



MAASAI MARA UNIVERSITY

**REGULAR UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR
SECOND YEAR FIRST SEMESTER**

**SCHOOL OF PURE APPLIED AND HEALTH
SCIENCES
BACHELOR OF SCIENCE IN CHEMISTRY**

COURSE CODE: CHE 2112

COURSE TITLE: CHEMISTRY MATHEMATICS I

DATE: 13/12/2023

TIME: 8:30 - 10:30 AM

INSTRUCTIONS TO CANDIDATES

1. Answer Question **ONE** and any other **TWO** questions.
2. All Examination Rules Apply.

QUESTION ONE (30mks)

a) Define the following terms:

- i) Confidence limit
- ii) Confidence interval
- iii) Limit of detection.

(3mks)

b) If the optical absorbance (A) increases from 0.65 to 1.35 during a reaction. What is ΔA .

(2mks)

c) A chemist is making a species that requires three steps. The steps give 66%, 50% and 95% yields respectively. What is the overall percentage yield for this synthesis given that? *Overall Yield* = $\prod_{n=1}^3 \text{Yield of step } i$

(2mks)

d) In the esterification reaction $\text{CH}_3\text{OH} + \text{CH}_3\text{COOH} \rightarrow \text{CH}_3\text{COOCH}_3 + \text{H}_2\text{O}$. If the theoretical yield of the ester based on the amount of starting masses is 0.2g and the experimental yield is 0.013g. Calculate the percentage yield.

(2mks)

e) In an experiment, the pressure of a gas is monitored as the temperature is changed at constant volume and amount of gas. The following relationship was established: $P = 0.034T$.

- i) Identify the variables and coefficients in the equation
- ii) What is pressure a function of
- iii) Given that $T = 343$ what is the value of P

(4mks)

f) Consider the ideal gas equation $PV = nRT$, express the temperature as a function of pressure.

(2mks)

g) The equation for a straight line is $y = mx + c$. Define the terms in the equation.

(3mks)

- h) Solve the following simultaneous equations: $y + x = 5$ and $2y + x = 1$ **(3mks)**
- i) What is the other form of $\text{Log}(xy)$ **(1mk)**
- j) Use the product rule to determine dy/dx of $y = x^2 \text{Sin}x$. **(3mks)**
- k) Use the quotient rule to find dy/dx of $y = x^3/e^{3x}$ **(3mks)**
- l) Find dy/dx of the expression $y = \text{In}x^{3k}$. **(2mk)**

QUESTION TWO (20mks)

- a) Use the quadratic formula to solve the equation $3x^2 + 5x + 2$. **(3mks)**
- b) A hydrogen atom has a diameter of 106 pm. Calculate
- Its circumference
 - Area
 - Volume **(5mks)**
- c) Differentiate the following functions:
- $Y = x^3$
 - $Y = 2x^{-4} + x^3 + X + 5$
 - $Y = x^{1/4}$
 - $\text{Sin } X$
 - $\text{Cos } X$ **(6mks)**
- d) In an X-ray crystallography the Bragg relates the distance d between successive layers in a crystal. The wavelength of the x-rays, λ an integer n and the angle through which the x-rays are scattered θ is given by the equation: $\lambda = 2d/n \text{ sin } 3\theta$. What is the rate of change of λ with θ . **(4mks)**
- e) Differentiate y with respect to θ in $y = \text{cos } k\theta$ **(2mks)**

QUESTION THREE (20mks)

a) Differentiate the following functions with respect to x:

i) $Y = e^{2x}$

ii) $Y = e^{-2\beta hCBx}$

iii) $Y = dx/x$

iv) $y = e^{-1/3}$ **(5mks)**

b) Differentiate the following using the product rule:

i) $Y = x \ln x$

ii) $Y = 6e^2 \cos x$ **(6mks)**

c) Use the quotient rule to differentiate the following

i) $Y = \sin x / 3 \ln x$

ii) $Y = x/e^{2x}$ **(6mks)**

d) Use the chain rule to differentiate $y = (x^2 + 2)^3$ using the chain rule **(3mks)**

QUESTION FOUR (20mks)

a) Find the integrals of the following:

i) x^2

ii) $2x + 6x^2$

iii) $x(x+3)$ **(4mks)**

b) Find the integral of $x^2 + 2x^3 - 4x^4 / x^3$ **(3mks)**

c) Find the following:

i) $\int e^{6x} dx$

ii) $\int (e^x + 4e^{-3x}) dx$

iii) $\int 9e^{6z} dz$ **(6mks)**

d) Find the following:

i) $\int \cos(4x) dx$

ii) $\int 6\sin(3x) dx$ **(4mks)**

e) A curve of gradient $4x^5$ passes through the point (1,2),
what is the full equation of the line.

(3mks)

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