



**MURANG'A UNIVERSITY COLLEGE**  
*(A constituent college of Jomo Kenyatta University of Agriculture and Technology)*

**SCHOOL OF PURE AND APPLIED SCIENCES**  
UNIVERSITY EXAMINATIONS 2015/2016 ACADEMIC YEAR  
SEB 1241      ENGINEERING MATHEMATICS IV

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**QUESTION ONE:**

- a) Integrate the function:  $y = x^2\sqrt{(x^3 + 5)}$  (5 marks)
- b) If  $x = a \sin \theta$ ,  $y = b \cos \theta$ , find the area between  $\theta = 0$  and  $\theta = \pi$  (5 marks)
- c) Find the mean value of the function:  
 $y = 3x^2 + 4x + 1$  between  $x = -1$  and  $x = 2$  (5 marks)
- d) Find the volume generated when the plane figure bounded by  $y = 5 \cos 2x$ , the  $x$ -axis and ordinates at  $x = 0$  and  $x = \frac{\pi}{4}$ , rotates about the axis through a complete revolution. (5 marks)
- e) Find the position of the centre of gravity of solid formed when the plane figure bounded by the curve  $x^2 + y^2 = 16$ , the  $x$ -axis and the ordinates  $x = 1$  and  $x = 3$ , rotates about the  $x$ -axis. (5 marks)
- f) Find the area under the curve:  
 $y = x^2 + 2x + 1$  between  $x = 1$  and  $x = 2$  (5 marks)

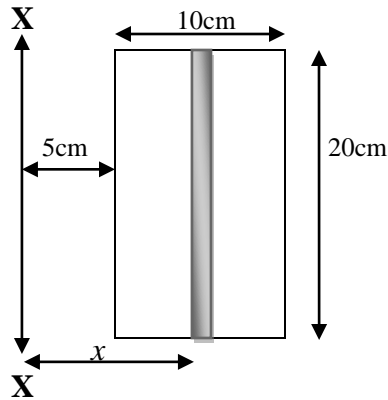
**QUESTION TWO:**

- a) Find the area generated when the arc of the parabola  $y^2 = 8x$  between  $x = 0$  and  $x = 2$ , rotates about the  $x$ -axis. (10 marks)

- b) Find the surface area generated when the arc of the curve  $y = 3t^2$ ,  $x = 3t - t^3$  between  $t = 0$  and  $t = 1$ , rotates about OX through  $2\pi$  radians. (10 marks)

**QUESTION THREE:**

- a) Find:  $I$  (moment of inertial) and the value of  $K$  for a rectangular plate  $20\text{cm} \times 10\text{cm}$ , of mass  $2\text{kg}$  about an axis  $5\text{cm}$  from one  $20\text{cm}$  side as:



$I$  = moment of inertial (or second moment of mass)  
 $K$  = radius of gyration about the given axis

- b) A metal door,  $40\text{cm} \times 60\text{cm}$ , has a mass of  $8\text{kg}$  and is hinged along one  $60\text{cm}$  side. Calculate:

- i)  $I$  about  $XX$ , the axis through the centre of gravity.
- ii)  $I$  about the line of hinge,  $AB$ .
- iii)  $K$  about  $AB$ . (6 marks)

- c) Find the radius of gyration of a metal disc of radius  $6\text{cm}$  and total mass  $0.5\text{kg}$ . (4 marks)

**QUESTION FOUR:**

a) Integrate:  $\int_0^1 x^2 \sqrt{x^2 + 1} dx$  w.r.  $x$  (5 marks)

b) Find:  $\int \frac{\ln x}{x} dx$  (5 marks)

c) Find:  $\int x^4 \ln x dx$  (5 marks)

d) Integrate:  $\int \frac{2x}{x^2+1} dx$  (5 marks)

**QUESTION FIVE:**

a) Integrate:  $\sqrt{1-x^2}$  w.r.t  $x$  by using the substitution  $x \equiv \sin \theta$  (6 marks)

b) Evaluate:  $\int_0^1 x e^x dx$

c) Find:  $\int \sin^5 \theta d\theta$  (4 marks)

d) Find:  $\int \cos x (\sin x)^3 dx$  (5 marks)