

P425/2

APPLIED MATHEMATICS

Paper 2

July 2023

3 Hours

CODE HIGH SCHOOL

INTERNAL MOCK EXAMS

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 Hours

### INSTRUCTIONS TO CANDIDATES

*Answer **all** the eight questions in section **A** and any **five** from section **B***

*Any addition question(s) answered will **not** be marked*

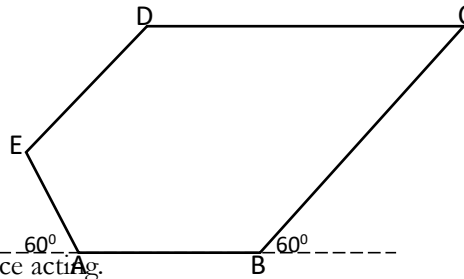
*All necessary working **must** be clearly shown*

*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.*

### SECTION A ( 40 MARKS)

- Given that  $P(A)=0.1$  ,  $P(B)=0.75$ ,  $P(A \cap B)=0.05$ . Determine  $P(A/B)$ . [ 5 marks]
- A particle of mass 5kg is prevented from sliding down a plane of inclination 1 in 20 by means of a horizontal force of magnitude 10N. Calculate the coefficient of friction between the particle and the plane. [ 5 marks ]
- A force of magnitude 50N acting in the direction  $3i + 4j + 5k$  moves a particle of mass 5kg from rest from rest. Determine the velocity of the particle at any time  $t$ . [ 5 marks ]
- A student who scored 16 and 64 had 18 and 82 as the scores entered on his report card respectively. Calculate his actual students score when the reported score is 55 [ 5 marks ]
- In the figure ABCDE, AB is parallel DC and ED is parallel to BC. Forces of magnitude 10N, 6N, 14N, 2N, 8N act along the directions CD, AB, EA, ED and BC respectively as shown in the polygon of forces below



Calculate the resultant force acting.

[ 5 marks ]

- Participants A,B,C,D,E,F,G and H were ranked in two aptitude tests and the results were summarized as follows

1 <sup>st</sup> Test	A	G	C	D	B	F	H	E
2 <sup>nd</sup> Test	G	A	C	B	D	F	E	H
Position	1	2	3	4	5	6	7	8

Calculate the rank correlation coefficient and comment on your answer at 5% level of significance. [ 5 marks ]

- A land surveyor proposes a formula for estimating the area of a plot as

$$\pi b^2 l$$

where  $\pi$  is a mathematical constant,  $b$  is the breadth and  $l$  is the length of the plot.

Suppose in measuring the breadth and length of the plot, he commits errors of magnitude  $\delta b$  and  $\delta l$  respectively.

Show that the relative error made in measuring the area of the plot is given by

$$\frac{2l|\delta b|}{b} + \frac{|\delta l|}{l}$$

[ 5 marks ]

- A biased coin whose head is thrice as likely to appear as the tail is rolled five times. Calculate the probability that at most three heads appear. [ 5 marks ]

### SECTION B (60 MARKS)

- A stone is thrown from a point O on a level ground with a speed of 13m/s at an angle of  $\tan^{-1} \frac{12}{5}$  to the horizontal. The stone just misses the top of the pole in its path and reaches a maximum height of twice the height of the pole.

At the instant the stone is thrown, a bird on top of the pole sets off with a constant speed  $v$  m/s away from O in a horizontal line in a vertical plane containing O and the pole. Take  $g=10\text{m/s}^2$

Find

- (a) The distance in metres of the base of the pole from O. [6 marks]  
 (b)  $v$ , given that the stone hits the bird. [ 6 marks]

10. (a) Show graphically that a root exists between 0 and 2 for the function  $f(x) = x^2 - 5\cos x + 2$ . Estimate the root. [5 marks]  
 (a) Hence using Newton-Raphson method, calculate the root correct to three decimal places. [ 7 marks ]

11. The table below shows the percentage marks of a group of math students of a certain school

Marks	Cumulative frequency
10-	15
20-	20
30-	30
50-	50
70-	90
90-	100

- (a) Calculate  
 (i) The mean mark using an assumed mean of your choice. [4 marks]  
 (ii) The standard deviation [3 marks ]  
 (b) Draw a histogram for the data hence estimate the median mark [5 marks ]

12. Using the trapezium rule with  $n+1$  ordinates show that

$$\int_0^1 x^2 dx \approx \frac{1}{3} + \frac{1}{2n} + \frac{1}{6n^2}$$

$$\text{Hint: } 1^2 + 2^2 + 3^2 + \dots + m^2 = \frac{m(m+1)(2m+1)}{6}$$

[ 7 marks ]

Hence

- (i) Using the trapezium rule with six ordinates, estimate  $\int_0^1 x^2 dx$  [2 marks ]  
 (ii) Calculate the percentage error in your estimate. [ 3 marks ]

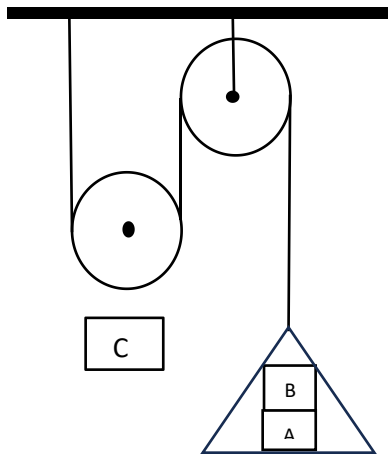
13. The volume of bottles of drinks of a certain company is normally distributed with mean and standard deviation. If 63% of the bottles have volume above 300ml and while 54% of the bottles have volumes below 350ml.

- (a) Find the mean and standard deviation [ 7 marks ]  
 (b) Calculate the percentage of bottles with volumes above 330mls [ 5 marks]

14. A non-uniform ladder of mass  $m$  kg rests on and over a smooth peg at a point three-quarters of the way up the ladder. A man of the same weight as the ladder climbs the ladder up to the point where the ladder is resting on the peg causing the foot of the ladder to be on the verge of slipping against the rough horizontal floor. Show in terms of  $\theta$  that the angle of friction between the ladder and the floor is given by

$$\tan^{-1} \left( \frac{7\tan\theta}{-1+6\tan^2\theta} \right) \quad [ 12 \text{ marks} ]$$

15. Urn A contains three black beads and six red beads. Urn B contains six black beads and three red beads. An urn is randomly selected, and a bead is randomly picked from the urn.
- (a) Calculate the probability that the beads picked are of the same colour [ 4 marks ]
- (b) Construct a probability distribution for the number of red beads picked hence calculate
- The expected number of red beads
  - The most likely number of red beads
- [ 8 marks]
16. One end of a light inelastic string is attached to the ceiling. The string passes under a smooth light pulley carrying a weight C and the over a fixed smooth light pulley. To the free end of the string is attached to a light scale pan in which two weights A and B are placed with A on top of B as shown. Each of the weights A and B has a mass of  $M$  kg and the weight of C has a mass of  $\beta M$  kg.



- If the system is released from rest, find the acceleration of the moveable pulley and that of the scale pan and show that the scale pan will ascend if  $\beta > 4$  [ 5 marks ]
- When the system is moving freely, find:-
  - The tension in the string
  - The reaction between the weights A and B [ 7 marks ]

**END**