General Certificate of Education
January 2004
Advanced Subsidiary Examination

MATHEMATICS (SPECIFICATION A) **MAME**
Unit Methods

Thursday 8 January 2004 Afternoon Session

In addition to this paper you will require:

- an 8-page answer book;
- one sheet of graph paper for use in Question 2;
- a ruler;
- the AQA booklet of formulae and statistical tables.

You may use a standard scientific calculator **only**.

Time allowed: 1 hour 20 minutes

Instructions

- Use blue or black ink or ball-point pen. Pencil should only be used for drawing.
- Write the information required on the front of your answer book. The *Examining Body* for this paper is AQA. The *Paper Reference* is MAME.
- 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 tables or calculators should normally be given to three significant figures.
- Tie loosely any additional sheets you have used to the back of your answer book before handing it to the invigilator.

Information

- The maximum mark for this paper is 60.
- Mark allocations are shown in brackets.
- Additional sheets of graph paper are available on request.

Advice

- Unless stated otherwise, formulae may be quoted, without proof, from the booklet.

Answer **all** questions.

1 The probability distribution of a random variable X is given in the table below.

x	-2	-1	0	1	2
$\mathrm{P}(X = x)$	0.1	0.1	0.2	0.3	0.3

Calculate:

(a) the mean of X; *(2 marks)*

(b) the variance of X. *(3 marks)*

2 [A sheet of 2 mm graph paper is provided for use in this question.]

A survey was made of the number of items bought by each of 30 customers at a supermarket. The results are shown in the following stem and leaf diagram.

1	2	4	7	8		
2	0	1	3	3	7	7
3	2	5	5	8		
4	1	3	5	6	8	9
5	0	4	4	4	9	
6	3	6	8			
7	2	5				

KEY: 1 | 2 represents 12 items.

(a) Find the median and quartiles of the distribution. *(4 marks)*

(b) Draw, on the graph paper provided, a box and whisker diagram to illustrate the distribution. *(4 marks)*

3 It is given that

$$f(x) = x^3 + 4x^2 - 3x - 18\,.$$

(a) Find the value of $f(2)$. *(1 mark)*

(b) Use the Factor Theorem to write down a factor of $f(x)$. *(1 mark)*

(c) Hence express $f(x)$ as a product of three linear factors. *(4 marks)*

4 Measurements were made of the lengths, x miles, of 20 roads connecting towns in a certain region. The results were summarised as follows:

$$\Sigma x = 320, \quad \Sigma x^2 = 5300\,.$$

(a) (i) Calculate the mean of the lengths of the roads in miles. *(1 mark)*

(ii) Show that the standard deviation of the lengths of the roads is 3 miles. *(2 marks)*

(b) The lengths were then converted to kilometres using the formula

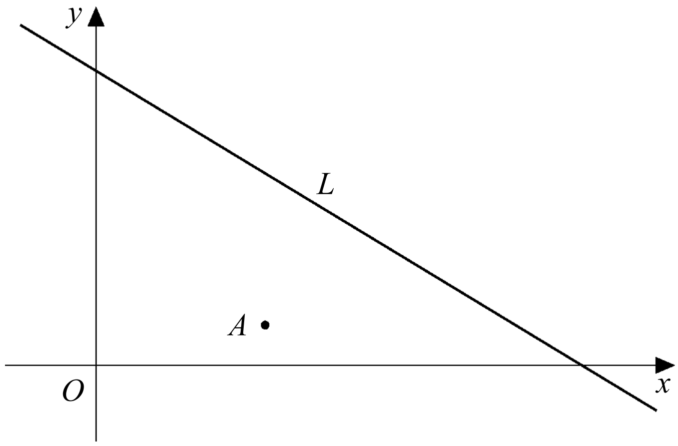
$$y = 1.6x\,,$$

where y kilometres is equivalent to x miles.

Calculate the mean and the standard deviation of the lengths of the roads in kilometres. *(2 marks)*

TURN OVER FOR THE NEXT QUESTION

5 The diagram shows a line L which represents a pipeline, and a point A which is to be connected to the pipeline by the shortest possible connection.



The equation of the line L is

$$2x + 3y = 24\,,$$

and A is the point $(4, 1)$.

