P425/2
APPLIED MATHEMATICS
PAPER 2
July/August
3hours

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; $P(A \cup B) = \dfrac{19}{30}$, $P(A) = \dfrac{5}{15}$ and $P(^A/_B) = \dfrac{5}{9}$.

   Determine the;   (03 marks)
   Find (a) $P(A \cap B)$ (02 marks)
         (b) $P(^{\bar{A}}/_B)$

2. A particle of weight 10N is suspended by two strings. If the strings make angles of 30^0 and 40^0 to the horizontal, find the tensions in the strings.
                                                            (05 marks)

3. Given that; $f(2.09) = 1.9042$, $f(2.15) = 2.2345$, $f(2.19) = 2.4979$ and $f(2.23) = 2.8198$. Use linear interpolation or extrapolation to find;
                                                            (03 marks)
   (a) $f(2.11)$ (02 marks)
   (b) $f^{-1}(3.0096)$

4. Use the trapezium rule with 6 sub-intervals to estimate.

   $$\int_1^{1.2} x^2 \sin\left(\frac{1}{2}x\right) dx.$$

   Correct to three decimal places.   (05 marks)

5. A car approaching a town does two successive half-kilometers in 16 and 20 seconds respectively. Assuming the retardation is uniform, find the further distance the car runs before stopping.   (05 marks)

6. A machine manufacturing nails makes approximately 85% that are within the set tolerance limits. If a random sample of 200 nails is taken, find the probability that more than 21 nails will be outside the tolerance limits.   (05 marks)

7. The following marks were scored in a mathematics test.

Marks	20-30	30-40	40-45	45-55	55-65	65-75
Frequency density	0.5	1.6	2.4	2.0	1.8	0.6

   Calculate the median.
                                                            (05 marks)

8. The force, $\underset{\sim}{F}$, acting on a particle of mass 2 kg is given by $\underset{\sim}{F} = (5+4t)N$, where t is the time in seconds.

   Given that initially the particle is moving at a speed of 5 ms⁻¹, find the speed of the particle when $t = 2$ seconds.
                                                            (05 marks)

SECTION B (60 marks)

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

9. The table below shows the marks scored by students in physics (x) and mathematics (y)

Physics (x)	28	20	40	28	21	22	31	36	29	30	24	21
Mathematics (y)	30	20	40	28	22	25	45	35	27	31	22	33

   (a) Draw a scatter diagram to represent the data above. Hence draw the line of best fit. (05 marks)

   (b) Use your diagram in (a) to estimate the score in Physics when the score in Mathematics is 24. (01 mark)

   (c) Calculate the rank correction coefficient for the data and comment on your result at 5% level significance. (06 marks)

10. A rectangle ABCD (3m x 4m) has forces of magnitudes 5N, 10N, 15N, 20N and 15N acting along the lines BA, CB, DC, AD and CA respectively. If $\overline{AB}$ = 3m is the positive x-axis and $\overline{AD}$ = 4m is the positive y-axis; find the;

   (a) magnitude of the resultant force and its direction. (08 marks)

   (b) line of action of the resultant and where it cuts the x-axis. (04 marks)

11. A random variable x has a probability density function given by;

$$f(x) \begin{cases} \lambda x & ; 0 \le x \le 1 \\ \dfrac{\lambda}{2}(3-x); & 1 \le x \le 3 \\ 0 & ; \text{otherwise} \end{cases}$$

   Where λ is a constant.
   Determine the;

   (a) value of λ. (03 marks)

   (b) expected value of x. (02 marks)

   (c) variance of x. (02 marks)

   (d) cumulative distribution function, $f(x)$ and hence $P(0.5 \le x \le 2.5)$ (05 marks)

12. Two cyclists P and Q are 11 km apart with Q on a bearing of 110^0 from P. Cyclist P is riding at 5 kmh^{-1} due North-East and Q is riding due N15^{0}W at 8 kmh^{-1}.
   Find the;

   (a) closest distance between them in the subsequent motion. (09 marks)

   (b) time that elapses before they are closest to each other. (03 marks)

13. (a) The numbers $x = 3.7$ and $y = 70$ are each rounded off with percentage error of 0.2 and 0.05 respectively. While the number $z = 26.23$ is calculated with relative error of 0.04. Find the interval within which the exact value of $\dfrac{x}{y-z}$ lies; correct to 4 significant figures. (06 marks)

(b)   The height and radius of a cylindrical water tank are given as $H = 3.5 \pm 0.2$ and $R = 1.4 \pm 0.1$ respectively. Determine in m^3, the least and greatest amount of water the tank can contain. Hence, calculate the maximum possible error in your calculation.   (06 marks)

14.   Given the equation $xe^{-x} - 3x + 4 = 0$
       (a)   (i)   Show that the equation has a root between $x = 1$ and $x = 3$. (03 marks)
              (ii)   Use linear interpolation to obtain an approximation of the   (02 marks)
                     root to two decimal places.
       (b)   Use the Newton Raphson formula to find the root of the equation by performing two interactions correct to three decimal places.   (07 marks)

15.   A car of mass 1,200 kg pulls a trailer of mass 300 kg up a slope of 1 in 100 against a constant resistance of 0.2N per kg. Given that the car moved at a constant speed of 1.5 ms^{-1} for 5 minutes, calculate the;   (05 marks)
       (a)   tension in the tow bar.   (04 marks)
       (b)   work done by the engine of the car during this time.
       (c)   total resistance if the engine developed power of 15 kW at a maximum speed of 120 kmh^{-1} on a level road.   (03 marks)

16.   The speeds of cars passing a certain point on a motor way can be taken to be normally distributed. Observations along the motor way at a certain point show that 95% of the cars are travelling at less than 85 kmh^{-1} while 10% of the cars are travelling at less than 55 kmh^{-1}.
       (a)   Determine the average and standard deviation of the speeds of the cars passing that point along the motor way.   (06 marks)
       (b)   If a random sample of 25 cars is selected, find the;
              (i)   Probability that their average speed is not more than 70 kmh^{-1}.   (03 marks)

              (ii)   95% confidence interval for the average speed.   (03 merks)

END