P425/2

APPLIED MATHEMATICS

PAPER 2

3 HOURS

UGANDA ADVANCED CERTIFICATE OF EDUCATION

APPLIED MATHEMATICS

(PRINCIPAL SUBJECT)

PAPER 2

TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES:

- Answer all EIGHT questions in section A and FIVE questions from section B.
- Any additional question(s) answered will not be marked.
- All working must be shown clearly.
- Graph paper is provided.
- Silent, non-programmable scientific calculator and mathematical tables with a list of formulae may be used.
- In numerical work, take acceleration due to gravity(g) to be $9.8ms^{-2}$.

SECTION A: (40 MARKS)

Answer all the questions in this section.

1. Two forces A and B act in the direction of vectors $\begin{pmatrix}4\\3\end{pmatrix}$ and $\begin{pmatrix}1\\-2\end{pmatrix}$, if the magnitude of A is 25N and the magnitude of the resultant force of A and B is 25N. Find the magnitude of B. **(5 marks)**

2. Use the trapezium rule with 6 ordinates to estimate $\int_0^{\frac{\pi}{3}} \cos x \, dx$ correct to three decimal places. **(5 marks)**

3. 10 students scored the following in two tests.

Test 1	65	45	40	55	60	50	80	30	70	65
Test 2	60	60	55	70	80	40	85	50	70	80

Calculate the rank correlation coefficient and comment at 1% level of signifance. **(5 marks)**

4. A ball is thrown vertically upward from a point 0.5m above the ground level with a speed of $7ms^{-1}$. Find the;
   (i) Height above this point reached by the ball.
   (ii) Speed with which it hits the ground. **(5 marks)**

5. Show that $f(x) = 3xe^x - 1$ has a root between $x = 0.2$ and $x = 0.3$, use linear interpolation once to estimate the root correct to 3 decimal places. **(5 marks)**

6. A biased coin is such that the chance of a head appearing uppermost is twice that of a tail, if the coin is tossed 10 times determine the probability that between 5 and 8 heads will appear. **(5 marks)**

7. A uniform rod AB of mass 5kg rests on a smooth point C with the end A on a smooth horizontal ground. Given that $AC = \frac{3}{4} AB$ and the rod

is inclined at 40^0 to the horizontal, determine the magnitudes of the normal reactions at A and C. (5 marks)

8. The table below shows the expenditure of a certain family for 2018 and 2019.

Items	Expenditures		Weight
	2018	2019	
Food	300,000	325,000	5
Accommodation	260,000	362,500	3
Electricity	150,000	160,000	1
Miscellaneous	620,000	725,000	2

Taking 2018 as the base year, determine the;

(i) Price Index for each item.

(ii) Hence the average weighted price Index. (5 marks)

SECTION B: (60 MARKS)

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

9. A random variable X has a cumulative distribution function $(F(x))$ given below.

$$F(x) = \begin{cases} 0 & ;x \leq 0 \\ ax & ;0 \leq x \leq 1 \\ \frac{x}{3} + b & ;1 \leq x \leq 2 \\ 1, x \geq 2 \end{cases}$$

Find the;

(a) Values of a and b.

(b) Hence $p((x < 1.5)/(x > 1))$

(c) Probability density function and Mean. (12 marks)

10. (a) Given that a and b have respective errors e_1 and e_2, show that the maximum relative error of $\frac{a}{\sqrt{b}}$ is $\left|\frac{e_1}{a}\right| + \frac{1}{2}\left|\frac{e_2}{b}\right|$.

(b) Hence find the maximum percentage error of $\frac{a}{\sqrt{b}}$ if a = 2.5 and b = 4.21. (12 marks)

11. A jet fighter and a cruiser start at 11:30 a.m and noon respectively with the following position and velocity vectors.

	Position Vectors	Velocity Vectors
Jet fighter	$(-6i + 12j)$km	$(16i - 4j)$kmhr^{-1}
Cruiser	$(12i - 15j)$km	$(8i + 16j)$kmhr^{-1}

If the velocities remain constant, determine the;

(a) Position of the Jet fighter at noon.

(b) Position of Jet fighter relative cruiser at time (t).

