THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering & Technology

DEPARTMENT OF CIVIL AND BUILDING ENGINEERING

DIPLOMA IN CIVIL ENGINEERING AND CAD

DCC 07 (A & B)

FINAL EXAMINATIONS

APRIL/MAY 2010 SERIES

MATHEMATICS

TIME: 2 HOURS

Instructions to Candidates

This paper consists of **TWO** Sections: Section **I** and **II.**

Section **I**: has **30** marks and Section **II** has **40 marks.**

Attempt **ALL** Question in Section **I** and **ONLY TWO** Questions from Section **II.**

Calculators and mathematical tables allowed.

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SECTION I

Question ONE

Differentiate following functions:

(i). $\sin(3x^2 + 2)$

(ii). e^{4t}

(4 Marks)

Question TWO

Solve:

$$\frac{dy}{dx} = xy - y$$ **(3 Marks)**

Question THREE

The distribution shown represents marks awarded to students after an assessment.

Marks	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
Frequency	5	8	7	12	28	20	10	10

Determine:

(a).   First quartile
(b).   Second quartile
(c).   Third quartile

(6 Marks)

Question FOUR

Integrate the following functions with respect to x.

(a). $\dfrac{1}{\sqrt{(9 - x^2)}}$

(b). $(x - 2)^2$

(6 Marks)

Question FIVE

(a). Determine the area of a parallelogram whose sides are given by the vectors.
$A = 3i - 3j + 2k$ $B = -2i - 3j + 2k$ **(5 Marks)**

(b). Determine a positive constant α such that the angle between the vectors.

$u = \alpha(i + j)$ and $v = i + \alpha j$ is $\dfrac{\pi}{6}$ radius.

(6 Marks)

SECTION II

Attempt TWO Questions ONLY from this Section (40 Marks)

Question SIX

A company monitored the number of days(x) of business trips taken by executives of the company and the corresponding claims (£y) they submitted to cover the total expenditure of these trips.

A random sample of 10 trips gave the following results.

X(days)	10	3	8	17	5	9	14	16	21	13
Y£	116	39	85	159	61	94	143	178	225	134

(a). Plot these data on a scatter diagram.   **(4 Marks)**

(b). Find an equation of the regression time of y and x in the form of $y = a + bx$.
(6 Marks)

(c). Find the expected expenditure of a trip lasting 11 days.**(2 Marks)**

A machine hire company kept records of the ages x months, and the maintenance costs, £y, of machine. The following table summarizes the data for a random sample of 10 machines.

| Machine	A	B	C	D	E	F	G	H	I	J
Age x	62	12	34	81	51	14	45	74	24	89
Maintenance costs y	111	25	41	181	64	21	51	145	43	241

Calculate to (3 decimal places) the product-moment correlation coefficient.
(8 Marks)

Question SEVEN

(a).   (i).   A construction company investment on machinery was Kshs.150,000/- in the first year and Kshs.250,000/- each for the following 15 years.

Determine the company's total investment in machinery after 10 years.   **(3 Marks)**

(ii).   Determine an approximate value of $\sqrt{10}$ by substituting $x = \dfrac{1}{9}$ in the binomial expansion of $(1+x)^{\frac{1}{2}}$ upto the term in x^3.

(8 Marks)

(b).   The fourth term of a geometric series is 10 and the seventh term of the series is 80. For this series, find:

(a).   the common ratio   **(4 Marks)**
(b).   the first term   **(3 Marks)**
(c).   the sum of the first 20 terms, giving your answer to the nearest whole number.   **(2 Marks)**

Question EIGHT

(a).   The figure below shows an open-topped water tank, in the shape of a cuboid, which is made of sheet metal. The base of the tank is a rectangle x metres by y metres. The height of the tank is x metres.
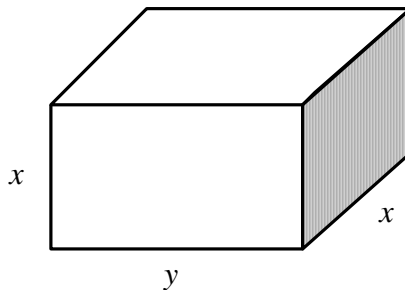
The capacity of the tank is 100m³.

(i)   Show that the area A m² of the sheet metal used to make the tank is given by:

$$A = \frac{300}{x} + 2x^2$$

(4 Marks)

(ii)   Use calculus to find the value of x which A is stationary.

(4 Marks)

(iii)   Prove that this value of x gives a minimum value of A.

(2 Marks)

(iv)   Calculate the minimum area of sheet metal needed to make the tank

(2 Marks)

(b). (i).   Express $\dfrac{2x-1}{(x-1)(2x-3)}$ in partial fractions.   **(3 Marks)**

(ii).   Given that $x \geq 2,$ find the general solution of the differential equation

$$(2x-3)(x-1)\frac{dy}{dx} = (2x-1)y$$ **(5 Marks)**