

P425/2
APPLIED
MATHEMATICS
Paper 2
June/ July 2022

Uganda Advanced Certificate of Education
S6 RESOURCEFUL EXAMINATION
APPLIED MATHEMATICS
Paper 2
June/July 2022

INSTRUCTIONS TO CANDIDATES:

- Answer *all* the **eight** questions in section **A** and only **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 a 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 g to be 9.8 ms^{-2} .

Section A (40marks)

1. Two events A and B are such that $P(A/B) = 0.4$ and $5P(A) = 8P(B)$,
 $P(A \cup B) = 0.12$. Determine the;
 (i) $P(B)$, correct to 3 decimal places
 (ii) $P(A \cap B')$. (05marks)

2. Mr. Kajjiri imported the following commodities A, B, C from Dhubai, Britain and Japan respectively.

commodity	price	
	2015 = 100	2016
A	UAE Dirham. 5000	UAE Dirham. 6000
B	UK. Sterling 10000	UK. Sterling 11000
C	Jp.Yen. 15000	Jp.Yen. 16000

Calculate a suitable simple price index for 2016. Give reasons for the choice of the method you have used.

3. A uniform rod AB of mass 5 kg, which is smoothly hinged at A is maintained in equilibrium by a horizontal force P acting at B. Given that the rod is inclined at 30° to the horizontal with B below A, find;
 (i) the magnitude of the force P,
 (ii) the direction of the reaction at the hinge. (5 marks)

4. The table below is an extract from tables of tangents.

θ	24'	30'	36'	42'
$\tan 25^\circ$	0.4748	0.4770	0.4791	0.4813

Use linear interpolation or extrapolation to find,

- (i) $\tan 25^\circ 18'$ (ii) $\tan^{-1} 0.4775$. (5 Marks)

5. A pair of five sided dice is tossed and the sum of the numbers that show uppermost recorded. Find the probability that in ten tosses, a sum of seven appears:
 (i) exactly five times (ii) more than three times. (5marks)

6. A car travelling at 80kmh^{-1} on a rough incline plane of incline 1 in 80 has a mass of 420kg and accelerating at a rate of 1.5 ms^{-2} . If the power developed is 5kW, find the frictional force. (5 marks)

7. Use the trapezium rule with six ordinates to estimate $\int_1^2 \sin^2 2x \, dx$, correct to two decimal places. (5 Marks)
8. A City A is 600km from city B, a pilot sets off from A in an aero plane traveling at 250kmh^{-1} on a bearing of $S60^\circ E$ towards city B, wind blows in the bearing of 240° at the speed of 60kmh^{-1} . Find the time it takes the pilot to travel to city B. (5marks)

Section B(60marks)

9. (a) The table below shows the order in which ten candidates were ranked in two examinations.

Exam 1	A	F	D	C	H	J	K	B	E	L
Exam 2	D	F	C	A	J	K	H	B	L	E

Calculate the rank correlation coefficient between examinations 1 and 2.

Comment on your result at 5% level. (5marks)

- (b) The marks of 100 students were as shown in the table below:

Marks	Frequency
Below 10	6
10 and under 25	11
25 and under 35	17
35 and under 45	28
45 and under 50	20
50 and under 65	15
65 and under 80	3

- (i) Calculate the mean mark.
- (ii) Draw a histogram to represent the distribution and use it to estimate the mode. (7 marks)
10. (a) Show by drawing graphs of the equation $y = e^{2x}$ and $y = -4x + 5$ that the equation $e^{2x} + 4x - 5 = 0$ has only one real root between 0 and 1. (04 marks)
- (b) Use the Newton – Raphson iterative method to find the root of the equation in (a) above giving your answer correct to 2 decimal places (08 marks)

11. Forces of 10N, 25N, 30N, 40N and 25N act respectively along the sides PQ, QR, RS, ST and TU of a regular hexagon of sides 3 m, the directions being indicated by the order of the letters.
- Calculate the magnitude and direction of the resultant force.
 - Find the length of PX, where X is the point where the line of action of the resultant force meets PQ produced. (12marks)
12. (a) The volume of a certain drink bottled by a company is approximately normally distributed with mean 300 ml and standard deviation 2ml. Determine the probability that in a sample of 10 bottles, at least two contain less than 299.4 ml.
- (b) It is estimated that on average one match in five in a football league is drawn. If ninety matches are selected at random. What is the probability that between 13 and 20 inclusive of the matches is drawn? (6marks)
13. (a) The volume of a cone is estimated using the formula $v = \frac{1}{3}\pi r^2 h$. Errors e_r, e_h are made in measuring the radius r and height h of the cone. Show that the maximum relative error in the volume of the cone is given by
- $$2 \left| \frac{e_r}{r} \right| + \left| \frac{e_h}{h} \right|.$$
- (b) Given that the numbers $x = 3.9$ and $y = 27$ are rounded off to the given number of decimal places respectively. Find the
- Relative error in $\frac{x - y}{y}$, correct to three significant figures,
 - Limits within which the exact value of $\frac{x - y}{y}$ lies.
14. (a) A body moves along a curve so that at a time t , its position vector is given by $\mathbf{r} = (t^2 + 2)\mathbf{i} + (t^3 - 6)\mathbf{j} - (6 + 2t^3)\mathbf{k}$. Find the magnitude of the acceleration of the particle when $t = 3$ s. (06marks)
- (b) A particle P of mass 8kg rests on a smooth horizontal table and is attached by a light inelastic string to particles Q and R of mass 2kg and 6kg respectively. The strings pass over light smooth pulleys on opposite edges of the table so that Q and R hang freely. If the system is released from rest, Determine the acceleration of the particles and the tensions in the strings. (06 marks)

15. (a) Two events A and B are such that $P(B) = \frac{5}{6}$, $P(A \cap B) = \frac{1}{12}$ and

$$P(B/A) = \frac{1}{3}. \text{ Find}$$

$$(i) P(A \cup B) \quad (ii) P(A \cup \bar{B}) \quad (iii) P(\bar{A}/B). \quad (6\text{marks})$$

- (b) Ann can either use a bus or a taxi to go to work. The chance that she

uses a bus is $\frac{1}{5}$. If she uses a bus, the chance that she will be late is $\frac{2}{3}$,

otherwise it is $\frac{3}{4}$. Find the chance that she will:

(i) be late on a particular day.

(ii) use a taxi given that she is punctual.

16. At time $t = 0$, the position vectors and velocity vectors of two particles A and B are as follows. $\mathbf{r}_A = (3\mathbf{i} + \mathbf{j} + 5\mathbf{k})m$, $\mathbf{V}_A = (4\mathbf{i} + \mathbf{j} - 3\mathbf{k})ms^{-1}$

$$\mathbf{r}_B = (\mathbf{i} - 3\mathbf{j} + 2\mathbf{k})m \quad \mathbf{V}_B = (\mathbf{i} + 2\mathbf{j} + 2\mathbf{k})ms^{-1}$$

Determine the;

(i) Position vector of **B** relative to **A** at time (t).

(ii) Time when **A** and **B** are nearest to each other

(iii) Shortest distance.

(12marks)

END