



FORTPORTAL CITY UACE MATHEMATICS-2024 SEMINAR
APPLIED MATHEMATICS – 02th Nov 2024 – St LEO’S COLLEGE KYEGOBE
PAPER FORMAT

SETTING AREA		NO. OF QNS		TOPICS
		A	B	
1. MECHANICS	DYNAMICS	1	1	<ul style="list-style-type: none"> Newton’s laws of motion and related topics e.g; <ul style="list-style-type: none"> Connected particles Linear momentum Friction (dynamic) Work energy and power. Elasticity S.H.M Circular motion
	KINEMATICS	1	1	<ul style="list-style-type: none"> Linear motion Projectiles Resultant velocity and motion. Vector mechanics
	STATICS	1	1	<ul style="list-style-type: none"> Coplanar forces. Moments Equilibrium of rigid bodies Jointed rods Centre of gravity. Friction (static)
NUMERICAL METHODS		2	2	<ul style="list-style-type: none"> Linear interpolation/extrapolation. Trapezium rule. Error Analysis. Location and estimation of roots. Flow charts.
STATISTICS		1	1	<ul style="list-style-type: none"> Correlation and scatter graphs. Descriptive statistics. Index numbers
PROBABILITY All in this section, two questions in	PROBABILITY THEORY	≤ 1	≤ 1	<ul style="list-style-type: none"> Theory of events. Tree diagrams.
	DISCRETE	≤ 1	≤ 1	<ul style="list-style-type: none"> General discrete

section A and two in B will be set. Care is taken that a subsection does not dominate.	RANDOM VARIABLES			random variables.
	CONTINUOUS RANDOM VARIABLES	≤ 1	≤ 1	<ul style="list-style-type: none"> Binomial distribution General continuous random variables. Uniform distribution. Normal distribution. Normal approximation to binomial. Distribution of the sample mean. Estimation and confidence intervals.

STATISTICS AND ELEMENTARY PROBABILITY

Question 1 – KYEBAMBE GIRLS' SECONDARY SCHOOL

a) The table below shows the prices of items for the years 2016 and 2017

Item	PRICE (,000 Shs)		Weights
	2016	2017	
A	25	28	5
B	x	y	3
C	30	36	2

Given that the simple aggregate price index and the weighted mean price index for 2017 based on 2016 are 120 and 119 respectively; Find the value of x and y.

(05 marks)

b) The table below shows grades in Maths and ICT obtained by eight students in a mock examination.

Maths	A	O	E	B	C	B	F	D
ICT	D ₂	F ₉	C ₄	D ₁	D ₁	C ₃	P ₈	C ₆

Calculate the rank correlation, comment on your results.

(05 marks)

Question 2 – St MARIA GORRETTI SECONDARY SCHOOL

The table below shows the cumulative frequency of ages of 240 students admitted to a certain university.

Age(years)	<18	<19	<20	<24	<26	<30	<32
Cumulative frequency	0	24	94	170	218	234	240

a) Calculate the;

(i) Mean age

(ii) The 20th to the 70th percentile range.

(05 marks)

b) Draw an ogive and use it to find the median age.

(07 marks)



Question 3 – St LEO’S COLLEGE KYEGOBE

The table below shows marks scored by 8 students in mock and UNEB final examinations in Applied Mathematics.

Mock Examination	79	67	52	71	97	55	41	86
Final Examination	75	60	45	55	85	43	30	70

- a) (i) Draw a scatter diagram for the data and comment on your result.
(ii) On the same diagram draw a line of best fit.
(iii) Use the line of best fit to estimate the mark that a student who scored 68 in mock will score in UNEB.
- b) Calculate the rank correlation coefficient for the marks in Mock and UNEB and comment on your result.

