P425/2
APPLIED MATHEMATICS
Paper 2
Oct. 2023
3 HOURS

UGANDA ADVANCED CERTIFICATE OF EDUCATION

APPLIED MATHEMATICS

(PRINCIPAL SUBJECT) Set 12

Paper 2

TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES:

Answer **all** *the* **Eight** *questions in Section* **A** *and* **Five** *questions from Section* **B**.

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

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

Begin each answer on a fresh sheet of paper.

Graph paper is provided.

Silent, non-programmable scientific calculators and mathematical tables with a list of formulae may be used.

In numerical work, take g *to be* $9.8\ ms^{-2}$.

SECTION A: (40 MARKS)
*Answer **all** the questions in this section.*

1. Two events A and B are such that $P(AuB) = \frac{7}{10}$, $P\left(\frac{A}{B}\right) = \frac{7}{12}$ and $4P(A) = 3P(B)$. Find
   (i) $P(AnB)$
   (ii) $P(AuB')$ (05 marks)

2. A particle is projected horizontally from a point 15m above the ground level with a speed of $80ms^{-1}$. Find the;
   (i) Time taken to hit the ground
   (ii) Distance it travelled horizontally. (05 marks)

3. The table below shows the cost (y) in shs for hiring a motorcycle for a distance (x) in km

Distance ($x\ km$)	10	20	30	40
Cost (y shs)	2,800	3,600	4,400	5,200

   Use either linear interpolation or extrapolation to estimate
   (i) Cost (y), when the distance (x) is $45km$
   (ii) Distance (x), when the cost (y) is 14,000 shs (05 marks)

4. For every 20 glasses produced by the machine, 11 are non-defective. If a sample of 15 glasses is selected, find the probability that.
   (i) Exactly 8 glasses are defective
   (ii) Less than 2 glasses are non-defective (05 marks)

5. A particle of mass 3kg resting on a rough horizontal plane is pushed by a force of magnitude 20N inclined at an angle of 30° to horizontal. If the particle is in limiting equilibrium, find the minimum value of the coefficient of friction
   (i) Normal reaction
   (ii) Co-efficient of friction (05 marks)

6. Use the trapezium rule with 6 ordinates to estimate $\int_1^5 5e^{-2x}\ dx$, correct to 3 decimal places (05 marks)

7. Nine students were given two separate tests and the following are the scores.

Mathematics (x)	C	D	E	C	C	B	A	E	D
Physics (y)	A	E	C	A	B	B	C	D	B

Calculate the rank correlation co-efficient and comment at 5% level of significance. (05 marks)

8. A car of mass 2,000kg has maximum power of 45kW, moves up a slope of 1 in 20 against a constant resistance to motion of 500N, determine
   (i) Driving force of the car
   (ii) Acceleration of the car when its speed is 20ms^{-1} (05 marks)

SECTION B: (60 MARKS)
*Answer any **five** questions in this section. All questions carry **equal** marks*

9. A cumulative distribution function F(x) of a continuous random variable X is given by

$$F(x) = \begin{cases} 0; & x \leq 0 \\ \frac{1}{4}x^2; & 0 \leq x \leq 1 \\ \frac{1}{2}x - \frac{1}{4}; & 1 \leq x \leq 2 \\ k(6x - x^2 - 5); & 2 \leq x \leq 3 \\ 1; & x \geq 3 \end{cases}$$

   Where k constant, determine;
   (i) Values of k.　　　　　　　　　　　(ii) $P(0.5 < x < 2.1)$
   (iii) $E(x)$　　　　　　　　　　　　　　　　　　　　　(12 marks)

10. ABCD is a rectangle with AB= 5a as the positive x-axis and AD=12a as the positive y-axis. Forces of 5N, 4N, 15N, 10N and 13N acting along the sides BA, CB, DC, AD and AC respectively. Find the;
    (a) Magnitude of the resultant force and its direction
    (b) Line of action and the point at which the resultant force crosses x-axis by taking moments about point A. (12 marks)

11. (a) By sketching graphs of $y = lnx$ and $y = 2 - x$ on the same axes in the interval $1 \leq x \leq 2$, show that the equation $lnx + x - 2 = 0$ has a root. State it to 1 decimal place.
    (b) Hence use the Newton Raphson method to find the root of the equation correct to 3 decimal places (12 marks)

12. The age of people in a certain town and their respective numbers are as indicated in the table below

Age in years	0– < 10	– < 20	– < 25	– < 30	– < 35	– < 45	– < 55
Number in thousand	4.2	8.3	10.7	14.4	7.8	10.1	4.5

(a) Determine the mean age and standard deviation of the people in the town
(b) Draw a histogram and use it to find the mode. (12 marks)

13. A jet fighter and a cruiser have the following position and velocity vectors

	Displacement (s)	Velocity vector (v)	Time (t)
Jet	$s_1 = (-6i + 12j)$km	$v_1 = (16i - 4j)kmh^{-1}$	11:30am
Cruiser	$s_2 = (12i - 15j)$km	$v_2 = (8i + 16j)kmh^{-1}$	12:00pm

(a) Find the position vector of the jet fighter at noon
(b) If these velocities remain constant
    (i)   Show that collision occurs and find time of collision
    (ii)   Hence find the position of collision. (12 marks)

14. The numbers $x = 14.2, y = 8.28$, and $z = 5.332$ have percentage errors 5, 6 and 8 respectively, calculate
    (a) Errors in x, y and z
    (b) Range within which the exact value of $xy + \frac{y}{z}$ lies correct to 3 decimal places
    (c) Absolute error and Percentage error in $xy + \frac{y}{z}$ correct to 3 decimal places
    (12 marks)

15. In a school of 1000 students, their masses are normally distributed with mean of 55 kg and standard deviation of 7 kg.
    (i) The probability that a student picked at random has a mass between 53kg and 59kg
    (ii) Number of students whose mass is over 60kg
    (iii) Limit of middle 60% of the mass of students in the school. (12 marks)

16. A non-uniform beam AB of length 15m and mass of 10kg is supported horizontally by strings attached at A and B. The strings attached to A and B make angle of 40° and 50° with AB respectively. Find the;
    (a) Tensions in the strings acting at A and B
    (b) Distance from A at which the mass acts. (12 marks)

END.