



**MAASAI MARA UNIVERSITY REGULAR
UNIVERSITY EXAMINATIONS
2023/2024 ACADEMIC YEAR
SCHOOL OF PURE, APPLIED AND HEALTH
SCIENCES
FIRST YEAR EXAMINATION FOR
THE DEGREE OF BACHELOR OF SCIENCE IN
MATHEMATICS,PHYSICS**

MAT:1207-1 ANALYTIC GEOMETRY

Instructions to candidates:

Answer Question 1 and TWO other Questions .

All Symbols have their usual meaning

DATE:

TIME:

Question 1(20 Marks)

- (a) With the aid of diagrams where necessary describe the plane Cartesian and the plane polar coordinate systems and show the relationship between them. (4 Marks)
- (b) Express the following polar coordinates in Cartesian form and draw a sketch to show the indicated points (4 Marks)
- (i) $(5, 30^\circ)$
 - (ii) $(2, 330^\circ)$
 - (iii) $(-2, -120^\circ)$
 - (iv) $(-3, -60^\circ)$
- (c) Express the following Cartesian coordinates in polar form (3 Marks)
- (i) $(1, \sqrt{3})$
 - (ii) $(-1, -\sqrt{3})$
 - (iii) $(1, -\sqrt{3})$
- (d) Determine the length of the straight line segment
- (i) from the (polar) point $(2, \frac{\pi}{6})$ to the point $(4, \frac{7\pi}{6})$ (2 Marks)
 - (ii) from the (Cartesian) point $(4, 2)$ to the point $(12, -4)$ (2 Marks)
- (e) Determine two points of intersection of the curves: $r^2 = 2b^2 \sin 2\theta$, $r = b$ where b is a non-zero constant (2 Marks)
- (f) Describe and illustrate (3 Marks)
- (i) right circular cone in 3-space
 - (ii) conic sections

Question 2 (15 Marks)

- (a) (i) Determine the polar equation of a circle of radius a with centre at (b, α) (5 Marks)
- (ii) Draw a sketch with $0 < \alpha < \frac{\pi}{2}$ (1 Mark)
- (b) (i) Determine the equation if the circle in part a passes through the origin (3 Marks)
- (ii) Determine the equation if the centre of the circle in part b is on the y-axis (3 Marks)
- (c) Write down the equation of a circle of radius 2 passing through the origin with centre on the y-axis (2 Marks)

Question 3 (15Marks)

- (a) A conic section has eccentricity e , focus at the origin and a vertical directrix L at a distance d to the left of F . Prove that if the curve is a parabola or an ellipse then the curve lies to the left of the origin and its equation is

$$r = \frac{ed}{1 - e \cos \theta} \quad (5 \text{ Marks})$$

- (b) The polar equation of a conic with a focus at the origin and a vertical directrix to the right of F is

$$r = \frac{6}{3 + \cos \theta}$$

Determine

- (i) the eccentricity e ,
 (ii) the distance from the focus to the directrix

Sketch the curve showing its position relative to the origin (6 Marks)

- (c) A conic section has eccentricity $\frac{1}{2}$, directrix $3x + 4y = 25$ and focus at the origin. Determine the distance from the focus to the directrix and draw a sketch to show the relative location of the curve in the

Cartesian xy plane (4 Marks)

Question 4 (15 Marks)

- (a) The equation of a curve is given by $r = r(\theta) = \sqrt{3} - \sin \theta$, $0 \leq \theta \leq 2\pi$

- (i) Determine values of θ for which $\frac{dr}{d\theta} = 0$
 (ii) Show that $r(\theta) = r(\pi - \theta)$
 (iii) Determine the minimum value of r
 (iv) Determine the maximum value of r
 (v) Write down $r(0)$, $r(\frac{\pi}{2})$, $r(\pi)$, $r(\frac{3\pi}{2})$

Sketch the curve (9 Marks)

- (b) Sketch the curve $r = 1 + 2 \sin \theta$
 and comment on any similarities and differences with the curve in part (a) (6 Marks)