Question 4 – St MARY’S SEMINARY, VIRIKA

- a) Two events X and Y are such that $P(X) = \frac{2}{5}$, $P(X/Y) = \frac{1}{2}$ and $P(Y/X) = \frac{2}{3}$, find;
- (i) $P(X \cap Y')$
(ii) $P(Y'/X')$ (06 marks)
- b) A box P contains 3 red and 5 black balls, while another box Q contains 6 red and 4 black balls. A box is chosen at random and from it a ball is picked and put in another box. A ball is then randomly drawn from the later. Find the probability that;
- (i) Both balls are red
(ii) First ball drawn is black given that the balls picked were of different colors. (06 marks)

RANDOM VARIABLES

Question 5 – MONT CLAIR SECONDARY SCHOOL

A random variable X takes the integer value x with $P(x)$ defined by;

$$P(X=1)=P(X=2)=P(X=3)=kx^2, P(X=4)=P(X=5)=P(X=6)=k(7-x)^2$$

Find the;

- a) value of the constant k , hence sketch the graph of $f(x)$.
b) $E(Y)$ and $\text{Var}(Y)$ where $Y=4X-2$.

Question 6 – KAMENGO SECONDARY SCHOOL

- a) The chance that Moses wins a game is $\frac{1}{3}$. If he plays nine games in a row, what is the;
- (i) expected number of games,
(ii) chance of winning at least two games.



- c) At a bottle manufacturing factory, the new machine approximately makes 19% of the bottles that are damaged. If a random sample of 200 bottles is taken, find the probability that;
- (i) more than 31 bottles will be damaged,
 - (ii) between 30 and 40 bottles inclusive will be damaged.

Question 7 – CITY HILL CHRISTIAN SCHOOL

The continuous random variable Y has a cumulative distribution function given by;

$$F(x) = \begin{cases} 0; & y < 1 \\ Ay^2(y^2 - 1); & 1 < y < 2 \\ 1; & y > 2 \end{cases}$$

Find the:

- a) value of A .
- b) 90th Percentile
- c) $f(x)$, probability density function of Y .
- d) $E(X)$
- e) $\text{Var}(2Y + 3)$

Question 8 – NYAMIRIMA VILLAGE SECONDARY SCHOOL

A continuous random variable X , is such that $X \sim R(a, b)$.

Show that;

- a) $E(2X + b) = a + 2b$
- b) $\text{Var}\left(\frac{X}{a+b}\right) = \frac{1}{12}\left(\frac{a-b}{a+b}\right)^2$
- c) The cumulative mass function of X , $F(x) = \frac{x-a}{b-a}; a < x < b$

Question 9 – RUTEETE SECONDARY SCHOOL

A continuous random variable X has a probability density function defined by;

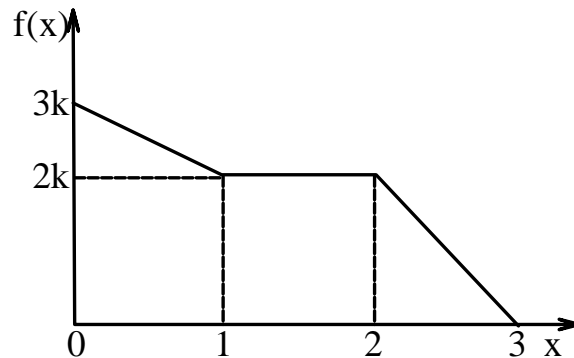
$$f(x) = \begin{cases} \frac{k}{2} & ; 0 < x < 2 \\ \frac{k}{2}(3-x) & ; 2 < x < 3 \\ 0 & ; \text{elsewhere} \end{cases}$$

- a) Sketch $f(x)$ and hence find the constant k .
- b) Find the;
 - (i) Mean, $E(X)$
 - (iii) $P\left(x \leq 1.5 / x > 1\right)$

(12 marks)

Question 10 – TOORO PEAS HIGH SCHOOL/ SHALOM HIGH SCHOOL

The sketch below is of a probability density function of a continuous random variable ,X.



- Find the value of k .
- Obtain the probability density function, $f(x)$ for X .
- Find the mode and the semi inter quartile range of X .

