Apply graphical models, using relational thinking, in solving problems.	Apply graphical models, using extended abstract thinking, in solving problems.

ASSESSMENT ACTIVITY
MATHEMATICS AND STATISTICS

INSTRUCTIONS

- Read the introduction and the information in the tasks carefully.
- Write your answers on your own paper, showing all working. Write your name and Te Kura ID on each page used.
- You may need to use a calculator.

PIRITI – BRIDGES

INTRODUCTION

Different bridge designs can be found throughout the world. You can find truss, arch, cable, beam, suspension and cantilever bridges in different areas. The type of bridge used largely depends on the distance it must cover and the amount of load it must bear.

Geometric design is important in bridge design. Properly used, geometric figures can create extremely strong bridges. For thousands of years bridges all over the world have been made in the shape of mathematical curves. For example, the design of the ancient Ponte Sant'Angelo in Rome is based on the top half of circles.

ISTOCKPHOTO.COM

Ponte Sant'Angelo in Rome on the Tiber river

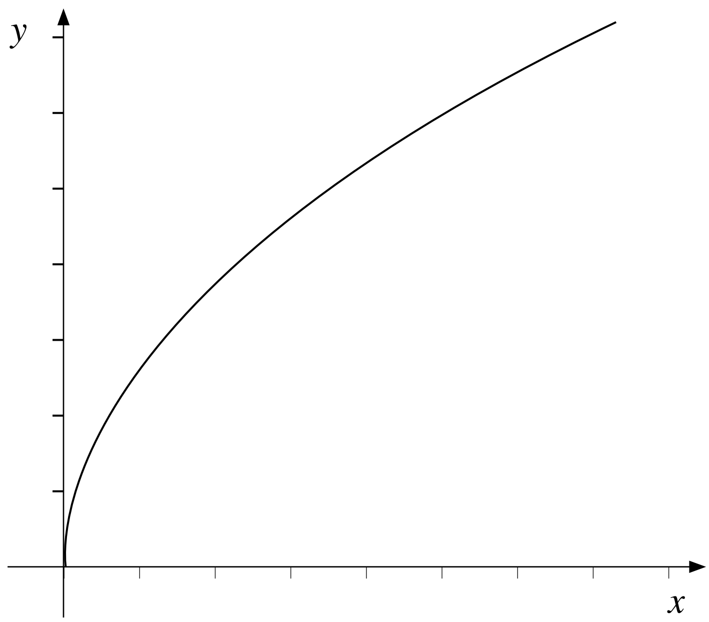
This assessment activity investigates mathematical models that can be used for some bridges.

Some examples of the different mathematical curves used in bridge design can be found in the student resource sheet.

TASK 1

PART ONE:

A symmetrical bridge is being designed to cross a river. A **sketch** of **half the bridge** is shown below.



The maximum height of the bridge is 20 metres and the total length is 100 metres.

The shape of this section of the bridge could be modelled by any of these functions: a parabola, cubic, square root, hyperbola or a trigonometric function.

- Draw graphs of at least three different functions that could be used to model the half bridge as shown above.
- Give the equation of the function used in each model.
- Discuss the features or properties for each model.

PART TWO:

The complete bridge will be symmetrical. The total length of the bridge is to be 100 metres and its maximum height above the river will be 20 metres.

Using your designs from Part One, you are required to model the complete bridge. You may use a piecewise function if necessary.

Your design of the complete bridge must include:

- the equation of any function(s) used in your model
- features or properties of your model.

PART THREE:

Your completed bridge design may be used in other countries as well to cross different widths of rivers. The highest point will remain as 20 metres above the river. The total length of the bridge will be L metres.

You are required to generalize your model in Part Two to meet these requirements. For your generalized model:

- Give the equation in terms of L of any function(s) used in your model.
- Discuss the features properties of the functions used in your model.

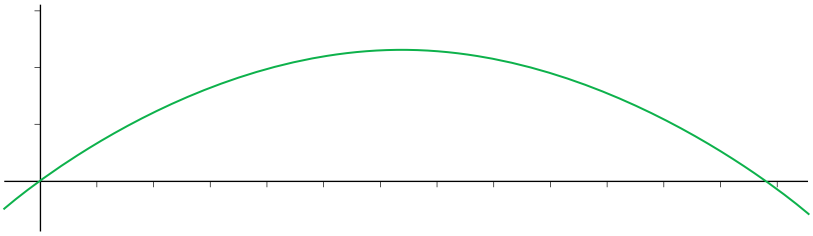
The quality of your reasoning, and how well you link the context to generalisations of graphical and algebraic models, will determine the overall grade. Show all your calculations, and clearly communicate your method using appropriate mathematical statements.

Upload your completed assessment to the MXO2023Y1 assessment dropbox.

ASSESSMENT RESOURCES

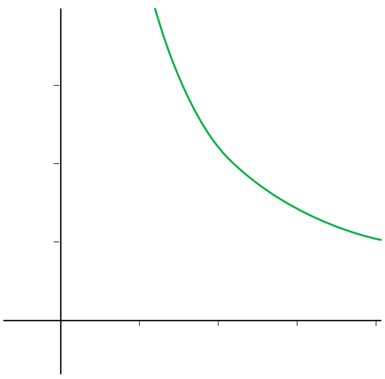
BRIDGE 1 – SYDNEY OPERA BRIDGE

ISTOCKPHOTO.COM



BRIDGE 2 – LONDON TOWER BRIDGE

ISTOCKPHOTO.COM



FORMULA REFERENCE

You may find these formulae useful.

QUADRATICS

If $ax^2 + bx + c = 0$

then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

and $\Delta = b^2 - 4ac$

LOGARITHMS

If $y = b^x$ then $x = \log_b y$

$\log_b(xy) = \log_b x + \log_b y$

$\log_b(x/y) = \log_b x - \log_b y$

$\log_b(x^n) = n\log_b x$

If $y = e^x$ then $x = \log_e y$ (= ln y)

ACKNOWLEDGEMENTS

Every effort has been made to acknowledge and contact copyright holders. Te Aho o Te Kura Pounamu apologises for any omissions and welcomes more accurate information.

Photo: Ponte Sant'Angelo in Rome on the Tiber river, iStockphoto.com, 1126406308

Photo: Tower Bridge London, iStockphoto.com, 579742828

Photo: Sydney Harbour Bridge, iStockphoto.com, 1130626521

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STUDENTS – PLACE STUDENT ADDRESS LABEL BELOW OR WRITE IN YOUR DETAILS.	
Full Name	
ID No.	
Address (If changed)	