

THE MALAWI NATIONAL EXAMINATIONS BOARD

ADDITIONAL MATHEMATICS

Subject Number: M132/I

September

Time Allowed: 2 hrs 30 mins
1.30-4.00 pm

PAPER I (100 marks)

Paper contains 5 pages. Please check.

Answer all seven questions in Section A and any two questions from Section B.

Section A carries 60 marks and Section B carries 40 marks.

Calculator and four-figure mathematical tables will be provided.

Calculators may be used.

Necessary working should be shown and any numerical expression being evaluated. Calculator or mathematical tables must be clearly stated; otherwise marks for method will be lost.

Final answer to questions requiring the use of tables or calculators should be given to three significant figures.

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).



Section A (60 marks)

Answer all the seven questions in this section.

1. a. Differentiate with respect to x the following expressions:

(i) $\sqrt{x} + \frac{1}{\sqrt{x}}$ ✓

(2 marks)

(ii) $\frac{\cos x}{x}$

(3 marks)

- b. Find $\frac{dy}{dx}$ at the point $\left(\frac{\pi}{3}, 0\right)$ on the curve $y = \sin 3x$.

(3 marks)

2. a. Evaluate the following integrals:

(i) $\int_1^3 (4 + 3x - x^3) dx;$

(3 marks)

(ii) $\int_0^{\frac{\pi}{2}} (\sin 2x - \cos x) dx.$

(4 marks)

- b. The expression $p + qx - x^2$ has its greatest value 5 when $x = 2$.

- (i) By completing the square or otherwise find the numerical values of p and q .

(4 marks)

- (ii) Sketch the curve $y = p + qx - x^2$ with these values of p and q .

(2 marks)

3. The functions f and g , where $0 \leq x \leq \pi$, are defined by:

$$f: x \rightarrow \cos x \text{ and } g: x \rightarrow x - \frac{\pi}{2}.$$

Find:

a. $f(\pi),$

(1 mark)

b. $g(\pi),$

(1 mark)

c. $fg\left(\frac{\pi}{2}\right),$ and

(2 marks)

d. the value of x if $fg(x) = \sin^2 x.$

4. a. Solve the equation: $2^{2x+1} - 15(2^x) = 8.$ ✓

(3 marks)

- b. Draw the graph of $y = 2^x$ for values of x from -4 to 4 . (Take the scale of $1 \text{ cm} = 1$ unit on the x -axis and $1 \text{ cm} = 1$ unit on the y -axis). From the graph estimate the solution of the equation

(3 marks)

$$2^{x+1} = 4x$$

(7 marks)

Continued



5. a. Using the Binomial Theorem write down the coefficients of x^4 and x^5 in the expansion of $(2+x)^7$. (3 marks)
- b. Calculate the value of x if the 5th and 6th terms in the expansion of $(2+x)^7$ in ascending powers of x are equal. (3 marks)
6. a. Solve the equation:
 $2 \tan^2 x - 3 \tan x + 1 = 0$, giving all the solutions between 0° and 360° . (4 marks)
- b. (4 marks)

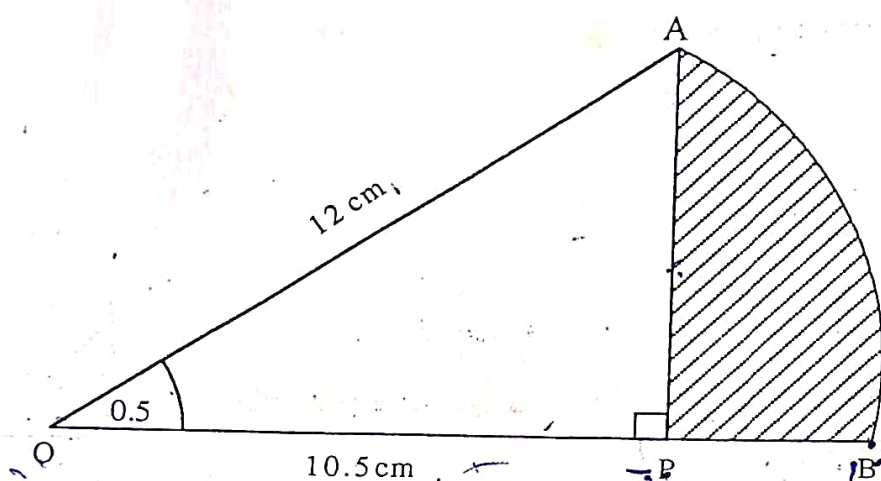


Figure 1

The above shows a sector OAB of a circle centre O and radius 12 cm.
 AP is perpendicular to OB, OP is 10.5 cm and OAP is a right-angled triangle in which angle AOP is 0.5 radian.

Calculate:

- (i) ~~OP~~, AP , (2 marks)
- (ii) the area of the sector OAB, (2 marks)
- (iii) the area of the shaded part APB. (2 marks)

Solve the following inequalities:

- a. $|x-3| < 2$; (2 marks)
- b. $\frac{x+2}{x-1} < 3$ (4 marks)



Section B-(40 marks)

Answer any two questions from this section.