Question 11 – ST JOHN’S KIBIITO HIGH SCHOOL

On day one of the Coachella music festival, the height of the revelers can be modeled into a normal distribution with mean 1.75 m and variance 0.0064 m^2 . A draw is to be carried out and it is decided that one should have a height greater than 1.67 m but less than 1.83m to participate.

- Find the:
 - Percentage of the people who qualify to take part in the draw.
 - fraction that is rejected because they are too tall.
- By day three of the event, the heights of the people present are normally distributed with mean μ , and standard deviation 0.085m. When the criteria used to select participants is not altered, 3.5% of the revelers are rejected because they are too short.
 - Find the:
 - value of μ
 - probability that a reveler whose height exceeds the mean qualifies to take part in the draw.

Question 12 – St MARIA GORETTI SEC. SCHOOL

The marks in an examination were normally distributed with mean μ and standard deviation σ . 30% of the candidates scored more than 60 marks and 55% scored between 35 and 60 marks. Find the;

- values of μ and σ *(08 marks)*
- percentage of candidates who scored more than 50 marks. *(04 marks)*



NUMERICAL METHODS

Question 13 – St LEOS’S COLLEGE KYEBOBE

(a) Use trapezium rule with five strips evaluate $\int_3^4 \frac{1}{\sqrt{(x-1)^2 - 3}} dx$, correct to three decimal places.

(b) Find the exact value of $\int_3^4 \frac{1}{\sqrt{(x-1)^2 - 3}} dx$.

(c) Find the percentage error in the approximation in a) above and suggest how this error can be reduced. (12 marks)

Question 14 – KYEBAMBE GIRLS’ SECONDARY SCHOOL

a) The positive decimal numbers X and Y were approximated with errors E_1 and E_2 respectively. Show that the maximum possible relative error in the approximation of the product X^3Y^2 is $3\left|\frac{E_1}{X}\right| + 2\left|\frac{E_2}{Y}\right|$. (07 marks)

b) Given that $X = 5.64$ and $Y = 10.0$, rounded off to the given number of decimal places. Find the;

(i) Maximum possible errors in X and Y .

(ii) Percentage error made in the approximation of X^3Y^2 . (05 marks)

Question 15 – CITY HILL CHRISTIAN SCHOOL

a) Show that the equation $\ln x = \sin x + 2$ has a root between $x = 3$ and $x = 4$. Use linear interpolation to estimate the initial approximation x_0 to one decimal place.

b) Using the x_0 above and the Newton Raphson method find the root correct to 3 decimal places. (12 marks)

Question 16 – MONT CLAIR SECONDARY SCHOOL

The iterative formulae below are used for calculating the positive root of the equation $f(x) = 0$.

$$A: x_{n+1} = \frac{1}{3} \left(\frac{2x_n^3 + 12}{x_n^2} \right)$$

$$B: x_{n+1} = \sqrt{\left(\frac{x_n^3 + 12}{2x_n} \right)}$$



- a) Taking $x_0 = 2$, use each formula twice and hence deduce the most suitable for solving $f(x) = 0$.
- b) Find the root of the equation $f(x) = 0$ correct to three decimal places.
- c) Find the equation whose root is in b) above. (12 marks)

Question 17 – NYAMIRIMA VILLAGE SECONDARY SCHOOL

- a) The table below shows the values of x and their corresponding natural logarithm

x	5.0	5.2	5.4	5.7	6.0
$\ln x$	1.609	1.647	1.686	1.740	1.792

Use linear interpolation or extrapolation to find;

- (i) $\ln(5.56)$
- (ii) $e^{1.575}$. (05 marks)
- b) A car consumed fuel amounting to Shs 14,800, Shs 15,600, Shs 16,400 and Shs 17,200 in covering distances of 10km, 20km, 30km and 40km respectively. Estimate the;
- (i) Cost of fuel consumed for a distance of 45 km,
- (ii) Distance travelled if fuel of shs 16,000 is used. (05 marks)

MECHANICS

Question 18 – RUTEETE SECONDARY SCHOOL

A particle of mass 2 kg is acted upon by a force $F = 54t^3\mathbf{i} + 24t^3\mathbf{j} - 18t\mathbf{k}$ where t is time. Initially, the particle is located at a point with position vector $(1, 0, 0)$ m and moving with velocity $(1, 0, 1)$ ms^{-1} .

