

MATHEMATICS (SPECIFICATION A)
Unit Methods

MAME

Monday 10 January 2005 Afternoon Session

In addition to this paper you will require:

- an 8-page answer book;
- one sheet of graph paper for use in Question 4;
- 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	1	2	3	4
$P(X = x)$	0.1	0.4	0.4	0.1

- (a) Show that the mean of X is 2.5. *(1 mark)*
- (b) Calculate the variance of X . *(3 marks)*

2 It is given that

$$f(x) = x^3 + x^2 - 16x - 16.$$

- (a) (i) Find the value of $f(-1)$. *(1 mark)*
- (ii) Hence write down a factor of $f(x)$. *(1 mark)*
- (b) Express $f(x)$ as a product of three linear factors. *(4 marks)*

3 Simplify the following expressions, giving each answer in the form

$$p + q\sqrt{2},$$

where p and q are integers:

- (a) $\sqrt{2}(3\sqrt{2} + 4)$; *(2 marks)*
- (b) $\frac{\sqrt{2}}{3\sqrt{2} - 4}$. *(3 marks)*

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

In a survey, each of 20 employees was asked to estimate the distance, in kilometres, travelled from home to work each day.

The results are shown in the following stem and leaf diagram.

0	3	7					
10	0	2	4	5			
20	1	2	4	6	8		
30	1	2	4	5	5	8	
40	1	4	8				

KEY: 40 | 8 represents 48 km.

- (a) Find estimates for the median and quartiles of the distances shown. *(4 marks)*
- (b) On the graph paper provided, draw a box and whisker diagram to illustrate the distribution. *(3 marks)*
- (c) The **total** distance travelled by each employee between home and work in a week was calculated as ten times the distance shown in the stem and leaf diagram.

Given that the distances shown have mean 26 km and variance 156 km^2 , write down the mean and variance of the **total** distances. *(2 marks)*

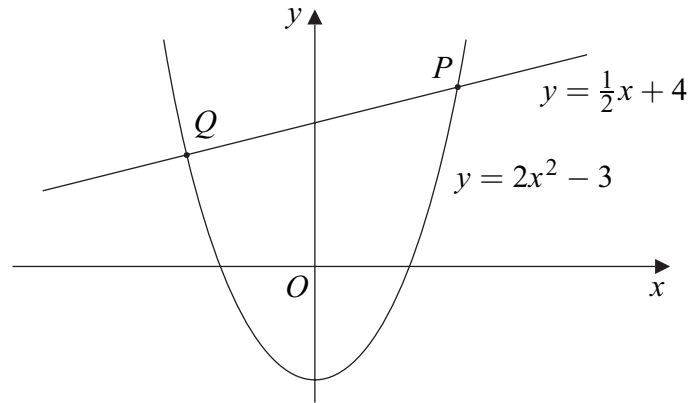
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5 The diagram shows the graphs of

$$y = \frac{1}{2}x + 4 \quad \text{and} \quad y = 2x^2 - 3,$$

intersecting at the points P and Q .



- (a) Show that the x -coordinates of P and Q satisfy the equation

$$4x^2 - x - 14 = 0. \quad (2 \text{ marks})$$

- (b) Solve this equation and hence find the coordinates of P . (3 marks)

- (c) Find the equation of the straight line which is perpendicular to the line

$$y = \frac{1}{2}x + 4$$

and which passes through P . (4 marks)

- 6 Of the patients in an accident unit, 30% have a sports injury.

Past records for the accident unit suggest that:

a patient with a sports injury has a probability of 0.2 of being admitted to hospital;

a patient who does **not** have a sports injury has a probability of 0.4 of being admitted to hospital.

A patient is chosen at random from those in the accident unit.

- (a) (i) Write down the probability that the chosen patient has a sports injury. (1 mark)
- (ii) Find the probability that the chosen patient has a sports injury and is admitted to hospital. (1 mark)
- (iii) Show that the probability that the chosen patient is admitted to hospital is 0.34. (2 marks)
- (b) Given that the chosen patient is admitted to hospital, find the conditional probability that the patient has a sports injury. (3 marks)

- 7 The number of points per game, x , scored by a basketball team in n games has mean 98 and standard deviation 8.

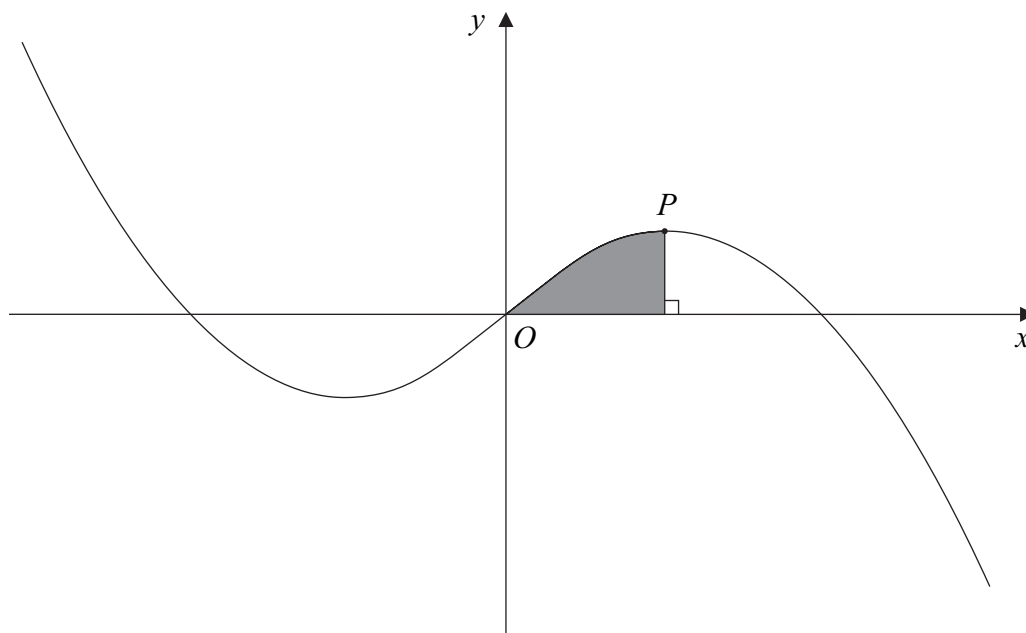
In their next game the team scores 110 points, which makes their mean score over the $n + 1$ games exactly 100.

- (a) (i) Verify that $n = 5$. (2 marks)
- (ii) Show that, for the first five games played, $\sum x^2 = 48\,340$. (3 marks)
- (b) Calculate:
- (i) the value of $\sum x^2$ for the six games played; (2 marks)
- (ii) the standard deviation of x over the six games. (2 marks)

8 The diagram shows the graph of

$$y = x - 3x^3,$$

which passes through the origin O and has a stationary point P at which $x > 0$.



- (a) (i) Find $\frac{dy}{dx}$. (2 marks)
- (ii) Hence show that the x -coordinate of P is $\frac{1}{3}$. (2 marks)
- (b) (i) Find $\int (x - 3x^3) dx$. (2 marks)
- (ii) Hence find the area of the shaded region. (2 marks)
- (iii) Find the value of

$$\int_{-\frac{1}{3}}^{\frac{1}{3}} (x - 3x^3) dx$$

and comment on the significance of your answer. (3 marks)

END OF QUESTIONS

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