

P425/2
APPLIED
MATHEMATICS

Paper 2
August 2019
3 HOURS



MASAKA DIOCESAN EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

JOINT MOCK EXAMINATION 2019

APPLIED MATHEMATICS

PAPER 2

3 HOURS

INSTRUCTIONS TO CANDIDATES:

- Answer all the **eight** questions in Section A and **five** from section B.
- All necessary working must be shown clearly.
- In numerical work take g to be 9.8ms^{-2} .
- Mathematical tables with a list of formulae and squared papers may be used.
- Extra numbers will not be marked.

SECTION A (40 MARKS)

1. A and B are independent events in a sample such that $P(A^c) = 0.6$ and $P(A \cup B) = 0.8$. Find:
 - (i) $P(B)$ (3 marks)
 - (ii) $P(A \cup B^c)$ (2 marks)

2. A constant horizontal force of 85N causes a particle of mass 10kg to move across a rough horizontal plane, a distance of 5m from a speed of 5ms^{-1} to 10ms^{-1} . Find the;
 - (a) acceleration of the particle (2 marks)
 - (b) coefficient of friction between the particle and the plane. (3 marks)

3. A car consumed fuel amounting to shs. 14,800, Shs. 15,600, Shs. 16,400 and Shs. 17,200 in covering distances of 10km, 20km, 30km and 40km respectively Estimate the;
 - (a) Cost of fuel consumed for a distance of 45km (3 marks)
 - (b) Distance travelled if fuel of shs. 16,000 is used (2 marks)

4. A continuous random variable X is uniformly distributed over the interval $a \leq x \leq \beta$. Given that $E(X) = 2$ and $P(X \leq 3) = \frac{5}{8}$. Find the;
 - (a) values of a and β (4 marks)
 - (b) *p.d.f* of X (1 mark)

5. One end of a light inextensible string of length 75cm is fixed to a point on a vertical pole. A particle of mass 1.2kg is attached to the other end of the string. The particle is held in equilibrium 21cm away from the pole by a horizontal force, P Newtons. Find the;
 - (i) tension in the string (3 marks)
 - (ii) magnitude of P (2 marks)

6. Real numbers A and B are rounded off to give numbers a and b with maximum possible errors of e_A and e_B . Show that the maximum possible relative error made in computing AB is $\left| \frac{e_A}{a} \right| + \left| \frac{e_B}{b} \right|$. State any assumptions made. (5 marks)

7. The data below shows the ages X of patients and number of days taken, Y to recover from a particular disease.

X	55	51	62	66	72	59	78	55	62	70
Y	34	44	49	49	48	43	51	41	46	51

- (a) Calculate the rank correlation coefficient for the data (4 marks)
 (b) Comment on the significance of the age on the number of days taken by the patient to recover fully at 1% level of significance. (1 marks)

8. A truck of mass $4m$ kg moving with a velocity of 54kmh^{-1} makes a head on collision with a car of mass m kg moving with velocity of 36kmh^{-1} . If the truck moves in the same direction with the car embedded in it after collision, find the;
 (a) common velocity after collision (2 marks)
 (b) loss in kinetic energy (3 marks)

SECTION B (60 MARKS)
Attempt only five questions

9. The time, x seconds spend by each of a random sample of 100 customers at an Automated Teller Machine (ATM) are summarized in the table below.

Time (seconds)	Frequency density
$10 \leq x \leq 15$	0.4
$15 \leq x \leq 25$	0.8
$25 \leq x \leq 30$	3.4
$30 \leq x \leq 35$	5.2
$35 \leq x \leq 45$	2.4
$45 \leq x \leq 50$	3.2
$50 \leq x \leq 60$	0.6
$60 \leq x \leq 80$	0.05

- (a) Draw a histogram and use it to estimate the mode. (4 marks)
 (b) Calculate the;
 (i) Mean time,
 (ii) Semi-interquartile range of the time spent at the ATM (8 marks)
10. A force $24t\mathbf{i} - 12t\mathbf{j}$ Newtons acts on a particle of mass 2kg initially at rest at point $(-4,3)$. Find the;
 (a) position vector of the particle after t seconds. (7 marks)
 (b) work done by the force in the time interval $t = 1$ to $t = 2$ seconds. (5 marks)
11. (a) Use the trapezium rule with six ordinates of estimates $\int_2^1 \sin^2 x dx$, correct to three significant figures. (6 marks)
 (b) Determine the error made in your calculation in (a) above and suggest how this error can be reduced. (6 marks)
12. The marks of 500 candidates in Subsidiary Mathematics are normally distributed with a mean of 45 marks and standard deviation. (20 marks)

Find the;

- (a) Percentage of candidates who scored at least 68 marks. (4 marks)
- (b) Number of candidates who will pass if the pass mark is 35. (4 marks)
- (c) The lowest mark for a point if 290 candidates score a point in Subsidiary Mathematics. (4 marks)

13. (a) A body of mass 5kg is in limiting equilibrium on its own when it is placed on a rough incline plane. If the angle is friction is $\tan^{-1}\left(\frac{3}{4}\right)$. Find the minimum force acting parallel to the incline that will just move the body up the incline. (6 marks)
- (b) $ABCD$ is a square of side 6cm. Forces of magnitudes 10N, 12N, 15N, 7N and $5\sqrt{2}N$ act along AB , BC , CD , DA and DB respectively in the direction shown by the order of the letters. Show that the forces reduce to a couple. (6 marks)

14. (a) (i) Show that the equation $x^3 = 5x + 1$ has a root between $x = 2$ and $x = 2.5$
- (ii) Use linear interpolation to estimate the root to two decimal places. (5 marks)

(b) Given the two iterative formulae;

$$x_{n+1} = \frac{2x_n^3 + 1}{3x_n^2 - 5} \text{ and } x_{n+1} = \sqrt{5 + \frac{1}{x_n}}$$

use the root in (a) (ii) above to deduce with a reason the more suitable formula. Hence give the root, correct to 2 d.ps. (7 marks)

15. A discrete random variable Y has a $p.d.f$ given as;

$$f(y) = \begin{cases} ky & ;y = 1,2 \\ k(6-y); & y = 3,4 \\ k & ;y = 5,6 \end{cases}$$

where k is a constant. Determine the value of;

- (a) Value of k hence $f(y)$ (4 marks)
- (b) $E(Y)$ (3 marks)
- (c) $P(Y < \left(\frac{5}{Y}\right)) \geq 3$ (5 marks)

16. (a) if a stone falls past a window 2.45m high in 0.5 seconds, find the height from which the stone fell. (4 marks)
- (b) A body P is projected vertically upwards with velocity 28ms^{-1} . Two seconds later another body Q is projected vertically upwards from the same level with

velocity 21ms^{-1} . Find the velocity of each body when they are at the same height. (8 marks)

END