

P425/2
APPLIED MATHEMATICS
PAPER 2
3hours

WAKISSHA

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.*

Turn Over

SECTION A (40 MARKS)

Answer all questions in this section.

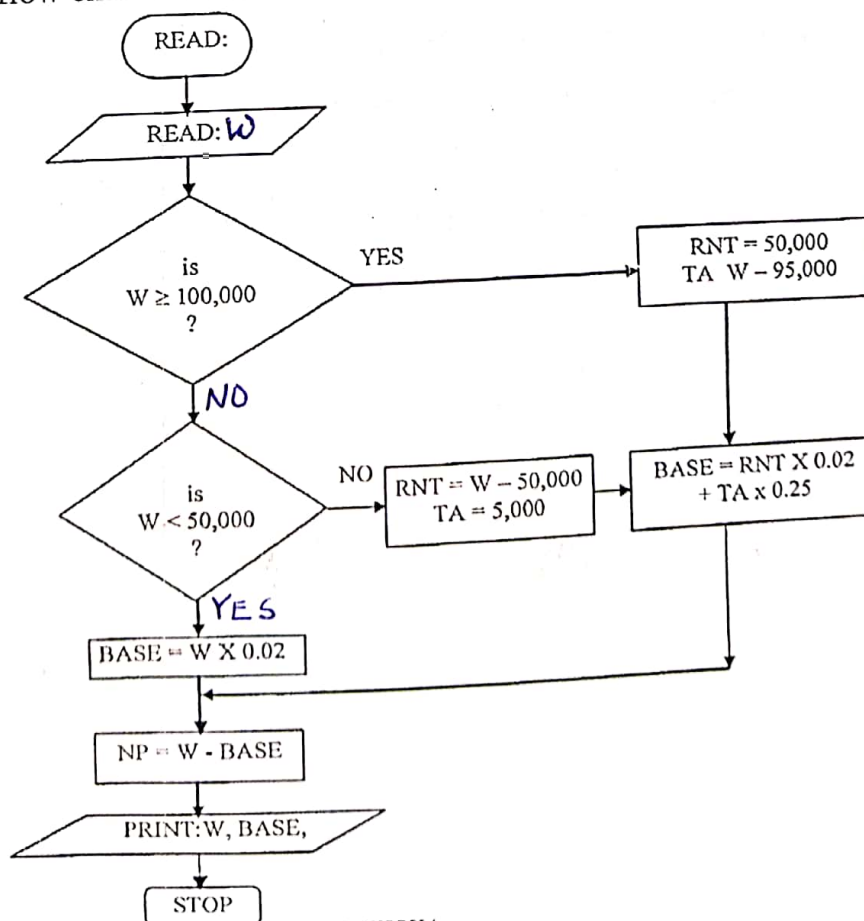
- Three fair tetrahedral, dice are tossed at once. If x is the number of times the figure 4 appears at the bottom, find the standard deviation of x . (5 marks)

- The table below shows the experimental variation of quantities x and y .

| | | | | |
|---|---------|--------|--------|--------|
| X | 0.022 | 0.146 | 0.209 | 0.311 |
| Y | 14.9834 | 9.0763 | 7.6348 | 4.3131 |

Using linear interpolation or linear extrapolation, find

- y when $x = 0.252$, (3 marks)
 - x when $y = 2.1473$ (2 marks)
- A taxi accelerates uniformly from rest at 1ms^{-2} . At the same time, a passenger is 4m behind the taxi runs with constant speed after the taxi and just manages to catch up with it. Find the speed of the passenger. (5 marks)
 - In a certain school, the response time of students to the assembly bells is uniformly distributed with mean 13 minutes and standard deviation $\frac{7}{\sqrt{3}}$. Find the probability that a student chosen at random will respond between 8 and 14 minutes after the bell is rung. (5 marks)
 - Study the flow chart below.



Copy and complete the table below.

| EFN | W | BASE | NP |
|---------|---------|------|----|
| A21B-03 | 32,000 | | |
| D69R-11 | 270,000 | | |
| P48M-47 | 84,000 | | |
| R29N-14 | 50,000 | | |
| L75Q-80 | 100,000 | | |

(5marks)

6. A mass of 4kg in contact with a smooth plane of 5 in 6 is connected by a light inelastic string passing over a smooth light fixed pulley at the top of the plane and under a light moveable pulley carrying a mass of 14kg. The other end of the string is fixed to a point above the fixed pulley. If the parts of the string supporting the moveable pulley are parallel and the system is released from rest, find the

(3 marks)

(i) tension in the string,

(2 marks)

(ii) acceleration of 14kg mass.

7. Events A and B are such that $P(B) = \frac{7}{20}$, $P(\bar{A}/B) = \frac{3}{7}$ and $2P(A) = 3P(A \cap \bar{B})$.

Find;

(3 marks)

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

(2 marks)

(ii) $P(A)$.

