

P425/2

APPLIED MATHEMATICS

Paper 2

June/July. 2024

3 hours



NGANWA HIGH SCHOOL

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS PRE MOCK EXAMS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES;

Answer all the eight questions in section A and any five questions from section B

Any additional questions (s) answered will not be marked.

All necessary working must be shown clearly\

Begin each answer on a fresh sheet of paper.

Graph paper is provided

Silent, non programmable scientific calculators and mathematical tables may be used

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

Turn Over

SECTION A; (40 marks)

Answer all the questions in this section

1. A discrete random variable R takes integer values between 0 and 4 inclusive with probabilities given by

$$P(R = r) = \begin{cases} \frac{r+1}{10} & (r = 0, 1, 2) \\ \frac{9-2r}{10} & (r = 3, 4) \end{cases}$$

Find the expectation and variance of R .

2. A particle P of mass 3kg moves such that its displacement s at time t seconds is given by

$$s = \left(\begin{array}{c} 3 + \sin 2t \\ \cos 2t \end{array} \right) \text{ metres}$$

- a) Calculate the value of t when p crosses the x -axis for the first time
b) Show that the speed of P is constant and calculate the force acting on P when $t = \frac{\pi}{2}$.
3. Two decimal numbers x and y are recorded off to give X and Y with the errors E_1 and E_2 respectively. Show that the maximum relative error recorded in approximating x^2y by X^2Y is given by

$$2 \left| \frac{E_1}{x} \right| + \left| \frac{E_2}{y} \right|$$

4. Events A and B are such that $P(A) = 1/2$, $P(B) = 3/8$, and $P(A/B) = 7/12$. Find
- i. $P(A \cap B)$
ii. $P(B/A^c)$

5. A mass of 5kg is suspended in equilibrium by two light inextensible strings which make angles of 30° and 45° with the horizontal. Calculate the tensions in the strings.
6. In 1992, the price index of a commodity, using 1998 as base year, was 112. In 1994, the index using 1992 as base year was 85. What would have been the index in 1994 using 1998 as base year?
7. Two numbers A and B have maximum possible errors e_a and e_b respectively.
 - a) Write an expression for the maximum possible error in their sum.
 - b) If $A=2.03$ and $B = 1.547$, find the maximum possible error in $A+B$.
8. A rough surface is inclined at $\tan^{-1}7/24$ to the horizontal. A body of mass 5kg lies on the surface and is pulled at a uniform speed a distance of 75cm up the surface by a force acting along a line of greatest slope. The coefficient of friction between the body and the surface is $5/12$. Find;
 - a) The work done against gravity
 - b) The work done against friction

SECTION B (60 marks)

Answer any five questions in this section

9. The continuous random variable x has pdf f(x) where

$$f(x) = \begin{cases} k(x+2)^2, & -2 \leq x \leq 0, \\ 4k, & 0 \leq x \leq \frac{4}{3}, \\ 0 & \text{otherwise} \end{cases}$$

- a) Find the value of the constant k
- b) Sketch f(x)
- c) Find
 - i. $P(-1 \leq x \leq 1)$
 - ii. $P(x > 1)$

10. A body of mass **3kg** moves along a curve under the action of a resultant force **FN**. At time t seconds the position vector \mathbf{r} m of the body is

$$\mathbf{r} = 2t\mathbf{i} + t^3\mathbf{j} + t^2\mathbf{k}$$

- Find the expression for **F** in terms of t .
- Find an expression for $P(t)$, the power of the force at time t seconds
- Calculate the work done by **F** between $t = 0$ and $t = 2$
- Verify that the work done calculated in (c) is equal to the change in kinetic energy of the body over the same interval.

11. The table below gives the points awarded to eight schools by three judges J_1, J_2, J_3 during a music competition. J_1 was the chief judge

J₁	72	50	50	55	35	38	82	72
J₂	60	55	70	50	50	50	73	70
J₃	50	40	62	70	40	48	67	67

- Determine the rank correlation coefficient between the judgments of
 - J₁** and **J₂**
 - J₁** and **J₃**
- Who of the two other judges had a better correlation with the chief judge? Give a reason (02 marks)

12. a) Sketch the graphs of $y = \ln x$ and $y = 2 - x$ in the interval $1 \leq x \leq 2$. State the initial approximation (x_0) to 1 decimal place.

- Use the first approximation (x_0) and the newton Raphson method to find the exact root correct to 4 decimal places.

13. a) The heights of boys at a particular age follow a normal distribution with mean 150.3cm and standard deviation 5cm. find the probability that a boy picked at random from this group has height;

- Less than 153cm
- Between 147cm and 149.5cm

b) If $x \sim N(100, 36)$ and $p(X < a) = 0.8907$. find the value of a .

14. ABCDE is a regular pentagon of side 2m.

Forces of 5N act along AB, BC, and AD. Find the;

- a. Force and its direction
- b. Find where its line of action cuts AB

15. find the range within which the exact values of the following lie

i. $\frac{15.21}{16.220} + \frac{14.1}{3.224}$

ii. $12.225 + \frac{11.421}{3.344} - \frac{1.447}{0.234}$

b). Given $x=2.2255$ and $y=0.449$, correct to the given number of decimal places.

State the maximum possible errors in the values of x and y . hence determine the;

i. Absolute error in $\frac{x}{y}$

ii. Limits within which the value of quotient $\frac{x}{y}$ lies giving your answer to 2 decimal places.

16. At time $t=0$, the position vectors and velocity vectors of two particles A and B are as follows.

$$\mathbf{r}_A = \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} \mathbf{m} \quad \mathbf{r}_B = \begin{pmatrix} 4 \\ -14 \\ 1 \end{pmatrix}$$

$$\mathbf{v}_A = \begin{pmatrix} -6 \\ 0 \\ 1 \end{pmatrix} \mathbf{ms}^{-1} \quad \mathbf{v}_B = \begin{pmatrix} -5 \\ 1 \\ 7 \end{pmatrix} \mathbf{ms}^{-1}$$

find;

- a. The position vector of B relative to A at time t seconds
- b. The value of t when A and B are closest together
- c. The least distance between A and B.

KEEP THE CANDLE BURNING

END