8. The table below shows corresponding values of x and y obtained in an experiment. It is known that x and y satisfy a relationship of the form: $y = ax^b$ where a and b are constants.

x	1.1	1.7	2.1	3.2	3.8
y	2.85	11.47	33.56	86.86	150.5

- a. Plot a suitable graph to verify the relationship between x and y . (10 marks)
- b. Use your graph to
- show which value of y in the table is not correct and give the correct value of this y ; (3 marks)
 - estimate the values of a and b ; (4 marks)
 - from (ii) above state the law connecting the two variables x and y ; (1 mark)
 - estimate the value of x when $y = 100$. (2 marks)
9. a. Taking a scale of 2 cm to represent 15° on the x -axis and 2 cm to represent 1 unit on the y -axis, draw, on the same axes, the graphs of:
 $y = 2 \sin 2x$ and $y = 2 \cos 3x$,
 plotting the values of y for which $x = 0^\circ, 15^\circ, 30^\circ, 45^\circ, 60^\circ, 75^\circ, 90^\circ, 105^\circ, 120^\circ, 135^\circ, 150^\circ, 165^\circ, 180^\circ$. (12 marks)
- b. Using your graphs in 9(a), estimate:
- the solutions to the equation $2 \sin 2x = 2 \cos 3x$; in the range from 0° to 180° ;
 - the range of values of x between 0° and 180° for which $\sin 2x \leq \cos 3x$. (8 marks)
10. a. If A and B are acute angles such that $\sin A = \alpha$ and $\cos B = \beta$. Find in terms of α and β :
- $\sin B$
 - $\cos A$
 - $\sin 2B$
 - $\tan(A+B)$
- b. Integrate

$$\int_{\frac{\pi}{4}}^{\frac{3\pi}{4}} 4 \sin^2 \theta d\theta$$

2/I 11. a.

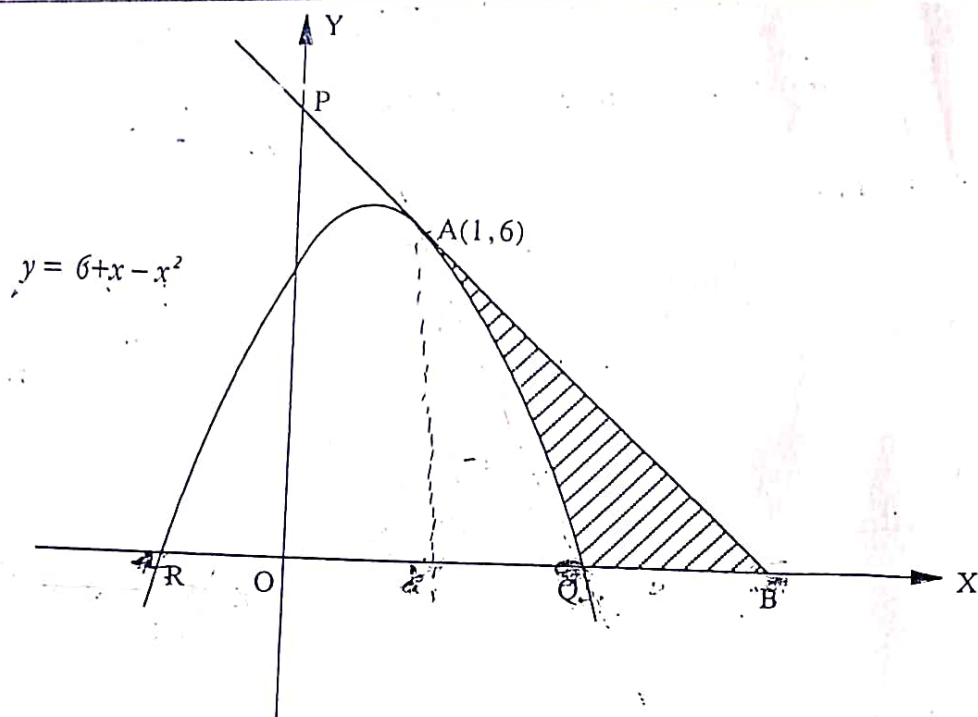


Figure 2

Figure 2 above shows a tangent AB drawn to the curve $y = 6 + x - x^2$ touching the curve at A and cutting the x-axis at B.

Calculate the:

- coordinates of B;
- coordinates of R and Q;
- area of the shaded region.

(13 marks)

b. A closed right circular cylinder has height 12 cm and radius r cm. The total surface area is A cm².

- Show that $\frac{dA}{dr} = 4\pi(r + 6)$.
- Use the result in (i) to approximate the percentage increase in the area when the radius increases from 4 cm to 4.02 cm, the height remaining constant.

(7 marks)

END OF QUESTION PAPER

This paper contains 5 pages.