

EXAMINATIONS COUNCIL OF ZAMBIA

Joint Examination for the School Certificate
and General Certificate of Education Ordinary Level

ADDITIONAL MATHEMATICS 4030/2
PAPER 2

Thursday

23 NOVEMBER 2006

2 hours 30 minutes

Additional materials:

Answer paper

Graph paper (3 sheets)

Mathematical tables/calculators

TIME 2 hours 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the spaces on the answer paper/answer booklet.

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There are **twelve (12)** questions in this paper. Answer **all** questions.

Write your answers on the separate answer paper provided.

If you use more than one sheet of paper, fasten the sheets together.

All working must be shown clearly.

If the degree of accuracy is not specified in the question and if the answer is not exact, the answer should be given to three significant figures. Answers in degrees should be given to one decimal place.

INFORMATION FOR CANDIDATES

The number of marks is shown in brackets [] at the end of each question or part question.

Calculators may be used.

Cell phones should not be brought in the examination room.

You are reminded of the need for clear presentation in your answers.

Check the formulae overleaf.

The total number of marks is 100.

This question paper consists of 6 printed pages.

Mathematical Formulae**1 ALGEBRA***Quadratic Equation*

For the equation $ax^2 + bx + c = 0$,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Binomial Theorem

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{r} a^{n-r} b^r + \dots + b^n,$$

where n is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!r!}$

2 TRIGONOMETRY*Identities*

$$\sin^2 A + \cos^2 A = 1.$$

$$\sec^2 A = 1 + \tan^2 A.$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A.$$

Formula for Δ ABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$a^2 = b^2 + c^2 - 2bc \cos A.$$

$$\Delta = \frac{1}{2} bc \sin A$$

3 STATISTICS*Mean and standard deviation**Ungrouped data*

$$\text{Mean } (\bar{x}) = \frac{\sum x}{n}, \text{ SD} = \sqrt{\left\{ \frac{\sum (x - \bar{x})^2}{n} \right\}} = \sqrt{\left\{ \frac{\sum x^2}{n} - (\bar{x})^2 \right\}}$$

Grouped data

$$\text{Mean } (\bar{x}) = \frac{\sum fx}{\sum f}, \text{ SD} = \sqrt{\left\{ \frac{\sum f(x - \bar{x})^2}{\sum f} \right\}} = \sqrt{\left\{ \frac{\sum fx^2}{\sum f} - (\bar{x})^2 \right\}}$$

Pure Mathematics

Solve the simultaneous equations:

$$-x + y + 3z = -9$$

$$2x - y - z = 11$$

$$x + 2y + 3z = -3 \quad [6]$$

Show that the equation $x^2 + (2 - k)x + k = 3$ has real roots for all real values of k . [6]

Solve the equations

(a) $\log x + \log (5x + 5) = 2$

(b) $2^{x+1} + 2^x = 9$ [6]

4 (a) In how many ways can 5 boys and 3 girls stand in a straight line, if

(i) there are no restrictions?

(ii) the boys stand next to each other? [4]

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(b) A collection of 16 books contains one of Harry Potter's books. Mary is going to choose 6 of these books to take on holiday.

(i) In how many ways can she choose 6 books?

(ii) How many of these choices will include the Harry Potter book? [4]

5 (a) Given that the expansion of $(b + x)(1 - 2x)^n$ in ascending powers of x is $3 - 41x + cx^2 + \dots$, find the values of the constants b , c and n . [6]

(b) Find the term independent of x in the expansion of $\left(2x - \frac{1}{2x^2}\right)^{12}$ [3]

6 The expression $x^3 + ax^2 + bx + 12$ is divisible by $x^2 + 2x - 3$.

(i) Find the value of a and b .

(ii) Find the remaining factor of the expression.

