(180)

(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2015/2016 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE

MATHEMATICS

COURSE CODE: **MAT 111**

COURSE TITLE: **GEOMETRY AND ELEMENTARY APPLIED MATHEMATICS**

DATE: 10/5/16 **TIME:** 11.30AM -1.30PM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

This Paper Consists of 4 Printed Pages. Please Turn Over.

QUESTION ONE (30marks)

(a) Show that $(1,2)$, $(4,7)$ $(-6,13)$ and $(-9,8)$ are vertices of a rectangle. (4mks)

(b) Find the acute angle to the nearest 0.1^0 between these pairs of lines $l_1: y = 2x + 3$ and $l_2: 2x - 3y + 7 = 0$. (3mks)

(c) Find a polar equation for a circle whose Cartesian equation is $x^2 + y^2 = 4x$. (2mks)

(d) Show that if you can find $g^2 + f^2 - c \geq 0$, then the equation $x^2 + y^2 + 2gx + 2fy + c = 0$ represents a circle. (3mks)

(e) Show the relationship between polar and rectangular coordinates (2mks)

(f)Prove that the vectors $3i - 5j$ and $10i + 6j$ are perpendicular (2mks)

(g)State the three equations of linear motion (3mks)

(h) Find the equation of circle passing through the origin with centre at $(2, -1)$. (3mks)

(i) Find all the points of intersection of $x^2 + y^2 = 25$ and $x + y = 2$ (3mks)

(j) Find the polar coordinates of the point P whose rectangular coordinates are $(-2,2\sqrt{3})$ (3mks)

(k) Find the Cartesian equation for the plane that contains the point $(-1,3,6)$ and is perpendicular to the vector $\begin{pmatrix} 2 \\ 4 \\ -1 \end{pmatrix}$. (2mks)

QUESTION TWO (20 MKS)

(a) Given $a = \begin{Bmatrix} p \\ q \\ r \end{Bmatrix}$, $b = \begin{Bmatrix} s \\ t \\ u \end{Bmatrix}$, and $c = \begin{Bmatrix} v \\ w \\ x \end{Bmatrix}$. Show that $a.(b + c) = a.b + a.c$ where a, b *and* c are not necessarily coplanar and state this property. (4mks)

(b) Determine the point of intersection and the angle between the pair of lines

$$r = i + j - 3k + \lambda(2i + j + 2k)$$

$$r = 9i + 2j + k + \mu(2i + j + 2k).$$ (4mks)

(c) Find to the nearest tenth of a degree, the acute angle between $r = i + 4k + s(2i - 3j + k)$ and the plane $r(i + 5j - 2k) = 17$. (4mks)

(d) Find the slope of the tangent line to the curve $r = 4cos\theta$ at the point where $\theta = \frac{\pi}{4}$. (4mks)

(e) Find the stationery points of $r = 1 + sin\theta$ and sketch the graph showing the relative positions of these points. (4mks)

QUESTION THREE (20 MKS)

(a) Find the area of the region R in the first quadrant within the cardioid $r = 1 - cos\theta$. (4mks)

(b) Derive the equation of motion $v^2 = u^2 + 2as$. (4mks)

(c) A box of mass $8kg$, standing on a rough horizontal ground is pulled by a string inclined at 30^0 to the horizontal . If the body is about to slide and $\mu = 0.5$, find the tension in the string. (4mks)

(d) Show that the points $(-1,-2), B(4,-1)$, $C(5,4)$ and $D(0,3)$ are vertices of a Rhombus (4mks)

(c) .Find the distance of the point $P(-1,5)$ from the line $l: x - 2y - 4 = 0$.(4mks)

QUESTION FOUR (20MKS)

(a)) Find the equation of the tangent and normal to the curve $y = 3x^2 - 8x + 5$ at the point where $x = 2$. (3mks)

(b) A uniform beam of mass $5kg$ and length $1.6m$ is laid horizontally across a smooth support at C and D at $10cm$ mark and $110cm$ mark. Find the reaction at C and D. (4mks)

(c) Find the equation of the set of points $P(x, y)$ that are equidistant from the origin O and the line $L: x = 4$. (4mks)

(d)). The motion of an object is governed by the equation $s = 60t - 2t^2$,where t is the time in seconds and s is the height of the object above the ground in metres. (take $g = 9.8m/s^2$).

(i) .Determine its velocity after 2 seconds. (2mks)

(ii).What is the maximum height reached by the object. (3mks)

(e) Find the equation of the common chord to the two circles $x^2 + y^2 - 14x + 2y + 40 = 0$ and $x^2 + y^2 - 2x - 4y - 20 = 0$ and hence find the coordinates of the points of intersection of the two circles. (4mks)

QUESTION FIVE (20 MKS)

(a). Find the equation of the circle which passes through the points $A(6,2)$, $B(8,-2)$ and $C(-1,1)$. (5mks)

(b) A block of wood is placed on a horizontal plank. The plank is tilted so that the angle of inclination increases to 25^0.At this angle the block begins to slide down the plank.

. Find the coefficient of friction. (4mks)

(c) Find the length of the tangents from the point $(8,5)$ to the

circle $(x-2)^2+(y+1)^2=16$. (4mks)

(d) Verify that the point $(1,2)$ lies on the circle $x^2+y^2-6x+4y-7=0$ and find the equation of the tangent at this point. (3 mks)

(e) A light rod AB rests to support one at A and one at B.The rod is in equilibrium when mass of $5kg$ and mass of $2kg$ are placed at $0.6\ m$ and $0.5m$ from ends A and B respectively. Given that the length of the rod is $2m$, find the reaction at the supports. (4mks)