P425/2
APPLIED MATHEMATICS
Paper 2
July/Aug. 2023
3 hrs.

UGANDA TEACHERS' EXAMINATIONS SCHEME

Uganda Advanced Certificate of Education

JOINT MOCK EXAMINATIONS

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

Attempt **all** *the* **eight** *questions in section* **A** *and any* **five** *questions from section* **B**.

Any additional question (s) answered will **not** *be marked.*

All *necessary working* **must** *be shown clearly.*

Begin each answer on a fresh sheet of paper.

Graph paper is provided.

Silent non – programmable scientific calculators Mathematical tables.

with a list of formulae may be used.

In numerical work, take acceleration due to gravity g to be $= 9.8ms^{-2}$.

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SECTION A (40 MARKS)

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

1. The table below shows the cost in shillings for hiring a motorcycle for a given distance kilometers.

Distance (km)	10	20	30	40
Cost (shs)	2800	3600	4400	5200

Use linear interpolation/ extrapolation to find;

(i) The cost of hiring a motorcycle for a distance of 45km *(03 marks)*

(ii) The distance travelled if one pays shs. 4000 *(02 marks)*

2. Two forces have magnitudes 5N and PN. If the resultant force has a magnitude 6N and acts at an angle of 40^0 to the 5N force, find the value of P. *(05 marks)*

3. Events A and B are such that $P(A) = {}^{1}/_{3}$, P(Ḃ)¼ and $P(A \cup B) = {}^{5}/_{12} + P(A \cap B)$, Calculate the;

(a) $P(A \cap B)$ *(02 marks)*

(b) $P({}^{B}/_{A'})$ *(03 marks)*

4. A particle of mass 200g and velocity $5\mathbf{i} + 7\mathbf{i}$ ms^{-1} collides with a particle of mass 300g and velocity $2\mathbf{i} - 3\mathbf{i}$ ms^{-1} if the particles couple together, find the;

(a) Common speed. *(02 marks)*

(b) Loss in kinetic energy *(03 marks)*

5. In Mbale college school,40% of the students supported Newcastle united in the premier league. If a random sample of 150 students is selected, find the probability that 55 students supported Newcastle united. *(05 marks)*

6. Nine voters in Kampala and Jinja were asked to give the government a score out of 100 on each of the nine issues. The results are shown below.

Issues	A	B	C	D	E	F	G	H	I
Kampala	62	54	46	34	54	46	36	29	14
Jinja	76	56	46	37	35	27	46	17	17

(i) Calculate the rank correlation coefficient between the voters in the two districts.

(ii) Comment on your results *(05 marks)*

7. A particle of mass 10kg is placed on a smooth plane inclined at $tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$ to the horizontal. Find the;

(i) Magnitude of the horizontal force required to keep the particle in equilibrium.

(ii) Normal reaction. *(05 marks)*

8. Use trapezium rule with five strips to find $\int_0^1 \frac{1}{1+sinx}\,dx$ correct to three decimal places. *(05 marks)*

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SECTION B (60 MARKS)

Answer any **five** questions in this section.

9. (a) A machine cuts poles whose lengths are normally distributed with mean 4.2m and standard deviation 1.2m. if a random sample of 100 poles is selected, find the probability that a pole selected at random has its mean sample length;

(i) In the range 4.0m to 4.4 *(04 marks)*

(ii) More than 4.1m *(03 marks)*

(b) A survey of 150 households asked how many people regularly eat bread for breakfast. The results of the survey are summarized below;

$\sum x = 173$ and $\sum x^2 = 355$.

Calculate the;

(i) Unbiased estimate of population variance. *(02 marks)*

(ii) 97.5% confidence interval for the mean number of people who regularly eat bread for breakfast. *(03 marks)*

10. A particle of mass 4kg is acted upon by force F at time, t where $\mathbf{F} = 4\mathbf{i} - 24t^2\,\mathbf{j} + 36t\mathbf{k}$. Initially the particle is at a point with position vector **i-5j-k** and its velocity is $3(\mathbf{i} + \mathbf{j})$. find the;

(a) The magnitude of acceleration after t = 3s *(04 marks)*

(b) The position vector of the particle at any time, t *(03 marks)*

(c) The work done by the particle after t = 3s *(05 marks)*

11. A function *f(x)* has the iterative formula based on Newton Raphson method given by

$$x_{n+1} = \left(\frac{x_n \cos x_n - \sin x_n + 1}{2 + \cos x_n}\right); \; n = 0,1,2,3,\ldots\ldots$$

(a) Derive the expression for the function *f(x)* *(03 marks)*

(b) Show that the equation $f(x) = 0$ has a root between $x = 0.3$ and $x = 0.4$. *(03 marks)*

(c) Use the Newton Raphson method to find the root of the equation $f(x)$ correct to three decimal places. *(06 marks)*

12. The table below shows the distribution of marks of a group of candidates during an examination.

Marks	Number of candidates
0-<10	10
10-<20	35
20-<40	65
40-<60	107
60-<70	123
70-<95	140

(a) Calculate the;

(i) Mean mark *(03 marks)*

(ii) Standard deviation. *(03 marks)*

(b) Draw a cumulative frequency curve and use to find;

(i) The medium mark

(ii) Middle range of 50% of the students who did the examination *(06 marks)*

13. Two bodies P and Q are simultaneously projected from a point O with the same speed but at different angles of elevation, and they both pass through a point C which is a horizontal distance 2h from O and at a height h above the level of O. The body P is projected at an angle $\tan^{-1}(2)$ above the horizontal. Show that;

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(a) The speed of projection is $\sqrt{\frac{10gh}{3}}$ *(04 marks)*

(b) Q is projected at an angle $\tan^{-1}(4/3)$ to the horizontal. *(04 marks)*

(c) The time interval between the arrivals of the two bodies at C is

$(3-\sqrt{5})\sqrt{\frac{2h}{3g}}$ *(04 marks)*

14. A continuous random variable X is defined by the pdf

$$f(x)= \begin{cases} k(x-\frac{1}{a}), & 0<x<3 \\ 0, & elewhere \end{cases}$$

Given that $P(x>1) = 0.8$, find the;

(a) Values of k and a *(06 marks)*

(b) Probability that x lies between 0.5 and 2.5 *(03 marks)*

(c) Mean of x. *(03 marks)*

15. Two numbers a and b are approximated by A and B with errors Δa and Δb respectively. Show that the relative error in approximating $\frac{a}{b}$ by $\frac{A}{B}$ is

$\left|\frac{\Delta a}{A}\right| + \left|\frac{\Delta b}{B}\right|$ *(06 marks)*

Determine the interval within which the exact value of $R = \frac{50.654}{6.4563}$ lies.

(06 marks

16. Six forces of magnitudes 7N, 5N, 4N, 1N, $5\sqrt{2}$N and $3\sqrt{2}$N along the lines **AB, BC, CD, DA, AC** and **BD** respectively of a square ABCD of side 1m. the direction of the forces is given by the order of letters. Taking AB and AD as reference axes, find;

(a) The magnitude, direction of the resultant force. *(08marks)*

(b) Where the line of action cuts the x-axis. *(04 marks)*

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