P425/2
APPLIED MATHEMATICS
Paper 2
Nov./Dec. 2024
3 hours

UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

This paper consists of **two** *Sections;* **A** *and* **B**.

Section **A** *is* **compulsory**.

Answer only **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 page.

Graph paper is provided.

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

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

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SECTION A (40 MARKS)

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

1. Two events A and B are such that $P(A) = 0.4$, $P(B) = 0.7$ and $P(A \cap B) = 0.35$. Find $P(A'/B')$.

(05 marks)

2. The resultant of two forces P and Q is a force of 15 N acting at an angle of 50° to force Q. Given that the magnitude of force Q is 12 N, determine the magnitude and direction of the force P.

(05 marks)

3. The table below shows the velocity V at any instant t seconds of a particle moving in a straight line.

t (s)	0	1	2	3	4
V (ms^{-1})	0	2	7	8	10

Calculate;

(a) the velocity of the particle after 1.5 seconds. *(03 marks)*

(b) the time when the velocity is 13 ms^{-1}. *(02 marks)*

4. The table below shows the unit prices (Shs) and quantities of food items in the years 2005 and 2010.

FOOD ITEM	QUANTITY	PRICE (SHS)	
		2005	**2010**
Sugar	25 kg	2500	3500
Meat	10 kg	5000	7000
Beans	50 kg	1500	2000
Fish	5 pieces	5000	8000
Maize flour	50 kg	800	1200

(a) Calculate the weighted price index of 2010 using 2005 as the base year. *(04 marks)*

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

5. A force $\boldsymbol{F}$ (N) is acting on a particle of mass 4 kg whose position vector at any time t is $\boldsymbol{r} = (t^3\boldsymbol{i} + \sin t\boldsymbol{j})$ m. Find $\boldsymbol{F}$ when $t = \frac{\pi}{3}$ (s). *(05 marks)*

6. A metallic container is in form of a cuboid. Its dimensions are 2.7 m, 4.80 m and 3.281 m correct to the given number of decimal places. Determine the possible minimum and maximum volumes of the container correct to **three** decimal places.

(*05 marks*)

7. A discrete random variable X, has a probability function given by

$$P(X = x) = \begin{cases} \frac{1}{10}x; & 1, 2, \ldots, n \\ 0, & \text{elsewhere.} \end{cases}$$

Given that $E(X) = 3$, find the value of n.

(*05 marks*)

8. A boy can swim in still water at a speed of 2.5 ms^{-1}. The boy wishes to cross a straight river which is 50 m wide and flowing at a speed of 3 ms^{-1}. He sets off at an angle of 60° to the bank of the river.

Determine;

(a) the time it takes him to cross the river. (*03 marks*)

(b) the boy's resultant velocity. (*02 marks*)

SECTION B (60 MARKS)

Answer any **five** *questions from this section.*
All *questions carry equal marks.*

9. The table below shows the distribution of time (minutes) spent by students revising for a test.

Time , T (minutes)	Frequency
$0 \leq T < 10$	20
$10 \leq T < 15$	18
$15 \leq T < 30$	60
$30 \leq T < 45$	45
$45 \leq T < 55$	50
$55 \leq T < 60$	30
$60 \leq T < 80$	60
$80 \leq T < 90$	10

(a) Calculate the mean revision time. (*05 marks*)

(b) (i) Draw a histogram for the data.
(ii) Use your histogram to estimate the modal revision time.

(*07 marks*)

10. (a) A ball was thrown with a velocity of 15 ms^{-1} vertically upwards from the ground. A girl on a balcony of a building 9 metres high, leaned and caught the ball on its way down.

(i) Calculate the time taken before the ball is caught by the girl. *(04 marks)*

(ii) Find the speed with which the ball was travelling when it was caught. *(03 marks)*

(b) A particle travels with an initial velocity of $(11\boldsymbol{i} - 8\boldsymbol{j} + 3\boldsymbol{k})$ ms^{-1} from a point with a position vector of $(-2\boldsymbol{i} + \boldsymbol{j})$ m. The particle moves with an acceleration of $\frac{1}{5}(2\boldsymbol{i} + 3\boldsymbol{j} - 4\boldsymbol{k})$ ms^{-2}.

Determine;

