

P425/2  
**APPLIED MATHEMATICS**  
**PAPER 2**  
July/August 2024  
3 hours



**WAKISSHA JOINT MOCK EXAMINATIONS**

**Uganda Advanced Certificate of Education**

**APPLIED MATHEMATICS**

**Paper 2**

3 hours

**INSTRUCTIONS TO CANDIDATES:**

- Attempt all questions in section A and any five questions from section B.
- Any additional question(s) answered will not be marked.
- All working must be shown clearly.
- Begin each answer on a fresh sheet of paper.
- Silent non programmable scientific calculators and mathematical tables with a list of formulae may be used.
- In numerical work, take  $g$  to be  $9.8\text{ms}^{-2}$ .
- State the degree of accuracy at the end of the answer to each question attempted using a calculator or table and indicate **Cal** for calculator, or **Tab** for mathematical tables.



### SECTION A (40 MARKS)

Answer all questions in this section.

1. Two events A and B are such that  $P(A) = \frac{1}{2}$ ,  $P(A \text{ or } B \text{ but not both } A \text{ and } B) = \frac{1}{3}$  and  $P(B) = \frac{1}{4}$ . Calculate; (03 marks)
  - $P(A \cap B)$  (02 marks)
  - $P(B'/A)$
2. In an examination, scaling is done such that a student K whose original mark is 35% gets 50% and student N whose original mark is 40% becomes 65%  
Determine the;
  - original mark for student M whose new mark is 80%
  - new mark for a student whose mark is 37%(05 marks)
3. A particle moving in a straight line covers distances of 90 meters and 240 meters in successive times of 2 seconds and 4 seconds respectively.  
Find the;
  - acceleration of the particle
  - initial velocity of the particle.(05 marks)
4. A discrete random variable y has a probability density function (p.d.f) given as;  

$$P(y = y) = \begin{cases} Ky^2 & ; y = 1, 2, 3 \\ K(y+1) & ; y = 4, 5 \\ 0 & , \text{ otherwise} \end{cases}$$
 Determine the;
  - value of constant K
  - mean of y
  - $P(2 < y \leq 4)$(05 marks)
5. The pressure (P), absolute temperature (T) and volume (V) of a fixed mass of a gas is given by the following relationship:  $P = \frac{KT}{V}$ , where K is the constant of proportionality. If  $e_1$  and  $e_2$  are the errors made in measuring the absolute temperature and volume respectively, show that the maximum possible relative error made in pressure is  $\left| \frac{e_1}{T} \right| + \left| \frac{e_2}{V} \right|$   
(05 marks)
6. A football striker took a free kick with a velocity of  $21 \text{ ms}^{-1}$  at  $30^\circ$  above the horizontal. The defender intercepted it with a header at a height of 3 m above the ground.  
Calculate the speed of the ball at impact. (05 marks)

7. The price relatives for the years 2000 and 2004 and their weights of a house hold expenditure on essential goods are given in the table below.

Item	Price Relatives		Weight
	2000	2004	
Food	100	125	35
Water	100	121	11
Rent	100	112	8
Electricity	100	108	6
Transport	100	118	22

Calculate the;

- (a) cost of living index for 2004. Comment on your results. (03 marks)  
 (b) cost of a cloth in 2004 that cost UGX 11,200 in 2000. (02 marks)

8. A particle executing simple harmonic motion about a point O has speeds of  $3\sqrt{3} \text{ ms}^{-1}$  and  $3 \text{ ms}^{-1}$  when covering distances 1m and 0.268 m respectively from the end point. Find the amplitude of the motion. (05 marks)

### SECTION B (60 MARKS)

Answer any five questions from this section.

All questions carry equal marks.

