

General Certificate of Education  
January 2005  
Advanced Subsidiary Examination



**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.

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Answer **all** questions.

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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.

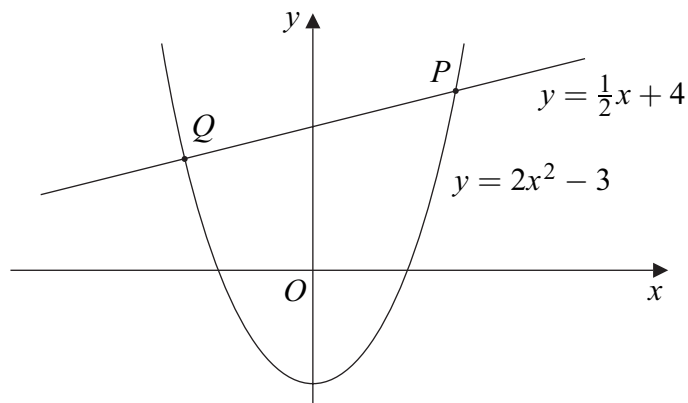
Given that the distances shown have mean 26 km and variance  $156 \text{ km}^2$ , write down the mean and variance of the **total** distances. *(2 marks)*

**TURN OVER FOR THE NEXT QUESTION**

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.

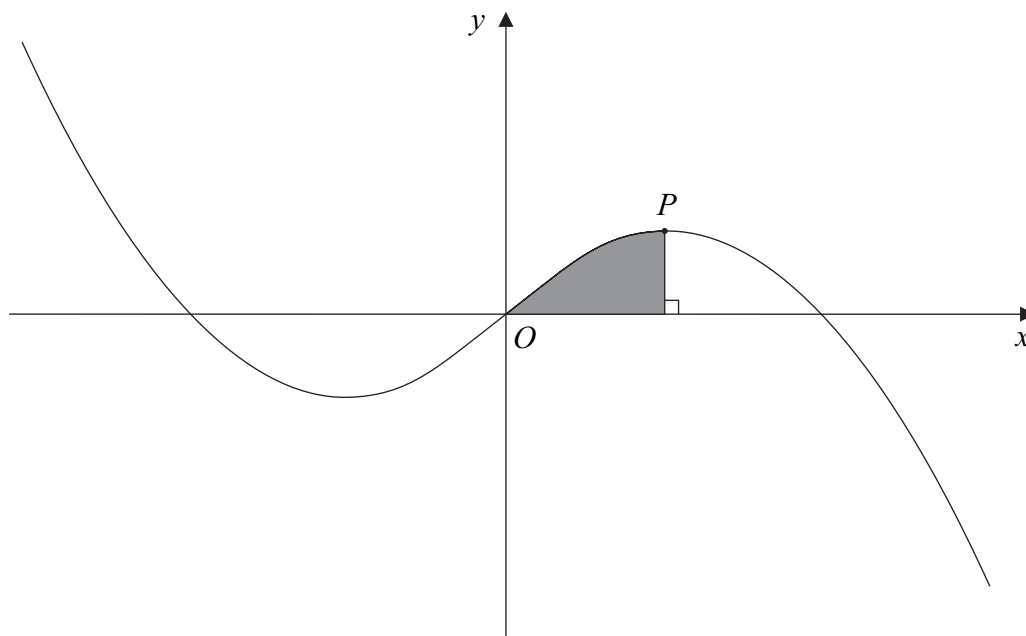
In their next game the team scores 110 points, which makes their mean score over the  $n + 1$  games exactly 100.

- (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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