

General Certificate of Education
June 2006
Advanced Subsidiary Examination



APPLYING MATHEMATICS
Paper 1

UOM4/1

Monday 22 May 2006 9.00 am to 10.00 am

For this paper you must have:

- an 8-page answer book
- a clean copy of the Data Sheet (enclosed)
- a graphics calculator
- a ruler

Time allowed: 1 hour

Instructions

- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- The *Examining Body* for this paper is AQA. The *Paper Reference* is UOM4/1.
- Answer **all** questions.
- All necessary working should be shown; otherwise marks for method may be lost.
- The **final** answer to questions requiring the use of a calculator should normally be given to three significant figures.
- You may **not** refer to the copy of the Data Sheet that was available prior to this examination. A clean copy is available for your use.

Information

- The maximum mark for this paper is 30.
- The marks for questions are shown in brackets.
- You will be awarded up to 3 marks for your ability to present information accurately using correct notation **and** up to 3 marks for mathematical arguments presented clearly and logically.

Answer **all** questions.

Use **Functional architecture?** on the Data Sheet.

- 1 (a) Sketch a graph of $g(x) = x^2$. (1 mark)
- (b) Describe the geometric transformations that will transform $g(x) = x^2$ to give $f(x) = -0.05x^2$. (3 marks)
- 2 Use the approximate dimensions of the Tyne Bridge arch given in **Figure 2** to show calculations to confirm that the coordinates of the right hand foot of the arch will be (13.5, -10). (One unit represents approximately 6 metres in both x and y directions). (3 marks)
- 3 The article states that for small values of x , $e^x \approx 1 + x + \frac{x^2}{2}$ and that this leads to the result $\frac{e^x + e^{-x}}{2} \approx 1 + \frac{x^2}{2}$. Show clearly the algebra that leads to this result. (4 marks)
- 4 The catenary function $f(x) = \frac{e^x + e^{-x}}{2}$ can be approximated by the quadratic function $g(x) = 1 + \frac{x^2}{2}$ for small values of x . On the same axes, sketch graphs of both $f(x)$ and $g(x)$ for $-5 \leq x \leq 5$. Indicate clearly which function is which. (3 marks)
- 5 Using the coordinate system shown in **Figure 2**, the function $f(x) = -0.05x^2$ represents the outline of the arch of the bridge. Assuming that the road supported by the bridge can be represented by the line $y = -5$, find the length of road inside the arch of the bridge. (4 marks)
- 6 Referring to the data in **Table 1**, the article states that: ‘at (1, 1.48), where the chain is supported, the catenary gives a value with just over a 4% error’. Show calculations to confirm that this is true. (2 marks)
- 7 Another bridge can be modelled by the function $h(x) = -0.075x^2$, where the origin of the coordinate system is aligned with the highest point of the bridge. In this case, one unit represents six metres in both vertical and horizontal directions. The height of this bridge is 90 metres. Find its span. (4 marks)

END OF QUESTIONS