4030

EXAMINATIONS COUNCIL OF ZAMBIA

EXAMINATION FOR SCHOOL CERTIFICATE AND
GENERAL CERTIFICATE OF EDUCATION ORDINARY LEVEL

Additional Mathematics

SPECIMEN PAPERS FOR EXAMINATIONS STARTING FROM 2020 FOR INTERNAL CANDIDATES AND FROM 2021 FOR EXTERNAL CANDIDATES

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Additional Mathematics (4030) – Preamble

Additional Mathematics is part of the Examination for School Certificate and General Certificate of Education Ordinary Level (Grade 12) taken at the end of the senior secondary school level. The examination for School Certificate and General Certificate of Education Ordinary Level is based on a three-year course covering Grades 10 to 12.

In 2019, the Examinations Council of Zambia undertook examination reforms which saw an introduction of School Based Assessments (SBA) for all practical papers and changes in some theory papers.

During the examination reforms process, the Additional Mathematics examination question papers were analysed and the Examination Syllabus was revised. As a result, Additional Mathematics **Paper 1** and **Paper 2** have been **reformed** to remove the **alternatives** in question 12. Therefore, the Examination Syllabus has been revised and a Specimen has been developed for both Paper 1 and Paper 2.

Assessment Objectives (AO)

AO1 Knowledge and Comprehension

AO2 Application

AO3 Analysis

AO4 Synthesis and Evaluation

Test Design

The examination will consist of two theory papers. Both **Paper 1** and **Paper 2** will consist of 12 questions. **Candidates will be expected to answer all questions**. Some questions will have parts from the same topic or different topics.

Paper Name	Paper Code	Duration	Number of questions	Marks	Weighting
Additional Mathematics Paper 1	4030/1	2 hours	12	80	45%
Additional Mathematics Paper 2	4030/2	2 hours 30 minutes	12	100	55%
Total				**180**	**100%**

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Additional Mathematics 4030/1

Paper 1

Specimen

Additional Materials:

Answer Booklet
Silent electronic calculator (Non programmable)

Time: 2 hours

Instructions to Candidates

Write your **name, centre number** and **candidate number** in the spaces on the Answer Booklet provided.

There are **12 questions** in this paper. Answer **all** the questions.

Write your answers in the **Answer Booklet provided**.

If you use more than one Answer Booklet, **fasten** the Answer Booklets together.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

Information for candidates

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

The total number of marks for this paper is 80.

The use of a non programmable electronic calculator is expected, where appropriate.

Cell phones are not allowed in the examination room.

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

Check the formulae overleaf.

MATHEMATICS FORMULAE

1 ALGEBRA

Quadratic Equation

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

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

Binomial Theorem

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

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

2 TRIGONOMETRY

Identities

$\text{Sin}^2 A + \cos^2 A = 1$

$\text{Sec}^2 A = 1 + \tan^2 A$

$\text{Cosec}^2 A = 1 + \cot^2 A$

Formulae for ΔABC

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

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

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

1 Find the equation of a line perpendicular to the line $5x - 2y - 11 = 0$ passing through the point $(2, -3)$. [4]

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2 Solve the simultaneous equations [5]

$2x + y = 7$,

$xy - x^2 = 4$.

---

3 Find the range of values of k, where $k > 0$, for which the line $y = kx - 2$ does not meet the curve $x^2 - 4y + 1 = 0$. [4]

---

4 The functions g and h are defined by $g: x \to \frac{1}{2x+1}, x \neq -\frac{1}{2}$ and $h: x \to x + 3$ respectively.

Find

(a) $hg(x)$, [2]

(b) the values of x for which $hg(x) = h(x)$. [4]

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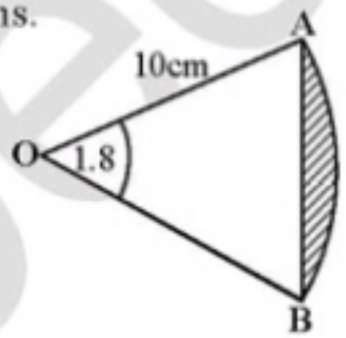
5 In the diagram below, OAB is a sector of a circle with centre O, radius 10cm and angle AOB = 1.8 radians.