(c) Hence show that they collide, state the time of collision.

(12 marks)

12. Given that $P(A) = \frac{3}{5}$, $P(A/B) = \frac{5}{7}$ and $P(B/A) = \frac{2}{3}$

(a) Find :

(i) $P(A \cap B)$

(ii) $P(B)$

(iii) $P(A/\bar{B})$

(b) State with reasons whether A and B are

(i) independent events.

(ii) mutually exclusive events. (12 marks)

13(a) Show that the simplest iterative formulae based on Newton Raphson method for solving the equation

$$x^2 - 4x + 2 = 0 \text{ is } x_{n+1} = \frac{x_n^2 - 2}{2x_n - 4} = \text{n=0,1,2,3,----}$$

(b) Construct a flow chart that:

(i) reads initial approximation (x_0).

(ii) computes, using the iterative formulae in (a) above.

(iii) limits the error to less than 5.0×10^{-4}.

(iv) prints the root of the equation.

(c) Using $x_0 = 3$ perform a dry run for the flow chat. **(12marks)**

14. A particle of mass 4kg starts from rest at position (2, 3, 4)m is acted on by a force $(F) = (2t\hat{\imath} + 3t^2\hat{\jmath} + 5\hat{k})$N, determine the;

(a) acceleration at time (t).

(b) velocity at time (t).

(c) position at time (t) hence work done by the force at t = 4 seconds.

(12 marks)

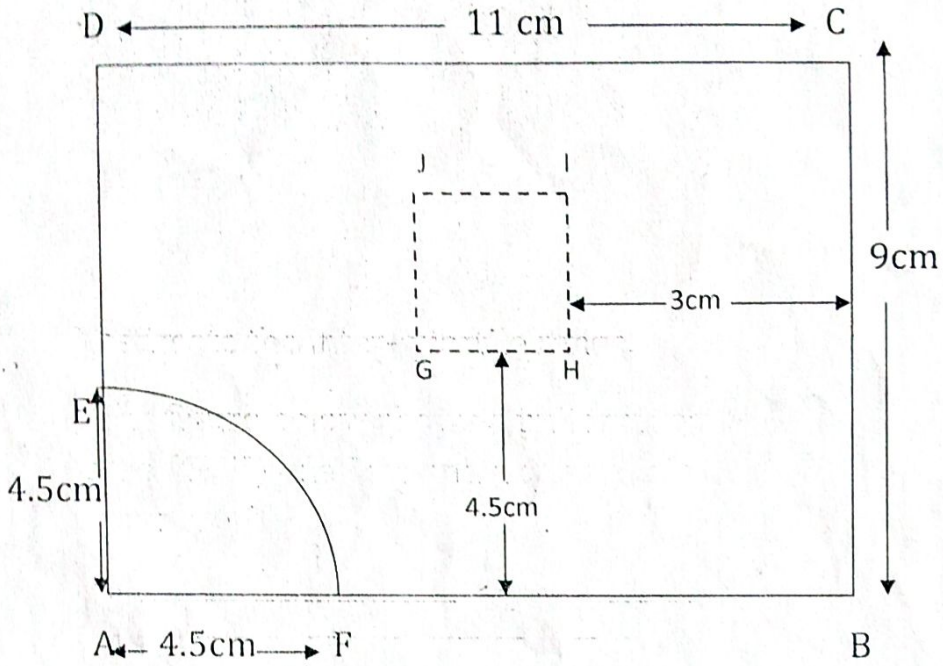
15. The marks obtained by 500 candidates of a certain district are normally distributed with mean of 45 marks and standard deviation of 20 marks.

(a) given that the pass mark is 41, estimate the number of candidates who passed the examination.

(b) if 5% of the candidates obtained a distinction by scoring x marks, estimate the value of x.

(c) estimate the inter-quartile range. (12 marks)

16 The figure below shows a uniform rectangular lamina ABCD with a square (GHIJ)side 3cm and a quarter circular section(AFE) of radius 4.5cm cut off.



Find the coordinate of the centre of gravity from sides AB and AD taken as the x and y axes respectively. (12 marks)

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