

P425/2
APPLIED MATHEMATICS
Paper 2
August. 2024
3hours



ERETA EDUCATION CONSULT LTD
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Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

PAPER 2

3HOURS

INSTRUCTIONS TO CANDIDATES

- Answer all the **eight** questions in section **A** and any **five** questions from section **B**.
- Any additional question(s) answered will **not** be marked
- All necessary working **must** be shown clearly.
- Begin each answer on fresh sheet of paper.
- Graph paper is provided
- Silent, non- programmable scientific calculators and mathematical tables with a list of formulae may be used
- In numerical work, take the acceleration due to gravity g , to be 9.8 ms^{-2} .

SECTION A (40 MARKS)

Answer all the questions in this section

1. A particle of mass 0.5kg is thrown across a table with a velocity of 20ms^{-1} . The resistance of the table to it is 45 N . How far will it travel before coming to rest? What must be the resistance if it travels only 4 m . (5marks)
2. A machine is supposed to cut lengths of rod 100cm long. A sample of 40 rods gave the following results for length, x . $\sum f(x) = 1994$, $\sum fx^2 = 99422$. Calculate the standard deviation of the length of 40 rods. (5marks)
3. Find an approximate value for $\int_0^{0.6} \frac{1}{(-x^2+1)^{\frac{1}{2}}} dx$. Using trapezium rule with the interval of 0.1 . Give your answer correct to 4 significant figures. (5marks)
4. The random variable r has probability density function given by;
$$f(r) = \begin{cases} 3(r^\beta), & 0 \leq r \leq 1 \\ 0 & \text{else where,} \end{cases}$$

Find the mean of r (5marks)
5. A particle is projected from the origin with a speed of 40ms^{-1} at an angle of 30° to the horizontal. Find
 - i. Velocity v , of a particle at time t , in vector form,
 - ii. Distance of the particle after 2 seconds. (5marks)
6. The table below shows how y varies with x

x	y
1.0	2.7200
0.2	0.0490
0.8	1.4240
0.4	0.2387

Find the;

- i. Value of y when $x=1.4$
 - ii. Value of x when $y=0.6560$ (5marks)
7. The force of $(8t^2i + 8tj + 14t^2k)\text{N}$ acts on a particle to give velocity of $(2ti - 6t^2j + 4tk)\text{ms}^{-1}$. Find
 - i. An expression for the power exerted
 - ii. The acceleration of the particle (5marks)
 8. Four cards are drawn at random from a pack of fifty-two playing cards. Find the probability that at least one of them is an ace. (5marks)

SECTION B (60 MARKS)

9. Electric bulbs, normally rated at 40 amperes (40 A), are tested by passing a gradually increasing electric current through them and recording the current, x amperes, at which they blow. The results of this test on a sample of 130 such bulbs are shown in the table below.

Current (A)	Number of bulbs
35 – < 38	7
< 39	13
< 40	28
< 41	30
< 42	18
< 43	14
< 44	9
< 45	5
< 50	6

(a). Use your data to draw a histogram. Hence estimate the modal current.

(b) Calculate;

i. Median current

ii. Mean current

(12 Marks)

10. A body of mass 6000 grams is initially at rest at the point R (4, -4, 6) meters. The body is acted upon by a force of $(8ti + 2t^2j + 10k)$ Newtons, where t is time in seconds. find the

a) Displacement of the body after 6 seconds

b) Speed of the body after 6 seconds

c) Acceleration of the body at any time, t .

(12 Marks)

11. (a) Show that the maximum relative error made in the expression $x^2 \cos 2y$ is given by:

$2 \left[\left| \frac{\Delta x}{x} \right| + \tan 2y |\Delta y| \right]$ where Δx and Δy are errors in x and y respectively (b) If $x = 1.24 \pm$

0.005 and $y = 15^\circ \pm 0.5^\circ$, find the percentage error in $x^2 \cos 2y$.

(12 Marks)

12. To one end of light inextensible string is attached a mass of 3000 grams which rests on a smooth inclined plane at an angle of 60° to the horizontal. The string passes over a smooth fixed pulley at the edge of the incline, under the second smooth moveable pulley of mass of 5000 grams and

over a third smooth fixed pulley and has a mass of 6000 grams attached to the other end. Assuming the portions of the string lie in the vertical plane, find

- i. Acceleration of masses and the moveable pulley,
- ii. Tension in the string. (12 Marks)

13. The speeds of trains passing a certain station on a railway can be taken to be normally distributed. Observations show that of trains passing the station, 95% are travelling at less than 85 m.p.h and 10% are travelling at less than 55 m.p.h.
- a) Find the average speed of the trains passing the station,
 - b) Find the proportion of trains that travel at more than 70 m.p.h. (12 Marks)
14. (a) Show that the Newton Raphson formula for finding the natural logarithm of any number N is given by;

$$x_{n+1} = \frac{e^{x_n}(x_n - 1) + N}{e^{x_n}}, n = 0, 1, 2 \dots$$

(b) Draw a flow chart that,

- i. Reads the number N and initial approximation x_n
- ii. Computes and prints the natural logarithm of a number N correct to 3 significant figures after two iterations.

(c). Taking $x_n = 4.6$ and $N=96.3$, Perform a dry run using your flow chart in (b) above. (12 marks)

- 15 (a) A particle p is moving with speed of $\alpha \text{ kmh}^{-1}$ in the direction $N30^\circ E$, a second particle Q is moving with a speed of $\beta \text{ kmh}^{-1}$ in the direction $N\theta^\circ E$, the velocity of P relative to Q is due north east. Show that $\alpha = \beta(1 + \sqrt{3})(-\sin \theta + \cos \theta)$

(b) At $t=0$, the position vectors and velocity vectors of two bodies A and B are;

$$r_A = \begin{pmatrix} 3 \\ 2 \\ 7 \end{pmatrix} m \quad V_A = \begin{pmatrix} 8 \\ 2 \\ -3 \end{pmatrix} m s^{-1}$$

$$r_B = \begin{pmatrix} 2 \\ -6 \\ 4 \end{pmatrix} m \quad V_B = \begin{pmatrix} 2 \\ 4 \\ 4 \end{pmatrix} m s^{-1}$$

Find the least distance between A and B (12 Marks)

16. Bag R contains 8 yellow and 6 blue marbles. Bag T contains 10 yellow and 12 blue marbles. Bag R is thrice as likely to be picked as bag T. If a bag is picked at random and two marbles are removed from it, one at a time without replacement,
- a) Calculate the probability that two marbles removed are of different colour.
 - b) (i) Construct a probability distribution table for the number of yellow marbles removed,
(ii) Find the expected number of yellow marbles removed. (12 Marks)

END