(a) Find the gradient of the line L. *(2 marks)*

(b) Hence write down the gradient of a line perpendicular to L. *(1 mark)*

(c) Show that the line through A perpendicular to L has equation

$$3x - 2y = 10.$$ *(2 marks)*

(d) Hence calculate the coordinates of the point of intersection of the two lines. *(3 marks)*

(e) Find the length of the shortest possible connection from A to the pipeline. *(2 marks)*

6 A customer goes into a store to buy a refrigerator and a microwave. From past experience it is known that 10% of the refrigerators and 5% of the microwaves will be found to be defective when tested. The customer chooses one refrigerator and one microwave at random and the items are tested.

(a) Find the probability that:

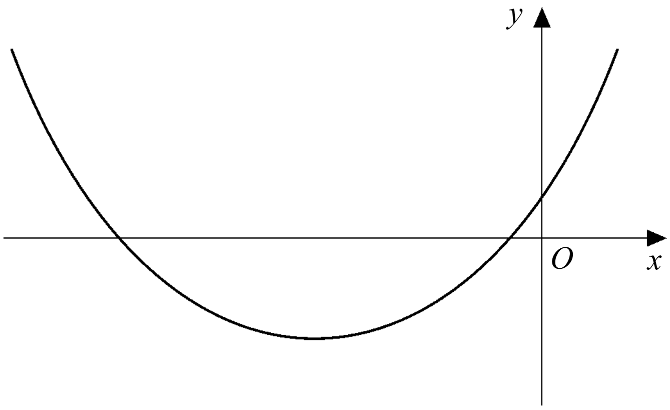
(i) both items are found to be defective; *(2 marks)*

(ii) neither item is found to be defective; *(2 marks)*

(iii) exactly one of the items is found to be defective. *(2 marks)*

(b) Given that exactly one of the items is found to be defective, find the probability that it is the refrigerator. *(3 marks)*

7 The diagram shows the graph of $y = \mathrm{f}(x)$, where $\mathrm{f}(x) = x^2 + 6x + 1$.



(a) Express $\mathrm{f}(x)$ in the form $(x + m)^2 + n$, where m and n are integers. *(2 marks)*

(b) Solve the equation $\mathrm{f}(x) = 0$, giving your answers in the form $p + q\sqrt{2}$, where p and q are integers. *(3 marks)*

(c) Solve the inequality $\mathrm{f}(x) < 0$. *(1 mark)*

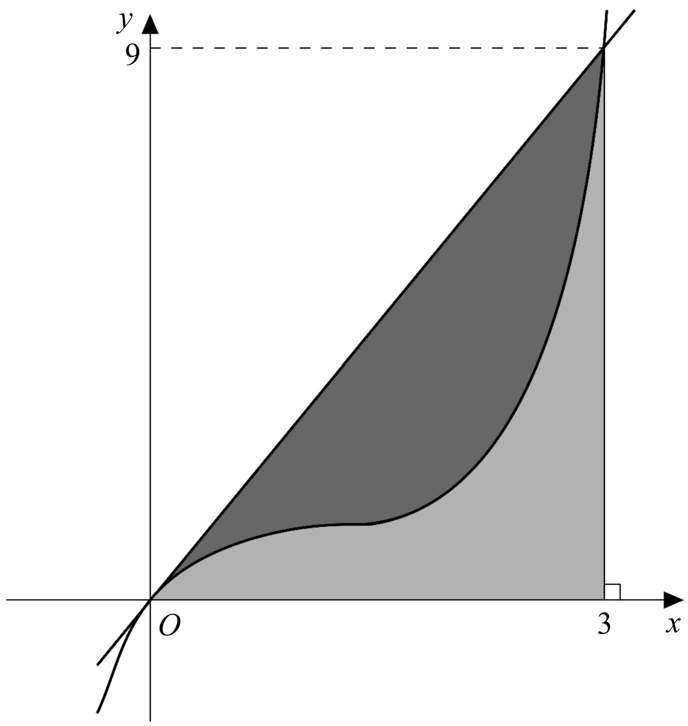
TURN OVER FOR THE NEXT QUESTION

8 The diagram shows the straight line

$$y = 3x$$

and the curve

$$y = x^3 - 3x^2 + 3x\,.$$



(a) (i) Differentiate $x^3 - 3x^2 + 3x$. *(2 marks)*

(ii) Find the coordinates of the stationary point on the curve

$$y = x^3 - 3x^2 + 3x\,.$$ *(3 marks)*

(b) (i) Find $\int (x^3 - 3x^2 + 3x)\,\mathrm{d}x$. *(3 marks)*

(ii) Show that the areas of the two shaded regions are equal. *(3 marks)*

END OF QUESTIONS