Find

(a) the perimeter of the shaded region, [3]

(b) the area of the shaded region. [2]

---

6 Prove the identity

$\tan\theta + \cot\theta \equiv \sec\theta \operatorname{cosec}\theta$. [4]

---

7 **(a)** Find the term independent of x in the expansion of $\left(3x + \frac{1}{x}\right)^{10}$. [4]

(b) Find the coefficient of x^2 in the expansion of $(1 + x)^7 (1 - 2x)^4$. [5]

---

8 **(a)** Find $\frac{dy}{dx}$ for the equation $y = \frac{3x-5}{x^2-4x}$. [4]

(b) Two variables x and y are related by the equation $y = 2x^2 - 3x$. Obtain an expression for $\frac{dy}{dx}$ and find the approximate change in y as x increases from 6 to 6.02. [5]

---

9 Find all the angles between 0° and 360° which satisfy the equation

$$|3\sin\theta - 1| = 2.$$ [5]

---

10 **(a)** A and B are points with position vectors $3i + j$ and $10i + j$ respectively. Find the position vector of a point which divides $\overrightarrow{AB}$ in the ratio 3:4. [4]

(b) The position vectors of P and Q are $ai + 2j$ and $3i + j$. Given that the angle between $\underline{p}$ and $\underline{q}$ is 45°, find two possible values of a. [5]

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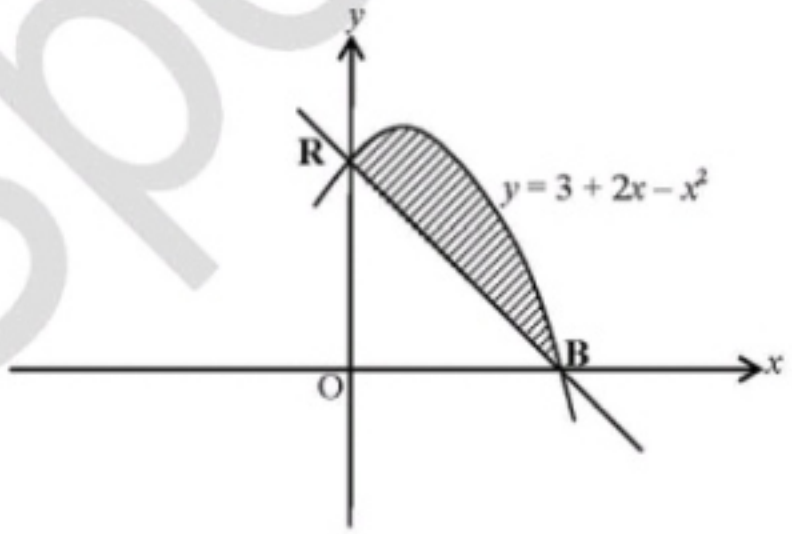
11 **(a)** Evaluate $\int_1^3 (3x-4)\,dx$. [2]

(b) The diagram below shows part of the curve $y = 3 + 2x - x^2$ which meets a straight line at B and R.



Find

(i) the coordinates of B, [2]

(ii) the equation of BR, [1]

(iii) the area of the shaded region. [5]

