



THE MALAWI NATIONAL EXAMINATIONS BOARD

1996 MALAWI SCHOOL CERTIFICATE OF EDUCATION EXAMINATION

ADDITIONAL MATHEMATICS

Pure Mathematics

Subject Number: M132/I

Monday, 22 July

Time Allowed: 2 hrs 30 mins
1.30-4.00 pm

PAPER 1 (100 marks)

1. This paper contains 4 pages. Please check.
2. Answer all seven questions in Section A and any two questions from Section B.
3. Section A carries 60 marks and Section B carries 40 marks.
4. Graph paper and four-figure mathematical tables will be provided.
5. Calculators may be used.
6. All necessary working should be shown and any numerical expression being evaluated by calculator or mathematical tables must be clearly stated; otherwise marks for method may be lost.
7. The final answer to questions requiring the use of tables or calculators should normally be given to three significant figures.
8. The marks allocated to each question (or part of a question) are shown in brackets at the end of each question (or part of a question).

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Turn Over



Section A (60 marks)

Answer all seven questions in this section.

1. Let $f(x) = 2x + 1$ and $g(x) = \frac{1}{1+x^2}$. Find:

a. $f(2)$

(2 marks)

b. $g(-3)$

(2 marks)

c. $g(f(0))$

(2 marks)

d. $f(g(0)) - g(f(0))$

(2 marks)

2. Solve for x in the equations:

a. $2^{x^2} = 16$

(3 marks)

b. $2^{2x} - 5(2^x) + 4 = 0$

(4 marks)

- ✓ 3. Write down the expansion of $(1+2x)^4$. Hence, showing all your working, evaluate $(1.02)^4$ correct to 3 decimal places.

(4 marks)

4. a. Sketch the graphs of the following for $0^\circ \leq x \leq 360^\circ$, clearly labelling your curves:

(i) $y = 2 \sin x$

(ii) $y = -\sin 2x$

(5 marks)

- b. Solve the equation

$$1 + \sin x = \cos^2 x \text{ for } 0^\circ \leq x \leq 360^\circ$$

(4 marks)

5. a. Solve the following inequalities:

(i) $x^2 + x < 2$

(ii) $\frac{1}{x-1} > 3$

(7 marks)

- b. By completing the square, find the minimum of $f(x) = x^2 + 4x - 1$ and the coordinates of the point where it occurs.

(3 marks)

$2x + 4 = 0$
 $x = -2$

Continued/...

6. a. Differentiate with respect to x :

(i) $y = x^2 \cos x$

(ii) $y = (3x^2 + 1)^5$

(iii) $y = \frac{x}{2x+3}$

(8 marks)

b. ✓ The gradient of the tangent to a curve at any point (x, y) is given by $6x^2 + 1$. The curve passes through the point $(1, 5)$. Find:

(i) the equation of the curve

(ii) the equation of the tangent to the curve at the point where $x = 0$.

(5 marks)

7. Evaluate:

a. $\int_1^2 (x^2 - 2x + 3) dx$

(3 marks)

b. $\int \cos(3x + 5) dx$

(2 marks)

c. $\int_0^1 x^2(x + 4) dx$

(4 marks)

Section B (40 marks)

Answer any two questions from this section.

* 8. a. The table below gives some experimental values of x and y .

x	2	3	4	5	6
y	1.09	0.74	0.55	0.44	0.37

It is known that x and y are related by an equation of the form $y = k/x$. By plotting a suitable graph, estimate the value of k .

(9 marks)

b. On the same axes, sketch the graphs of $y = \frac{1}{x-1}$ and $y = \frac{x^2}{4}$. Use your graphs to solve the inequality

$$\frac{x^2}{4} > \frac{1}{x-1}$$

(11 marks)

Continued/...

9. a. Solve the following equations for values of θ such that $0 \leq \theta \leq 360^\circ$:

(i) $2 \sin^2 \theta - \sin \theta - 1 = 0$

(ii) $\tan^5 3\theta - 1 = 0$

(10 marks)

- b. Prove that

$$\sin 3\theta = 3 \sin \theta - 4 \sin^3 \theta$$

and hence evaluate

$$\int \sin^3 \theta d\theta$$

(10 marks)

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

- a. Solve the equation $f(x) = 0$.

(3 marks)

- b. Find which turning points are maxima and which minima, giving the x -values only.

(5 marks)

- c. Sketch the graph of $y = f(x)$.

(6 marks)

- d. Find the finite area enclosed by the graph and the x -axis.

(6 marks)

11. a. A cylindrical tin, without a top, is to have a volume of $27\pi \text{ cm}^3$. Find the radius and height of the tin if its surface area is to be a minimum.

(10 marks)

- b. A curve is given by the equation

$$y = \frac{2x-1}{x-1}$$

Find:

- (i) the equation of the tangent to the curve at the point where $x = 2$.

- (ii) the equation of the normal to the curve at the point where $x = 2$.

- (iii) also the point where the normal cuts the curve again.

(10 marks)

END OF QUESTION PAPER

NB: This paper contains 4 pages.