8. A body of mass 0.5kg is suspended from a fixed point A by a light elastic string of natural length 4cm and modulus of elasticity 19.6N. The particle is pulled vertically downwards to a point d cm below equilibrium position and released. If it just reaches the level of A, calculate the

(3 marks)

(i) value of d ,

(ii) kinetic energy of the particle when it passes the equilibrium position for the first time.

(2 marks)

SECTION B (60 marks)

Attempt any five questions from this section.

9. Find the consecutive integers within which the root of the equation $x^3 + 4x^2 - 16 = 0$ lies. Use Newton-Raphson Method to find the root of the equation correct to four decimal places.

(12 marks)

10. (a) The probability that a marksman aims and hits a target with a single shot is 0.4. If the marksman is given 25 bullets, find the probability that he hits the target:

(5 marks)

(i) exactly 8 times,

(6 marks)

(ii) between 9 and 15 times inclusive.

Turn Over

- (b) A company packs salt in bags which are normally distributed with mean weight 50kg and variance $9(\text{kg})^2$. A random sample of 20 bags was taken. Find the probability that the sample mean lies between 49 and 50.5kg. (1 mark)

11. A square ABCD of side 4m has forces of magnitude 8N, 3N, 3N, 4N and $2\sqrt{2}\text{N}$ acting along AB, CB, DA, CD and BD respectively. Taking AB and AD as x and y axes respectively,

(a) find the distance from A where the line of action of the resultant crosses AB. (5 marks)

(b) When a couple of magnitude M is introduced, the force system is reduced to a single force passing through B. Find M and its direction. (7 marks)

12. The table below shows the distribution of marks of students in a test.

| Score | Frequency |
|------------------|-----------|
| $20 \leq x < 30$ | 4 |
| $x < 45$ | 3 |
| $x < 50$ | 9 |
| $x < 65$ | 21 |
| $x < 75$ | 3 |
| $x < 80$ | 5 |
| $x < 100$ | 14 |

(a) Draw a histogram and use it to estimate the modal mark. (5 marks)

(b) Calculate the;
 (i) mean score,
 (ii) standard score,
 (iii) median score.

(7 marks)

13. The exact numbers A and B have been estimated by a and b respectively. Given that E_A and E_B are the corresponding errors,

(a) Show that the absolute error in $\frac{A}{B}$ given by $\left| \frac{a}{b} \right| \left(\left| \frac{E_A}{a} \right| + \left| \frac{E_B}{b} \right| \right)$

Hence deduce the expression for error in $\frac{A-B}{C}$ (8 marks)

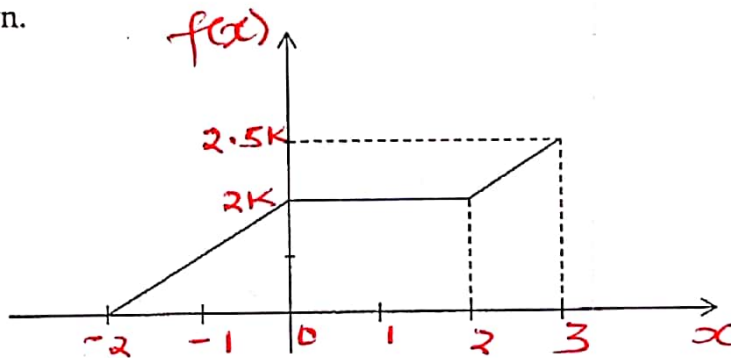
(b) The numbers $a = 4.314$, $b = 18.92$ and $c = 15.0214$ are each rounded off to the given number of decimal places. Use the expression in (a) to find the range of values within which the exact $\frac{a-b}{c}$ lies correct to four decimal places. (4 marks)

14. (a) A train of mass 250,000kg starts from rest and moves along a straight level track against resistance of 0.06Nkg^{-1} .

- (i) Find the driving force of the train if it attains a velocity of 40ms^{-1} after $\frac{5}{3}$ minutes. (5 marks)
- (ii) Calculate the power necessary to drive the train at a constant speed of 15ms^{-1} up an incline of 1 in 200. (2 marks)

- (b) A particle of mass 0.5kg is projected with kinetic energy of 750J up a plane inclined at 45° above the horizontal. If the coefficient of friction is 0.25 , find the work done against frictional force before the particle comes to rest. (5 marks)

15. The distribution function of a random variable x is represented graphically as shown.



Find the;

- (i) value of k ,
- (ii) $P((x > -1)/(-1.5 < x < 1))$, (12 marks)
16. Two equal uniform rods AB and BC, each 2m long and masses 10kg and 14kg respectively are freely hinged together at B and hang freely from the point A. A horizontal force F acting at C maintains equilibrium when the rod BC makes an angle of 60° with the downward vertical. Find the:
- (i) value of F ,
- (ii) magnitude of reaction at A,
- (iii) angle that AB makes with the vertical. (12 marks)

END