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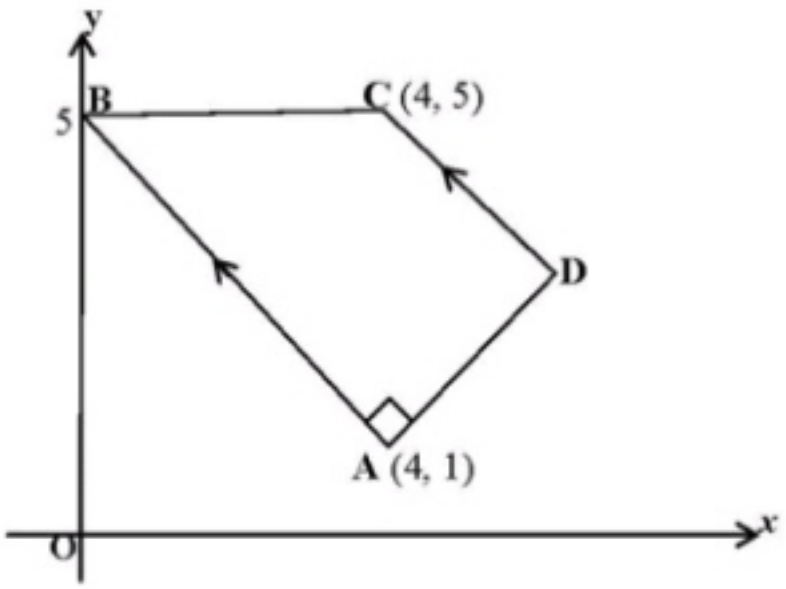
12 In the diagram below, ABCD is a trapezium with A(4, 1) and C(4, 5). The point B lies on the y-axis and angle DAB = 90°.



Find

(a) the equation of line AB, [3]

(b) the equation of line AD, [3]

(c) the coordinates of D. [4]

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for School Certificate Ordinary Level

Additional Mathematics 4030/2

Paper 2

Specimen

Additional Materials:

Answer Booklet;
Silent electronic calculator (non programmable)

Time: 2 hours 30 Minutes

Instructions to Candidates

Write your **name, centre number** and **candidate number** in the spaces on the separate Answer Booklet provided.

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

Write your answers on the **Answer Booklet** provided.

If you use more than one Answer Booklet, **fasten** the Answer Booklets together.

Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.

Information for candidates

The number of marks is shown in brackets [ ] at the end of each question or part question. The total number of marks for this paper is 100.

The use of a non programmable electronic calculator is expected, where appropriate.

Cell phones are not allowed in the examination room.

Check the formulae overleaf

Mathematical Formulae

1 ALGEBRA

Quadratic Equation

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

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

2 SERIES

Arithmetic $S_n = \frac{1}{2} n [2a + (n-1)d]$

Geometric $S_n = \frac{a(1-r^n)}{1-r}$ $(r \neq 1)$

$$S\infty = \frac{a}{1-r} \text{ for } |r| < 1$$

3 TRIGONOMETRY

Identities

$\sin (A \pm B) = \sin A \cos B \pm \cos A \sin B.$

$\cos (A \pm B) = \cos A \cos B \mp \sin A \sin B.$

$$\tan (A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$\sin 2A = 2 \sin A \cos B$

$\cos 2A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

4 STATISTICS

Mean and standard deviation

Ungrouped data

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

Grouped data

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

1 Solve the following systems of equations

$2x + 3y - z = 2$,

$x - 2y - 4z = 8$,

$3x + 5y + 2z = -7$. [6]

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2 **(a)** Find the range of values of x for which $3x^2 - 10x - 8 < 0$. [3]

(b) Express $12x^2 - 6x + 5$ in the form $a(x + b)^2 + c$, where a, b and c are constants. Hence, find the minimum value of $12x^2 - 6x + 5$. [4]

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3 Solve the equations

(a) $4^{3x-2} = 19$, [3]

(b) $\log_2(2x^2 + 3x + 5) = 3 + \log_2(x + 1)$. [4]

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4 **(a)** Find the value of k, given that the expression $3x^3 - 14x^2 - 7kx + 10$ is exactly divisible by $(x + 1)$. [3]

(b) Solve the equation $2x^3 - 3x^2 - 30x + 56 = 0$. [4]

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5 **(a)** In how many ways can the letters of the word 'UNGROUPED' be arranged? [2]

(b) A team of 5 people is to be selected from 7 women and 6 men. Find the number of different teams that could be selected if there must be more women than men in the team. [5]

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6 **(a)** Solve the equation $\cos(x + 60°) = 2\sin x$ for values of x in the range $0° \leq x \leq 360°$. [4]

(b) **(i)** Express $5\sin x + 12\cos x$ in the form $R\sin(x + \alpha)$, where $R > 0$ and $0° < \alpha < 90°$. [3]

(ii) Hence, find the maximum value of $R\sin(x + \alpha)$. [1]

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7 **(a)** The sum of the first 6 terms of an arithmetic progression is 555 and the sum of the next 6 terms is 1 455. Find the first term and the common difference. [4]

(b) In a geometric progression, the third term is 45 and the fifth term is 405. Find the

(i) first term and the common ratio ($r > 0$), [3]

(ii) sum of the first 8 terms. [2]

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8 The table below shows the points scored by 95 students in an examination.