9. At 7:30a.m daily, a bus leaves Kampala for Jinja. The times (minutes) taken to cover the journey were recorded over a certain period of time shown in the table below;

Time(min)	80-84	85-89	90-94	95-99	100-104	105-109	110-114	115-119
Frequency	10	15	35	40	28	15	4	3

- (a) Calculate the;  
 (i) Mean time of travel from Kampala to Jinja by the bus.  
 (ii) Median time of travel (07 marks)
- (b) (i) Draw a cumulative frequency curve. (Ogive) for the data.  
 (ii) Use the Ogive to estimate the number of times the bus arrived in Jinja between 9:00a.m to 9:25a.m (05 marks)

10. (a) A square lamina ABCD of side 2M is made of uniform thin material. When a semi-circular piece with AB as its diameter is removed from square, show that the centre of mass of the remaining lamina is at a distance  $\frac{20M}{3(8-\pi)}$  from the line AB. (07 marks)

- (b) The remainder of the lamina is suspended from a light string attached to C and hangs in equilibrium. Show that CD is inclined to the down ward vertical at angle  $\alpha$  where;  $\tan \alpha = \frac{2(14-3\pi)}{3(8-\pi)}$  (05 marks)

11. (a) Use the trapezium rule with 6 ordinates to estimate the values of  $\int_1^2 \left( \frac{x}{7x^2 - 3} \right) dx$ , correct to four significant figures. (05 marks)
- (b) (i) find the exact value of  $\int_1^2 \left( \frac{x}{7x^2 - 3} \right) dx$ , correct four significant figures.  
 (ii) Calculate the percentage error in your calculation in (a) above.  
 (iii) Suggest how the percentage error may be reduced. (07 marks)

Turn Over

12. Box X contains 4 red battons and 3 green battons. Box Y contains 5 red and 6 green battons. Box X is twice as likely to be picked as box Y. A box is chosen at random and two battons are removed from it at a time without replacement. Find the probability that the two battons removed are of the same colour. (05 marks)
- (a) Find the probability that the two battons removed are of the same colour. (05 marks)
- (b) Construct the probability distribution table for the number of red battons picked. (04 marks)
- (c) Calculate the mean number of red battons. (03 marks)
13. A particle moving with an acceleration given by:  
 $\mathbf{a} = (4e^{-3t} \mathbf{i} + 12 \sin t \mathbf{j} - 7 \cos t \mathbf{k}) \text{ ms}^{-2}$  is initially located at the point  $(5, -6, 2)$  and velocity  $\mathbf{V} = (11 \mathbf{i} - 8 \mathbf{j} + 3\mathbf{k}) \text{ ms}^{-1}$
- Find the; (02 marks)
- (a) magnitude of the acceleration when  $t = 0$ . (04 marks)
- (b) velocity at any time  $t$  seconds. (06 marks)
- (c) displacement at time  $t = 1$  second. (06 marks)
14. (a) Use a graphical method to show that the equation  $e^x + x - 4 = 0$  has only one real root. Hence obtain to one decimal place, an approximate root of the equation. (06 marks)
- (b) (i) Show that the Newton Raphson formula for estimating the root of the equation  $e^x + x - 4 = 0$  is given by  $x_{n+1} = \frac{e^{x_n}(x_n - 1) + 4}{e^{x_n} + 1}$ ,  $n = 0, 1, 2, 3, \dots$  (06 marks)
- (ii) Using equation in b (i) and taking the approximate root in (a) as an initial approximation, obtain the root of the equation. Give your answer correct to three significant figures. (06 marks)
15. A certain company came up with a program of rearing goats. They visited a certain village to find out the modern ways of rearing goats and discovered that the number of goats owned by the residents were normally distributed. 15% of the residents had less than 60 goats and 5 % of the residents had more than 90 goats.
- (a) Determine the mean and standard deviation of the number of goats. (08 marks)
- (b) If the village had 300 residents rearing goats, find how many residents had more than 80 goats. (04 marks)
16. Forces,  $(-2\mathbf{i} + 3\mathbf{j})\text{N}$ ,  $(-\mathbf{i} + 2\mathbf{j})\text{N}$ ,  $(4\mathbf{i} - 2\mathbf{j})\text{N}$  and  $(-\mathbf{i} - 3\mathbf{j})\text{N}$  act at points A(-2, 3), B(3, 1), C(-1, -3) and D(3, 1) respectively.
- (a) Show that the system of forces forms a couple. (05 marks)
- (b) If the force acting at points D(3, 1) is replaced by the force  $(2\mathbf{i} + \mathbf{j})\text{N}$ , determine the Cartesian equation of the line of action of the resultant force and where it crosses the  $x$ -axis. (07 marks)

**END**