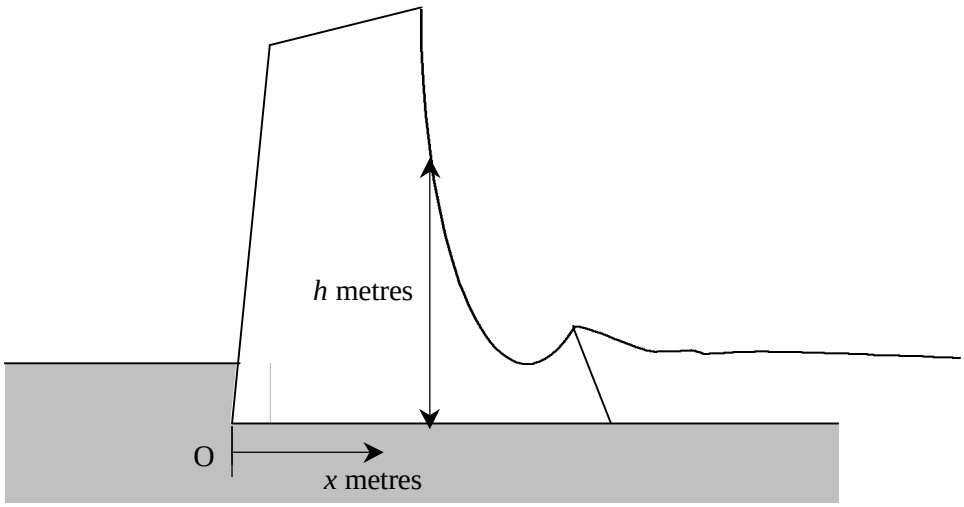
FREE-STANDING MATHEMATICS UNITS (ADVANCED LEVEL)
WORKING WITH ALGEBRAIC AND GRAPHICAL TECHNIQUES

ASSIGNMENT: SEA DEFENCE WALL



The diagram shows a cross-section of a sea defence wall. Detailed drawings of the structure give values for its vertical height above its base at points distance *x* metres from O. These are shown in the table below.

Horizontal distance from O, *x* metres	0	1	5	8	9	10
Vertical height of structure, *h* metres	0	12	14	3	4	0

Find suitable functions to model this data set. Consider the effectiveness of each function as a model and explain how the key features of each function relate to the real situation.

When work is completed on the wall measurements are taken at actual points and these values are given in the table below.

Horizontal distance from O, *x* metres	8.5	7.5	6.5	5.5
Vertical height of structure, *h* metres	3.5	3.5	5.5	9.5

Are these consistent with your model(s) or are the errors unacceptable? If the errors are too great, can you choose a better model / better models?

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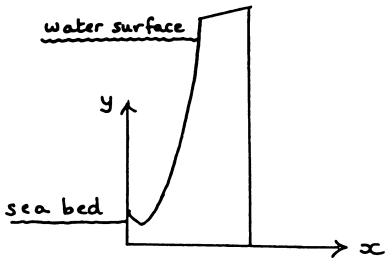
The figure is a sketch of the cross-section of a proposed sea defence wall for a harbour. The detailed drawings of the structure give the following values for x and y, referred to the axes shown. The units are metres.



x	0	1	2	3	4	5	6	7	8
y	4	3	4	7	12	12.5	13	13.5	14

(i) Plot these points on a graph and join them with appropriate lines/ curves.

(ii) A model for these values could be $y = px^2 + qx + r$ $\quad 0 \le x \le 4$

$y = mx + c$ $\quad 4 \le x \le 8$

Find suitable values for p, q, r, m and c, explaining your reasoning.

(iii) Describe how the curved part of the sea defence is related to the basic quadratic function, $y = x^2$.

(iv) Explain algebraically why the minimum depth of the sea defence is 3 metres.

(v) Describe the change in the gradient of the top of the cross-section of the sea defence.

(vi) When the wall is constructed, measurements confirm the values given in the table above. Further measurements give the following extra values:

x	0.5	1.5	2.5	3.5
y	3.5	3.5	5.5	9.5

Are these consistent with the model or are the errors unacceptable? If the errors are too great, can you choose a better model / better models?

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Teacher Notes

Two versions of the assignment are provided. The first is less structured and provides more opportunities for students to work independently. Using this version, students can explore different ways of tackling the problem and will need to make their own decisions about what to do next. Students who are able to work in this way are likely to achieve high marks for their Coursework Portfolio. Less able students may be given the alternative version which is more structured and therefore gives less scope for working independently.

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