THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

Faculty of Engineering & Technology

DEPARTMENT OF CIVIL AND BUILDING ENGINEERING

DIPLOMA IN ARCHITECTURE

DIPLOMA IN BUILDING ENGINEERING

(DA 09/DB09)

SEMESTER EXAMINATIONS

MAY 2010 SERIES

CALCULUS II

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** Questions in Section **I** and **ONLY TWO** Questions from Section **II.**
Calculators and Mathematical tables are allowed.
You should have a graph paper.

SECTION I

Attempt ALL Questions in this Section (30 Marks)

1. Civil Engineering students wanted to determine the cross-section area of a river at a construction site. They made the following measurements:

   Width = 15.0m
   Depth at equal intervals across the river in m:

   0, 2.40, 3.60, 4.70, 4.40, 2.80, 0

   Use trapezium rule to estimate the cross-section area of a river. **(3 Marks)**

2. An engineer wanted to find the amount earth removed when constructing a cutting. The following are the cross-sectional areas (in m2) at interval of 10m that he measured. 0, 3.2, 4.1, 4.9, 4.5, 2.8, 0. Apply Simpson's rule to determine volume of the earth excavated. **(3 marks)**

3. Integrate the following functions with respect to x.

   a) $\int \frac{1}{\sqrt{(16-x^2)}}$

   b) $\cos^2 x$

   c) $\sin^2 x \cos x$

   d) $3(16+x2)^{-1}$ **(8 Marks)**

4. Work out;

   $\int_0^3 (x+2)^2 dx$ **(4 Marks)**

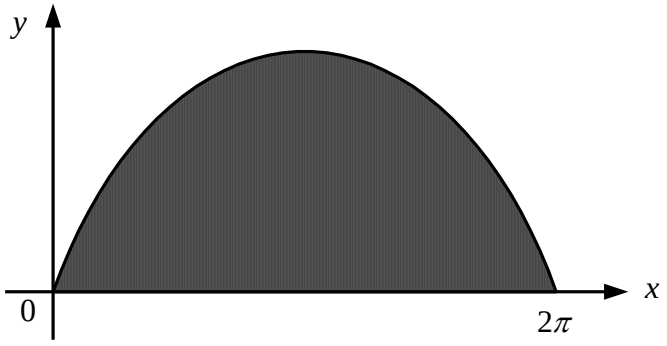
5. Express, $\frac{2x-1}{(x-1)(2x-3)}$, in partial fractions.

   Hence integrate, $\frac{2x-1}{(x-1)(2x-3)}$

   (6 Marks)

6. The curve with equation $y = 3\sin\frac{x}{2}, 0 \le x \le 2\pi$, is shown in Figure I.

The finite region enclosed by the curve and the x-axis is shaded.



Find, by integration, the area of the shaded region. **(3 Marks)**

7. The table below shows three corresponding values of f(x).

x	-1	2	5
f(x)	8	26	206

By Simpson's rule with 3 ordinates find an estimate for:

$\int_{-1}^{5} f(x)$ **(3 Marks)**

SECTION II

Attempt TWO questions ONLY from this section (40 Marks)

8. (a). (i). Copy and complete the table below for $y = 1/2\,x^2 - x + 3$ where $0 \le x \le 6$.

x	0	1	2	3	4	5	6
y							

(3 Marks)

(ii). Draw the graph of the above function on the grid provided.

(2 Marks)

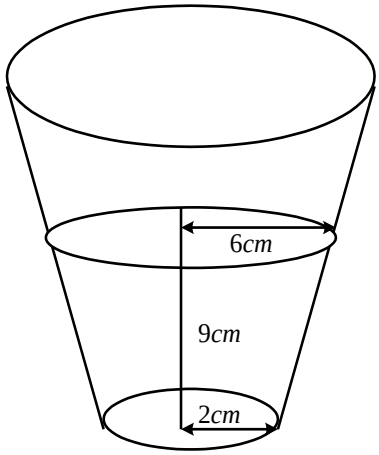
(iii). Calculate the mid-ordinates for 6 strips between x=0 and x=6. **(2 Marks)**

(iv). Use the mid-ordinate rule to calculate the area under the curve. **(2 Marks)**

(v). Find the area below the curve $y = 1/2x^2 - x + 3,\ x - axis$ x = 0 and x=6 by integration. **(3 Marks)**

(vi). Calculate percentage error of using mid ordinate rule (in iv) assuming that the area calculated in (V) is the actual area. **(2 Marks)**

(b). A glass in the form of a cone represented by the diagram below. The glass contains water to a height of 9cm. The bottom of the glass is a circle of radius 2cm while the surface of the water is a circle of radius 6cm. Determine volume of water. **(6 Marks)**



9. (a). Evaluate $\int_5^6 \frac{2x^2 - 13x + 13}{(x-4)^3} dx$ **(10 Marks)**

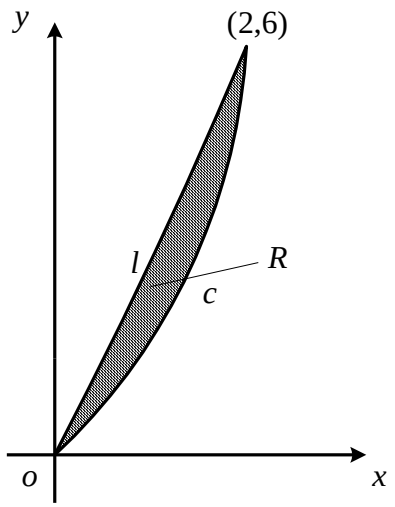
(b). Find the position of the centroid of the area bounded by the curve $y = 4x^2,\ x = 1\ \ and\ \ x = 3.$ **(10 Marks)**

10. (a). The curve C has equation $y = x\sqrt{(x^3 + 1)} \qquad 0 \le \times \le 2$

(i). Copy and complete the table below, giving the values of y to 3 decimal places at x=1, x= 1.5 and x=2. **(3 Marks)**

x	0	0.5	1	1.5	2
y	0	0.530			

(ii). Use the trapezium rule, with all the **y** values from your table, to find an approximation for the value of $\int_0^2 x\sqrt{}(x3+1)$, giving your answer to 3 significant figures. **(4 Marks)**



The figure above shows the curve C with equation $y = x\sqrt{(x^3+1)}$ $0 \le \times \le 2$, and the straight line segment *i*, which joins the origin and the point (2, 6). The finite region R is bounded by C and *i*.

(iii). Use your answer to part (ii) to find an approximation for the area of R, giving your answer to 3 significant figures. **(3 Marks)**

(b). (i). Use the identities for $\cos(A+B)$ to prove that $\cos 2A = 1/2(1+\cos 2A)$ **(4 Marks)**

(ii). Find the $\int \cos^4 x \sin^2 x dx$ **(6 Marks)**