(i) the position vector of the particle after 5 seconds. *(03 marks)*

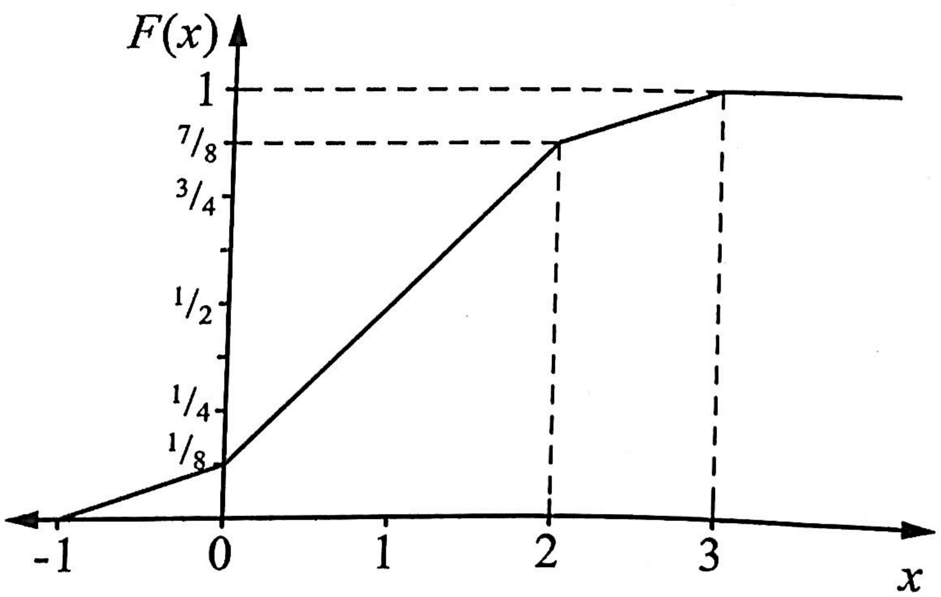
(ii) the distance covered in the 5 seconds. *(02 marks)*

11. (a) Using the trapezium rule with **six** ordinates, estimate $\int_0^1 xe^{(x^2+1)}\,dx$ giving your answer correct to **three** decimal places. *(07 marks)*

(b) Given that $\int_0^1 xe^{(x^2+1)}\,dx = 2.335$, find the percentage error for the estimate in (a). *(03 marks)*

(c) Suggest how the accuracy in (a) can be improved. *(02 marks)*

12. The cumulative distribution function $F(x)$ of a continuous random variable X is represented graphically as shown below.



Find:

(a) (i) $F(x)$. (05 marks)

(ii) $P(1 < X < 2.5)$. (02 marks)

(b) (i) the probability density function (pdf) $f(x)$. (02 marks)

(ii) $E(X)$. (03 marks)

13. A light inelastic string of length 80 cm is fixed at one end R and carries a particle of mass 0.1 kg at the other end S. The particle moves in a horizontal circle with angular speed 5 rads^{-1}. Determine;

(a) the tension in the string. (08 marks)

(b) the radius of the horizontal circle. (04 marks)

14. (a) Use the graphical method to estimate the root of the equation

$2x^3 - 4x + 3 = 0$ in the interval $-2 \leq x \leq -1$. (06 marks)

(b) Using the Newton Raphson method, find the root of the equation $2x^3 - 4x + 3 = 0$ taking the approximate root obtained in (a) as the initial value of x_0. Give your answer correct to **three** decimal places. (06 marks)

15. An examination consists of 120 multiple choice questions. Each question has four options for which there is only one correct option.

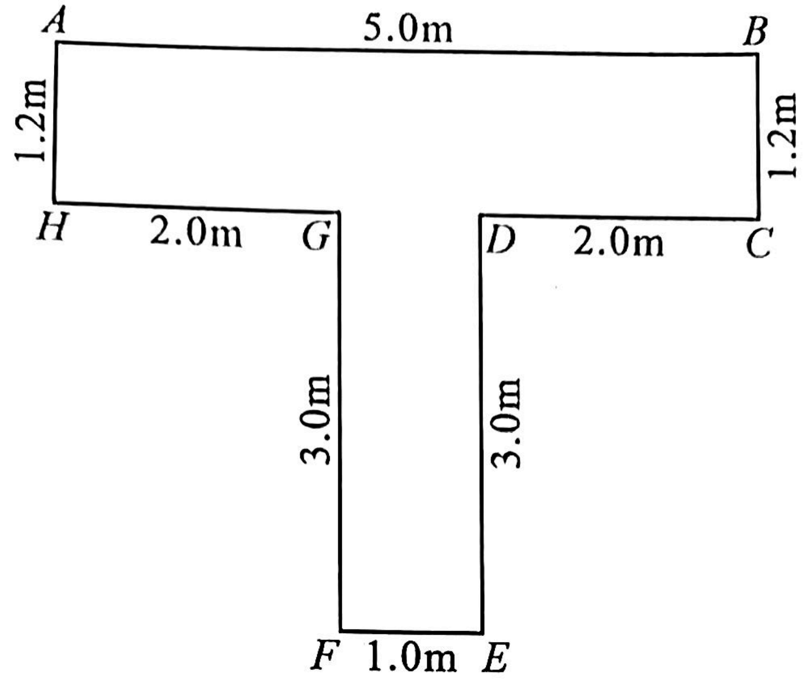
(a) If a candidate who sat for the examination is chosen at random, find the probability that the candidate obtained;

(i) between 20 and 40 (inclusive) correct options.

(ii) exactly 41 correct options. (07 marks)

(b) Determine the pass mark for 80 % of the candidates to pass the examination. (05 marks)

16. The diagram below shows a uniform lamina *ABCDEFGH.*



(a) Determine the distances of the centre of gravity of the lamina from the sides *AB* and *AH.* (*09 marks*)

(b) If the lamina is suspended from the vertex *A* and rests in equilibrium, calculate the angle which the side *AB* makes with the vertical. (*03 marks*)

END