(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2017/2018 ACADEMIC YEAR

FIRST YEAR SECOND SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION AND BACHELOR OF SCIENCE

COURSE CODE: MAT 122

COURSE TITLE: ELEMENTARY APPLIED MATHEMATICS

DATE: 08/08/18 **TIME:** 9 AM -11 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE COMPULSORY (30 MARKS)

(a) Briefly explain the following terms: (4 mks)

(i) Momentum

(ii) Impulse

(iii) Coefficient of restitution

(iv) Friction

(b) If θ is the angle between $\boldsymbol{p}$ and $\boldsymbol{q}$ prove that $\boldsymbol{p}.\boldsymbol{q} = \|\boldsymbol{p}\|\|\boldsymbol{q}\|cos\theta$ (4 mks)

(c) Triangle RST has vertices at R(-1,-2), S(-5,6) and T(7,3). Find the equation of the altitude from S (3 mks)

(d) Find the equation of the straight line joining the point (2,9) to the point of intersection of $2y = -7x + 18$ and $x - 12y + 22 = 0$ (4 mks)

(e) A body is thrown vertically upwards from the ground with an initial velocity of $20\ ms^{-1}$

(i) Determine the maximum height reached. (3 mks)

(ii) What velocity will the body have at 10m above the ground in its motion downwards? (2 mks)

(f) (i) Find a so that $2i - 3j + 5k$ and $2i + aj - 2k$ are perpendicular. (2 mks)

(ii) Find a unit vector perpendicular to the plane of the vectors $\boldsymbol{A} = 3i - 3j + 4k$ and $\boldsymbol{B} = i + j - 2k$ (4 mks)

(g) Two points (-1, -1) and (5, 7) are the end of a diameter of a circle. Find the equation of the circle in the form $x^2 + y^2 + ax + by = c$ (4 mks)

QUESTION TWO (20 MARKS)

(a) Represent the point with Cartesian coordinates (2,-2) in terms of polar coordinates (3 mks)

(b) Convert $r = -3cos\theta$ into Cartesian equation (2mks)

(c) Find the line through the points $A(-3,4,-5)$ and $B(-5,6,7)$ in parametric and symmetric forms (3 mks)

(d) Find the area enclosed between the curves $r_1 = 3cos\theta$ and $r_2 = 1 + cos\theta$ (6mks)

(e) Show that the equation of the circle through the midpoints of the sides of the triangle whose vertices are (a,0), (b,0) and (0,c) is $x^2 + y^2 = \frac{a+b}{2}x - \frac{ab-c^2}{2c}y$ (6 mks)

QUESTION THREE (20 MARKS)

(a) A body of mass $3kg$ is sliding down a smooth plane inclined at 30^0 to the horizontal.

(i)Show that the normal reaction exerted by the plane on the mass is given by $\frac{3\sqrt{3}}{2}g$ where g is the acceleration due to gravity. (5 mks)

(ii) Calculate the acceleration of the body down the plane. (3 mks)

(b) A uniform ladder $8m$ long weighing $220\ N$ rests on a rough ground and is propped against a vertical wall at an angle of θ^0 to the horizontal. If $\mu = 0.5$ for the ground and wall surfaces, find the value of θ when the ladder is just about to slip. (6 mks)

(c) Masses of 50g and 70g hang vertically from the ends of a light string which passes over a smooth pulley. The system is released. Find the speed of the masses after the larger one has descended 25cm. (4 mks)

(d) A particle P is projected from a point 5m above the ground. The horizontal and vertical components of the velocity of projection are each $24ms^{-1}$. Find the angle of projection. (2mks)

QUESTION FOUR (20 MARKS)

(a) Consider the plane $P = 2x + 3y - 7z = 17$ find the point of intersection of the plane with the line $x = 1 - 2t$ $y = -4t$ and $z = 3t - 1$ (4 mks)

(b) A particle of mass 150g travelling horizontally at 48 m/s hits a cliff and rebounds with a speed of 60 m/s. Find the impulse exerted on the ball. (2 mks)

(c) Write down the equation of the plane containing the points P(5,-2,2), Q(-2,0,2) and R(4,-1,7) (4 mks)

(d) Find the centre and radius of the circle passing through the points $A(-2,4)$, $B(2,7)$ and $C(7,-2)$ (7 mks)

(e) Show that from Newton's second law of motion $Force = kmass \times acceleration$ Where k is a constant (3 mks)

QUESTION FIVE (20 MARKS)

(a) Convert into Cartesian coordinates $(-2,\frac{\pi}{2})$ (2 mks)

(b) An object moves on a circular path of radius 10 cm at a velocity of $30ms^{-1}$. determine its frequency (3 mks)

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

(d) Write the equation of line L through A(-7,3,2) parallel to the vector $r = \langle 5,-3,1\rangle$ giving your answer in vector, parametric and symmetric forms (3 mks)

(e) If a line joins (-2,5,4) to (3,7,-2) find the direction angles (3 mks)

(f) Draw the graph of $r = 1 + sin\frac{\theta}{2}$ (5 mks)