Points scored	1 – 3	4 – 6	7 – 9	10 – 12	13 – 15	16 – 18	19 – 21	22 – 24
Frequency	12	9	8	11	7	20	13	15

(a) Find the median class. [1]

(b) Calculate

(i) an estimate of the mean, [2]

(ii) the standard deviation. [6]

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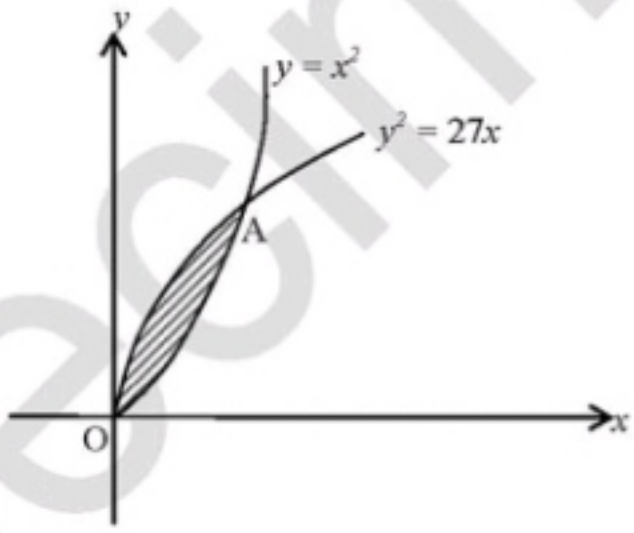
9 **(a)** A curve has equation $y = \frac{x+a}{x+2}$. Given that $\frac{dy}{dx} = -\frac{1}{25}$ when $x = 3$, find the value of a. [3]

(b) The diagram below shows part of the curves $y^2 = 27x$ and $y = x^2$ intersecting at O and A.



Find

(i) the coordinates of A, [3]

(ii) the volume obtained by rotating the shaded region through 360° about the x-axis. [4]

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10 The velocity, $V ms^{-1}$ of a particle moving in a straight line, t seconds after passing through a fixed point O, is given by $V = 36t - 3t^2$.

Find the

(a) value of t when the velocity is constant, [3]

(b) value of t when the velocity is at instantaneous rest, [3]

(c) distance of the particle from O when the particle is at instantaneous rest. [4]

---

11 **(a)** The curves $y = e^{3x}$ and $y = e^{2-x}$ intersect at the point B.

Find the

(i) coordinates of B. [3]

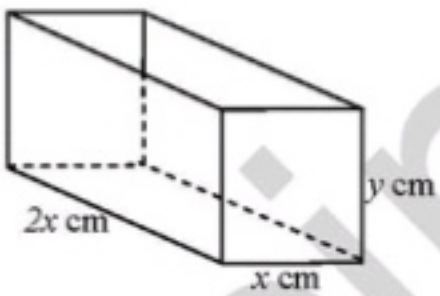
(ii) gradient of each curve in terms of e, at B. [3]

(b) When $\log_{10} y$ is plotted against x, a straight line is obtained passing through the points (0.6, 0.3) and (1.1, 0.2). Find $\log_{10} y$ in terms of x. [4]

---

12 **(a)** A curve has equation $y = 2x - 3\sin x$. find the smallest positive value of x for which the curve has gradient $\frac{1}{2}$. [3]

(b) The diagram shows a cuboid with a rectangular base of sides x cm and $2x$ cm. The height of the cuboid is y cm and its total surface area is 120cm^2.



(i) Show that the volume $V\text{cm}^3$, of the cuboid is given by $V = 40x - \frac{4x^3}{3}$. [3]

(ii) Given that x can vary, find the dimensions of the cuboid when V is a minimum. [4]