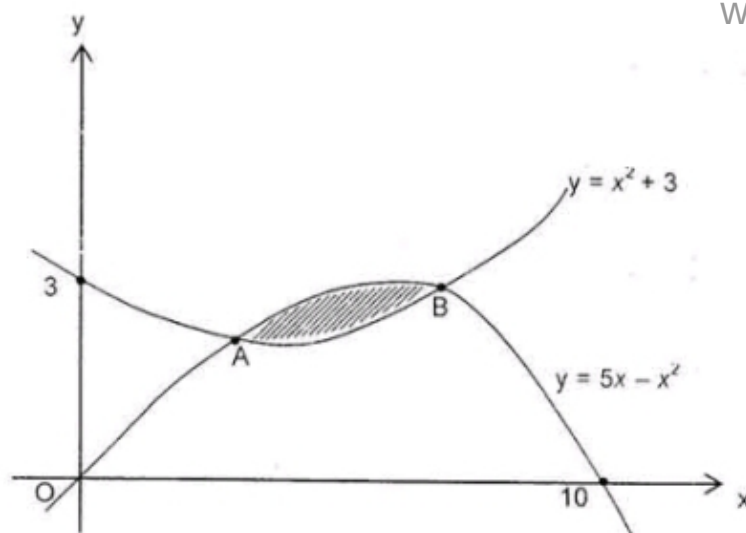
(iii) Hence, or otherwise, solve the equation $x^3 + ax^2 + bx = -12$. [9]

- 7 A particle moves in a straight line so that, at time t seconds after leaving a fixed point, its velocity V m/s is given by

$$V = \frac{27}{(2t+1)^2} - 3.$$

Find

- (i) the initial velocity,
 - (ii) the value of t for which the particle is at instantaneous rest,
 - (iii) the initial acceleration of the particle.
- 8 Find all the angles between 0° and 360° for which
- (i) $2 \sec^2 x = 8 - \tan x$,
 - (ii) $\cot^2 x + \operatorname{cosec} x = 11$.
- 9 The diagram shows the intersection of two curves $y = x^2 + 3$ and $y = 5x - x^2$ at the points A and B.



- (i) Find the x-coordinates of points A and B.
- (ii) Calculate the area of the shaded region.
- (iii) The shaded region is rotated through 360° about the x-axis to form a solid of revolution. Calculate the volume generated.

10 The curve $y = 3 - e^{2x}$ meets the x -axis at A and the y -axis at B.

(i) Find the coordinates of A and B. [3]

(ii) Sketch the curve for the domain $-3 \leq x \leq 1$. [3]

(iii) Find the equation of the straight line which must be drawn on the graph of $y = 3 - e^{2x}$ to obtain a solution of the equation $x = \ln \sqrt{2 - x}$. [4]

11 A random sample of 97 people who own mobile phones was used to collect data on the amount of time they spent per day on their phones. The result are displayed in the table below.

Time spent per day (t minutes)	$0 \leq t < 5$	$5 \leq t < 10$	$10 \leq t < 20$	$20 \leq t < 30$	$30 \leq t < 40$	$40 \leq t < 70$
Number of people	11	20	32	18	10	6

(i) Calculate estimates of the mean and standard deviation of the time spent per day on these mobile phones.

(ii) On graph paper, draw a fully labelled histogram to represent the data. [10]

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12 Either

(a) A geometric progression has a first term a and a common ratio r .

Given that the second term of the progression is 24 and the fifth term is $\frac{8}{9}$,

calculate the

(i) first term,

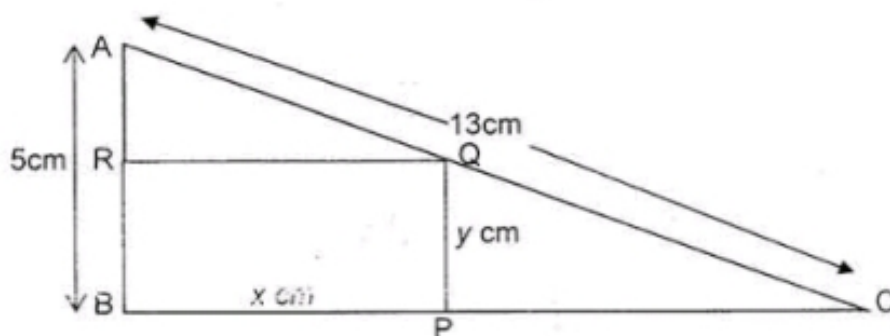
(ii) common ratio,

(iii) sum to infinity. [5]

(b) In an arithmetic progression T_n stands for the n th term and S_n stands for the sum of the first n terms. Given that $T_{15} = 2T_9$ and $S_{15} + S_9 = 279$, find the first term and the common difference. [5]

Or

In the triangle ABC, angle ABC = 90° , AB = 5cm and AC = 13cm as shown in the diagram. The rectangle BPQR is such that its vertices P, Q and R lie on BC, CA and AB respectively.



Given that BP = x cm and PQ = y cm,

(a) show that $y = \frac{60 - 5x}{12}$, [4]

(b) express the area of the rectangle in terms of x and hence calculate the maximum value of this area as x varies. [6]

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