7. Solve the equation $\text{Cosec}\theta = 3 + 4\text{Sin}\theta$ for $0^o \leq \theta \leq 90^o$. *(05 marks)*

8. A continuous random variable X has a probability density function (pdf) given by

$$f(x) = \begin{cases} kx, & 0 \leq x \leq 4 \\ 0 & \text{elsewhere,} \end{cases}$$

where k is a constant.
Determine:

(a) the value of k. *(03 marks)*

(b) $P(1 < X < 3)$. *(02 marks)*

SECTION B (60 MARKS)

Answer only **four** *questions from this section, choosing at least* **one** *question from each part.* **All** *questions carry* **equal** *marks.*

PART ONE: PURE MATHEMATICS

9. (a) Solve the differential equation:

$$3x^2 + \frac{dy}{dx} - 4x = 0$$

given that $y = 6$ when $x = 1$. *(05 marks)*

(b) The rate of increase of the number of organisms x, in a controlled environment at any time t is proportional to the number of organisms present. Initially when time $t = 0$, the number of organisms present is x_0.

(i) Form a differential equation (DE) and solve the DE to show that $x = x_0 e^{kt}$, where k is a constant. *(07 marks)*

(ii) Find in terms of k, the time required for the number of organisms to double. *(03 marks)*

10. A farmer wishes to improve the harvest on a farm by adding fertilizers to both the maize and cabbage sections.The farmer plans to buy **at least** 5 kg of fertilizers for maize and **at least** 15 kg of fertilizers for cabbages. A kilogramme (kg) of fertilizers for maize costs Shs15,000 and a kilogramme of fertilizers for cabbages costs Shs10,000. The farmer has only Shs300,000 available for buying fertilizers. The quantity of fertilizers for cabbages should **not** exceed that for maize.

(a) If x represents the number of kilogrammes of fertilizers for maize and y the number of kilogrammes of fertilizers for cabbage, write **four** inequalities to represent the given information. *(04 marks)*

(b) (i) Illustrate the inequalities formulated in (a) on a graph by shading the unwanted regions.

(ii) Use your graph to list all the possible combinations of fertilizers that the farmer could buy to minimise the cost.

(08 marks)

(c) Calculate the lowest amount of money the farmer will spend on buying fertilizers. *(03 marks)*

11. The curve $y = 2x^2 + 1$ and the line $y = 2x + 5$ intersect at two points.

(a) Find the coordinates of the points of intersection. *(05 marks)*

(b) Sketch, on the same axes, the graphs of the curve and the line. *(04 marks)*

(c) Use the sketch drawn in (b) to determine the area enclosed between the curve and the line. *(06 marks)*

12. (a) The roots of the equation $7x^2 - 2x + 1 = 0$ are a and b. Form a quadratic equation with integral coefficients whose roots are $\frac{1}{a}$ and $\frac{1}{b}$. *(07 marks)*

(b) Three consecutive numbers $p - 4$, $p + 2$ and $3p + 1$ are in a geometric progression (G.P.). Find the two possible values of the common ratio of the G.P. *(08 marks)*

PART TWO: STATISTICS

13. The table below shows the ages (x) years and intelligence quotient, IQ (y) of 10 scholars from a certain country.

AGE (x) (years)	60	48	60	91	85	72	40	69	70	30
IQ (y)	185	181	142	196	174	157	150	193	170	160

(a) (i) Calculate the rank correlation coefficient between the age and IQ of the scholars.

(ii) Comment on your result. *(07 marks)*

(b) (i) Plot a scatter diagram for the data.

(ii) On the same diagram, draw a line of best fit.

(iii) Use the diagram to find the value of x when $y = 165$. *(08 marks)*

14. The discrete random variable X has a probability distribution as:

$P(X = 0) = P(X = 4) = k$; $P(X = 1) = P(X = 3) = 2k$ and $P(X = 2) = 4k$.

Determine the;

(a) value of k. *(03 marks)*