SECTION A (40 MARKS)

Answer **all** *the questions in this section.*

1. (a) Express $\sqrt{147} - \sqrt{75}$ in the simplest surd form. *(02 marks)*

   (b) Rationalize $\dfrac{5 + 2\sqrt{3}}{2 + \sqrt{3}}$. *(03 marks)*

2. Two events A and B are such that $P(A) = 0.35$, $P(A \cap B) = 0.2$ and $P(A' \cap B') = 0.45$. Find $P(A/B)$. *(05 marks)*

3. Given the vectors $\boldsymbol{a} = 2\boldsymbol{i} - 4\boldsymbol{j}$ and $\boldsymbol{b} = 3\boldsymbol{i} + 5\boldsymbol{j}$, evaluate the modulus $|5\boldsymbol{a} + 2\boldsymbol{b}|$. *(05 marks)*

4. The table below shows the prices in shillings (Shs) of commodities X, Y and Z with their corresponding weights for the years 2015 and 2020.

COMMODITY	PRICE (Shs)		WEIGHT
	2015	2020	
X	1100	1500	25
Y	2000	3200	20
Z	4500	5000	05

   (a) Using 2015 as the base year, calculate the weighted aggregate price index. *(04 marks)*

   (b) Comment on your result. *(01 mark)*

5. Solve the equation:

   $\text{Cosec}\,\theta + 2\text{Cot}^2\,\theta = 1$, for $0° \leq \theta \leq 90°$ *(05 marks)*

6. A continuous random variable (X) has the probability density function (pdf) given by

$$f(x) = \begin{cases} cx\left(\frac{x}{2} + 1\right), & 0 \leq x \leq 3 \\ 0, & \text{otherwise} \end{cases}$$

   where c is a constant.

   Determine the;

   (a) value of C. *(02 marks)*

   (b) $P(X > 2)$. *(03 marks)*

7. Given that $y = 2t^2 - 5t$, show that $t^2\frac{d^2y}{dt^2} - 2t\frac{dy}{dt} + 2y = 0$. *(05 marks)*

8. A basketball team played five matches and the chance of winning any match was 0.85. Determine the probability that the team won **at least** 3 matches. *(05 marks)*

SECTION B (60 MARKS)

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

PART ONE: PURE MATHEMATICS

9. (a) Given that the roots of the equation $3x^2 - 18x - q = 0$ differ by 8, find the value of q. *(08 marks)*

(b) The sum of the first 15 terms of an arithmetic progression (A.P) is 615. The 13^{th} term is six times the 2^{nd} term. *(07 marks)*

Determine the;

(i) first term of the A.P.
(ii) common difference of the A.P.

10. A furniture company has received an order from a school to supply **at least** 100 single seater desks and **at least** 120 stools. The consignment must **not** exceed 300 items. A single seater costs Shs50,000 while a stool costs Shs25,000. At least 8 million shillings is available for the purchase of the single seaters and the stools.

(a) If x represents the number of single seaters and y the number of stools, form **four** inequalities to represent the given information. *(04 marks)*

(b) Using a scale of 1 cm to represent 25 items on each axis, draw a graph to illustrate the inequalities formed in (a). *(05 marks)*

(c) Use your graph to determine the;

(i) number of single seaters and stools the company must supply to maximise revenue. *(04 marks)*

(ii) maximum revenue. *(02 marks)*

11. A curve is defined by the equation $y = x^2 - 5x + 6$.

(a) Determine the coordinates of the stationary point of the curve. *(05 marks)*

(b) Sketch the curve. *(06 marks)*

(c) Find the area enclosed between the curve and the x – axis. *(04 marks)*

12. The rate of increase of a population of an organism at any time t days is proportional to its population size N. Initially the population was 100 and after one day it increased by 100.

(a) (i) Form a differential equation for the given information. *(02 marks)*

(ii) Solve the differential equation. *(08 marks)*

(b) Calculate the; *(02 marks)*

(i) size of the population after 5 days.

(ii) number of days that will elapse for the population to triple. *(03 marks)*

PART TWO: STATISTICS

13. The heights in centimetres (cm) and masses in kilograms (kg) of eight students ($A - H$) are given in the table below.

STUDENT	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
HEIGHT, *x* (cm)	154	157	137	172	155	145	151	165
MASS , *y* (kg)	40	42	32	59	44	35	40	52

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

(ii) Draw a line of best fit on the scatter diagram.

(iii) Use your line of best fit to estimate the mass of a student whose height is 160 cm. *(09 marks)*

(b) Calculate the rank correlation coefficient for the data. *(06 marks)*

14. The discrete random variable X has a probability distribution shown in the table below.

x	1	2	3	4	5
$P(X=x)$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{5}$	t	$\frac{1}{5}$

(a) (i) Find the value of t. *(02 marks)*

(ii) Sketch the graph of the probability distribution. *(03 marks)*

(b) Determine the:

(i) $P(1 < X < 4)$. *(03 marks)*

(ii) Expectation $E(X)$. *(04 marks)*

(iii) Standard deviation of X. *(03 marks)*

15. The table below shows the ages of patients who visited a health centre on a certain day.

Age (years)	0 – 9	10 – 19	20 – 29	30 – 39	40 – 49	50 – 59	60 – 69
No. of Patients	2	10	15	14	8	2	1

(a) Calculate the standard deviation for the ages. *(08 marks)*

(b) (i) Draw a cumulative frequency curve (Ogive) for the given data.

(ii) Use your Ogive to estimate the median age.

(07 marks)

16. The table below shows the number of motorcycles sold by a certain company from 2017 to 2019.

YEAR	**QUARTER**			
	1st	**2nd**	**3rd**	**4th**
2017	65	82	67	84
2018	67	84	71	90
2019	73	90	75	96

(a) Calculate the four-point moving averages for the data. *(04 marks)*

(b) (i) On the same axes, draw a graph of the original data and the moving averages. *(06 marks)*

(ii) Comment on the trend of the number of motorcycles sold over the 3 – year period. *(01 marks)*

(c) Use your graph to estimate the number of motorcycles that were sold in the first quarter of 2020. *(04 marks)*