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KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATIONS, 2024/2025 ACADEMIC YEAR
FIRST YEAR, FIRST SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS

KMA 2108: GEOMETRY I

DATE: 3RD DECEMBER 2024

TIME: 11:30AM – 1:30PM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE: COMPULSORY (30 MARKS)

- a) Find the distance of the points $(2, -1)$ from the line $3x + 4y = 6$. (3 Marks)
- b) Find the equation of the hyperbola with foci $(5, 2)$ and $(-1, 2)$ whose transverse axis is 4 units long. (4 Marks)
- c) Derive the equation of the ellipse having the Centre at the origin, one focus at $(5,3)$ and the length of semi-major axis is 5. (3 Marks)
- d) Find the angle between the lines $2x-3y+7 = 0$ and $7x+4y-9 = 0$. (3 Marks)
- e) Given the focus of a parabola is at $F(1,2)$ and the directrix is the line $y-5=0$. Find the equation of the parabola. (3 Marks)
- f) Find the equation of the line through the point $(2,3)$ and perpendicular to the line with the equation $2y + x = 4$ (3 Marks)
- g) The points $P(2,1)$, $Q(2,3)$, and $R(2,4)$ are the vertices of a triangle. Find the area of the triangle. (4 Marks)
- h) Determine the equation of the tangent to the circle $x^2 + y^2 - 2y + 6x - 7 = 0$ at the point $F(-2, 5)$. (4 Marks)
- i) Convert the polar equation $r = 7 \cos \theta$ into rectangular coordinate system. (3 marks)

QUESTION TWO: (20 MARKS)

- a) Given the parabola whose equation is $y^2 + 8y - 6x + 4 = 0$. Determine:
i. the coordinates of the vertex. (4 Marks)
ii. the coordinates of the focus. (2 Marks)
iii. equation of the directrix. (1 Mark)
- b) Find the length of the latus rectum of the curve $r \sin^2 \theta = \cos \theta$. (5 Marks)
- c) Find the Cartesian equation of $r = a(1 + 2 \cos \theta)$. (4 Marks)
- d) Convert the rectangular equation $x^2 + y^2 - 2ax = 0$ to polar form. (4 Marks)

QUESTION THREE: (20 MARKS)

- a) Given the ellipse $4x^2 + 9y^2 - 48x + 72y + 144 = 0$. Find:
- i) the lengths of the semi-major and semi-minor and coordinates of the vertices. (2 Marks)
 - ii) Coordinates of the foci. (2 Marks)
 - iii) the length and coordinates of the latera recta. (3 Marks)
 - iv) the eccentricity. (1 Mark)
 - v) Sketch the ellipse. (2 Marks)
- b) Derive the equation of the parabola with its vertex at (3,2) and focus at (5,2). (6 Marks)
- c) Find the coordinates of the points that is two-thirds of the distance from (5, -3) to (3, 6). (4 Marks)

QUESTION FOUR: (20 MARKS)

- a) Suppose a whispering chamber is 480 feet long and 320 feet wide.
- i) What is the standard form of the equation of the ellipse representing the room? (3 Marks)
 - ii) If two people are standing at the foci of this room and can hear each other whisper, how far apart are the people? (2 Marks)
- b) An arched underpass has the shape of a parabola. A road passing under the arch is 20 feet wide and the maximum height of the arch is 15 feet. Write an equation for the parabolic arch. (5 Marks)
- c) A circle is tangent to the line $2x - y + 1 = 0$, at the point (2,5) and center of the circle lies on the line $x + y = 9$. Find the equation of the line. (5 Marks)
- d) Show that $x^2 + 4x + y^2 - 4y + z^2 - 8z = 0$ is an equation of a sphere and hence find its centre and radius. (5 Marks)

QUESTION FIVE: (20 MARKS)

- a) Given the equation $4x^2 - 32x - y^2 - 4y + 24 = 0$, find;
- i) the lengths of the semi-major and semi-minor and coordinates of the vertices. (3 Marks)
 - ii) coordinates of the foci (2 Marks)
 - iii) the length and coordinates of the latera recta (2 Marks)
 - iv) the equations of the asymptotes (1 Mark)
 - i) Sketch the curve (2 Marks)
- b) A pair of buildings on a college campus are shaped and positioned like a portion of the branches of the hyperbola $225x^2 - 400y^2 = 90,000$ where x and y are in meters. How far apart are the buildings at their closest point? (4 marks)
- c) The design layout of a cooling tower is shown below. The tower stands 179.6 meters tall. The diameter of the top is 72 meters. At the closest, the sides of the tower are 60 meters apart. Obtain the equation which models the sides of the tower. (6 Marks)

