

P425/2
APPLIED MATHEMATICS
PAPER 2
July/August 2023
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 9.8ms^{-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. Events A and B are such that $P(B) = \frac{1}{6}$, $P(A \cap B) = \frac{1}{12}$, and $P(B/A) = \frac{1}{3}$.
 - (a) Find (i) $P(A)$. (02 marks)
(ii) $P(A/B^c)$. (02 marks)
 - (b) State with a reason whether events A and B are independent or not. (01 mark)

2. The table below shows variation of temperatures of cooling water with time.

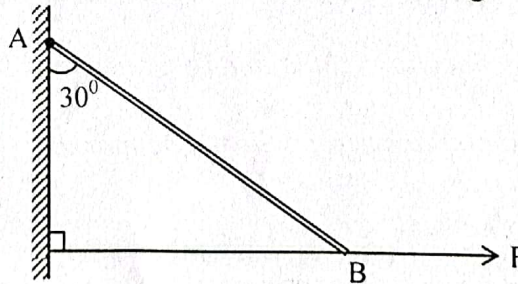
| | | | | | | |
|------------------------------------|-----|-----|-----|-----|-----|-----|
| Time (s) | 0 | 120 | 240 | 360 | 450 | 600 |
| Temperature ($^{\circ}\text{C}$) | 100 | 80 | 75 | 69 | 54 | 46 |

Use linear interpolation or extrapolation to find the;

- (i) temperature of water after 300 seconds. (03 marks)
 - (ii) time at which the temperature is 42°C . (02 marks)
3. A driver of a car traveling at 72 kmh^{-1} on a high way notices an accident 800 m ahead and suddenly applies the breaks which reduced the speed by half. For how long did the driver apply the breaks? (05 marks)
 4. In the year 2021, the price index of an item using 2000 as the base year was 90. In the year 2022, the index using 2021 as the base year was 120. Calculate the price of the item in 2022 given that the item costed Shs. 200,000 in year 2000. (05 marks)

5. Use trapezium rule to estimate $\int_1^2 x \sin x dx$ using six ordinates to 3 decimal places. (05 marks)

6. The diagram below shows a uniform rod AB of length 4 m and mass 2 kg freely hinged at A. A horizontal force, F, pulls it through an angle of 30° from the vertical.



Calculate the:

- (i) value of F. (03 marks)
 - (ii) magnitude of the reaction at the hinge. (02 marks)
7. Three people Jane, Mary and Alice are rolling a die. The winner is the first person to roll a six. If the die is unbiased and they roll a die in the order Jane, Mary and Alice, find the probability that;
 - (a) Alice wins on first attempt. (02 marks)
 - (b) Jane wins the game. (03 marks)

8. A particle of mass 2 kg is attached to one end of a light elastic string of natural length 1 m. The other end of the string is fixed to a point A. Initially the particle is held at A and when released, it falls vertically downwards and comes to rest at point 1.5 m below point A. Find the modulus of elasticity of the string. (05 marks)

SECTION B (60 marks)

Attempt any **five** questions from this section.

9. The height (in cm) of a certain tree plantation were recorded as below.

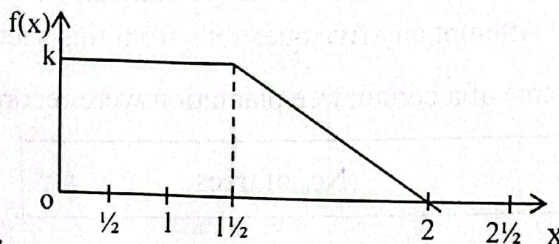
| Height (cm) | No. of trees |
|-------------|--------------|
| 120 - 124 | 5 |
| 125 - 129 | 17 |
| 130 - 134 | 20 |
| 135 - 139 | 25 |
| 140 - 144 | 15 |
| 145 - 149 | 6 |
| 150 - 154 | 2 |

- (a) Estimate the mean height and standard deviation of the trees. (06 marks)
- (b) Plot a cumulative frequency curve (Ogive). (03 marks)
- (c) Use your graph in (b) above to estimate;
- (i) median height. (01 mark)
- (ii) middle 60% height range. (02 marks)
10. (a) Show that the iterative formula for finding the fourth root of a number N is given by; $3\left[\frac{x_n}{4} + \frac{N}{12x_n^3}\right]$; $n = 0, 1, 2, \dots$ (04 marks)
- (b) Draw a flow chart that;
- (i) reads the initial approximation x_0 and N .
- (ii) computes and prints the fourth root of N after three iterations and gives the root correct to 2 decimal places.
- (c) Perform a dry run for $N = 99$ and $x_0 = 3$. (08 marks)
11. Four forces of magnitudes 3 N, 10 N, 6 N and 7 N act along sides AB, BC, DA and DB respectively. The direction of the forces being indicated by the order of the letters, of a rectangle ABCD with sides $\overline{AB} = 12$ m and $\overline{BC} = 5$ m.
- (a) Taking AB and AD as x and y axes respectively; find the magnitude and direction of the resultant of the forces. (06 marks)
- (b) If the line of action of the resultant of the forces cuts AB produced at point M, find the length MC. (06 marks)

Turn Over

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12. The probability density function, $f(x)$ of the random variable, X , takes on the form as shown below.



Find the:

- (i) Value of k . (02 marks)
 - (ii) Probability density function, $f(x)$. (04 marks)
 - (iii) $P(\frac{1}{2} \leq X \leq 1\frac{3}{4})$. (03 marks)
 - (iv) Expectation, $E(X)$ of X . (03 marks)
13. (a) Two positive numbers y_1 and y_2 are rounded off to give x_1 and x_2 respectively with errors e_1 and e_2 . Find in terms of x_1 and x_2 the maximum relative errors made by using x_1 x_2 as an approximation of y_1 y_2 . (06 marks)
- (b) The number; 2.675, 4.800, 15.2 and 0.92 have been rounded off to the given number of decimal places. Find the range of values within which the exact value of $2.675\left(4.800 - \frac{15.2}{0.92}\right)$ can be expected to lie, correct to 3 decimal places. (06 marks)
14. (a) A particle of mass 3 kg is moving on the curve described by $\underline{r} = (4\sin 3t \underline{i} + 8\cos 3t \underline{j})\text{m}$ where \underline{r} is the position vector of the particle at any time t .
- (i) Determine the position and velocity of the particle at the time, $t = 0\text{s}$.
 - (ii) Show that the force acting on the particle is $-27 \underline{r}$. (08 marks)
- (b) A pump draws water from the tank and supplies it at a speed of 10 ms^{-1} from the end of a hose of cross-sectional area 5 cm^2 , situated 4 m above the level from which the water is drawn. Find the rate at which the pump is working. (04 marks)
15. A total population of 350 students in a certain school sat for Mathematics test for which the pass mark was 50. Their marks were normally distributed. 14 students scored below 40 marks while 21 students scored above 60 marks.
- (a) Find the mean mark and standard deviation of the students' scores.
 - (b) What is the probability that a student chosen at random passed the test?
 - (c) Suppose the pass mark is reduced by 3 marks, how many more students will pass? (12 marks)
16. A ship, A, moving at a constant speed of 24 kmh^{-1} in the direction $\text{N}40^\circ\text{E}$ is initially 10 km from a second ship B. The bearing of A from B is $\text{N}30^\circ\text{W}$. If B moves with a constant speed of 22 kmh^{-1} , find;
- (a) The course that B must set in order to pass as close as possible to A.
 - (b) The distance between the ships when they are closest.
 - (c) The time taken (to the nearest minutes) for this to occur. (12 marks)

END