KIIRA COLLEGE BUTIKI

Uganda Advanced Certificate of Education

PURE MATHEMATICS

Paper 1

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SECTION A (40 MARKS)

1. Solve the simultaneous equations;

   $x + y = 4$

   $x^2 + y^2 - 3xy = 76$ *(05 marks)*

2. Solve the equation; $\sqrt{3}\ \sin\theta - \cos\theta + 2 = 0$ for $0 < 0 < 2\pi$. *(05 marks)*

3. Find the equations of the lines which pass through the point A(3, -2) and makes an angle $\theta$with the line $2x - 3y – 4 = 0$, where $\tan\theta = 2$. *(06 marks)*

4. Show that $\frac{(\sqrt{3} - i)^5}{\sqrt{3} + i} = -16$ *(05 marks)*

5. If $y = A\, x^k$, where A and K are non – zero constants , find the values of K such that; $x^2 \frac{d^2y}{dx^2} + 2x \frac{dy}{dx} - 2y = 0$ *(05 marks)*

6. Using the substitution $x = e^t$, evaluate the $\int_1^e \frac{3 - 1nx}{x^2}\ dx.$ *(05 marks)*

7. Given that A and B are points whose position vectors are **a** = 2**i** + **k** and **b** = **i** - **j** + 3**k** respectively.
   Determine the position vector of the point that divides AB in the ratio -4 : 1 *(04 marks)*

8. Find the area bounded by the three curves $y = x^2$, $y = \frac{1}{4}x^2$ and $y = \frac{1}{x^2}$ in the first quadrant. *(05 marks)*

SECTION B (60 MARKS)

9. (a) Find $\int \frac{1}{x^3 \sqrt{x^2-4}}\,dx$ *(06 marks)*

(b) Evaluate $\int_3^4 \frac{x^3}{x^2-x-2}\,dx$ *(06 marks)*

10. (a) The eighth term of an arithmetic progression is twice the fourth term, and the sum of the eight terms is 30. Find the

(i) first four terms, *(06 marks)*

(ii) sum of the first 12 terms, of the progression *(02 marks)*

(b) Find the number of ways in which the letters of the word STATISTICS can be arranged in a straight line so that,

(i) the last two letters are both Ts. *(02 marks)*

(ii) all the three **Ss** must be together *(02 marks)*

11. (i) Given that the roots of the equation $ax^2 + bx + c = 0$ are α and β. Show that $a^2 = b^2 - 4ac$ if $\alpha - \beta = 1$. *(06 marks)*

(ii) Find a quadratic equation whose roots are $(\alpha + \alpha\beta)$ and $(\beta + \beta\alpha)$ in terms of a, b and c. *(06 marks)*

12. (a) Differentiate with respect to x,

(i) $2^{\cos x^2}$ *(03 marks)*

(ii) $\log_e \left(\frac{(1+x)\, e^{-2x}}{1-x}\right)^{½}$ *(03 marks)*

(b) (i) Determine the equation of the normal to the curve $y = \frac{1}{x}$ at the point x = 2. *(03 marks)*

(ii) Find the coordinates if the other point where the normal meets the curve again *(03 marks)*

13. (a) Given the points A (3, 1, 2) and B (2, -2, 4), find the sin e of the angle BOC.
Hence determine the area of triangle AOB. Where O is the origin. *(06 marks)*

(b) Show that the line $\frac{x-2}{2} = \frac{2-y}{1} = \frac{3-z}{-3}$ is parallel to the plane r .(4**i** – **j** – 3**k**) = 4.
Hence find the perpendicular distance between the line and the plane. *(06 marks)*

14. (a) Show that for any triangle ABC,
$\cos A + \cos B + \cos C = 1 + 4\sin\frac{A}{2}\sin\frac{B}{2}\sin\frac{C}{2}$ *(05 marks)*

(b) Prove that $\tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$, hence solve the equation
$\tan(x - 45^0) = 6\tan x$, where $-180^0 \leq x \leq 180^0$ *(07 marks)*

15. (a) Find the equation and radius of a circle passing through the points A (0,1), B (0, 4) and C (2 , 5). *(05 marks)*

(b) A circle passes through the point P(1, -4) and is tangent to the y-axis. If its radius is 5 units, find its equation *(07 marks)*

16. (a) Given that y = 0 when x = 0, solve the equation $\frac{dy}{dx} = 2y + 3$, expressing y as a function of x. *(05 marks)*

(b) When a uniform rod is heated it expands in such a way that the rate of increase of its length, l, with respect to the temperature, θ^0 C, is proportional to the length. When the temperature is 0^0C the length of the rod is L. Given that the length of the rod has increased by 1% when the temperature is 20^0C, find the value of θ at which the length of the rod has increased by 5%. *(07 marks)*