- (a) Determine its distance from the origin after 2s.
- (b) Determine the work done in the time interval $t = 1\text{s}$ to $t = 2\text{s}$.

Question 19 – KAMENGO SECONDARY SCHOOL

ABCDEF is a regular hexagon of side 2 m. Forces of 3.5N, 4N, 6N, 1.5N, 3N and 2N act along the sides AB, BC, CD, ED, FE and FA respectively with the direction of the forces being indicated by the direction of letters. Find the;

- a) magnitude and direction of the resultant force.
- b) Equation of line of action of the resultant force and hence or otherwise find where it cuts AB.

Question 20 – TOORO PEAS HIGH SCHOOL/SHALOM HIGH SCHOOL

At noon, ships A and B are 65km apart with B due south of A. Ship A is sailing due East at a constant velocity of 20kmh^{-1} . At the same time ship B is sailing in the direction

$N60^{\circ}E$ at a constant velocity of 15 kmh^{-1} . If they continue sailing with these velocities in these directions, Determine the;

- time at shortest distance
- shortest distance.

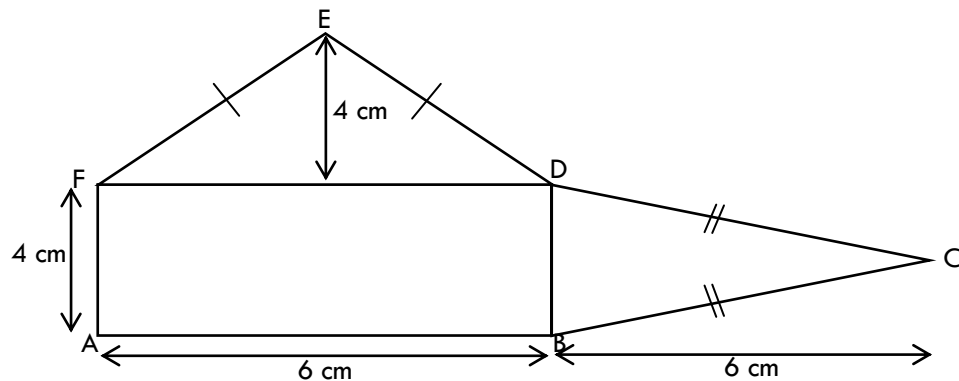
Question 21 – ST MARY’S SEMINARY , VIRIKA

A car of mass 1200 kg pulls a trailer of mass 300 kg up a slope of 1 in 100 against a constant resistance of 0.2 N per kg . Given that the car moved at a constant speed of 1.5 ms^{-1} for 5 minutes, calculate the;

- tension in the tow bar.
- work done by the car engine during this time
- a car has an engine that can develop 15 kW . If the maximum speed of the car on a level road is 120 kmh^{-1} , calculate the total resistance at this speed.

Question 22 – ST LEO’S COLLEGE KYEGOBE

The figure ABCDEF is made up of three laminas that are as indicated in the diagram below.



- Determine the centre of gravity from AB and AF taken as the x and y axes respectively (state it as a coordinate).
- The lamina is freely suspended through a smooth pivot at A and hangs in equilibrium under its own weight, find the angle θ between the side AB and the vertical.

JAMES 1:5

NB: ENDEAVOR THAT THE CANDIDATES GET AT-LEAST A COPY OF THIS QUESTION PAPER AND MATHEMATICAL TABLES AND FORMULAE.