P425/2
APPLIED
MATHEMATICS
July-August
2022
July / August, 2022
3 hours

MASAKA DIOCESAN EXAMINATIONS BOARD

JOINT MOCK EXAMINATIONS 2022

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** *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 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 acceleration due to gravity, $g = 9.8\ ms^{-2}$.

SECTION A (40 *marks*)

Attempt all questions in this section.

1. (a) If events A and B are independent, show that A' and B' are also independent. (03 *marks*)

(b) Given that $P(A) = 0.13$ and $P(B) = 0.724$, find $P(A' \cap B')$. (02 *marks*)

2. Real numbers X and Y are rounded off to 2.74 and 6.760 respectively.

Find the limits between which $\frac{X}{X-Y}$ lies, giving your answer correct to three decimal places. (05 *marks*)

3. A stone of mass 5kg is released from rest on top of a smooth inclined plane of inclination 2 in 5. Determine the velocity of the stone after covering 15m along the plane. (05 *marks*)

4. A student may travel to school by car, bicycle or on foot. The probability of using a car is $\frac{1}{3}$, of riding $\frac{1}{2}$, and going on foot is $\frac{1}{6}$. When the student uses a car, the probability of arriving in time is $\frac{3}{4}$, by bicycle is $\frac{2}{5}$, and on foot is $\frac{1}{10}$. Calculate the probability that the student;

(a) arrives in time, (02 *marks*)

(b) went on foot, if he did not arrive in time. (03 *marks*)

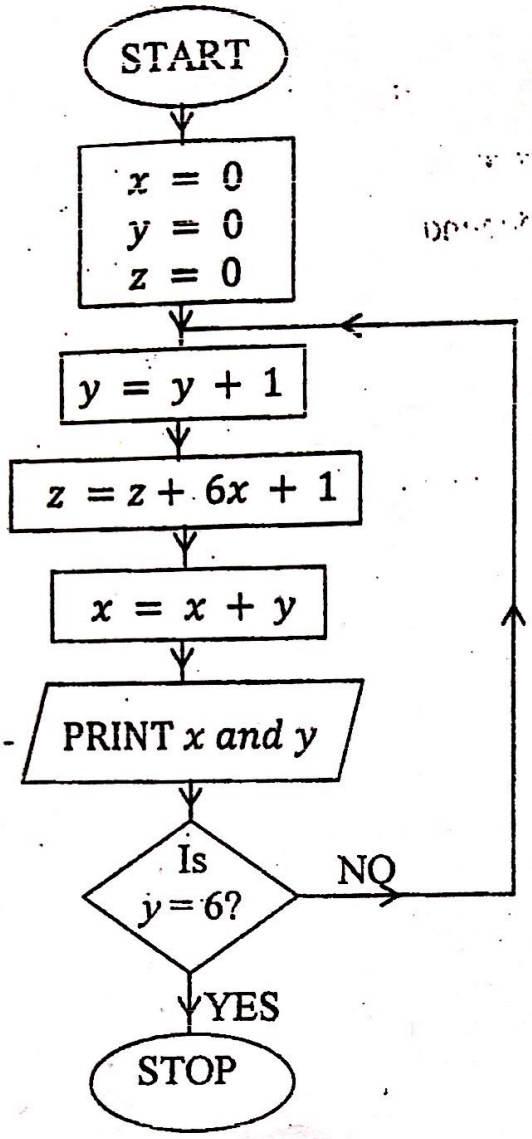
5. An aircraft P sets off with a velocity 250 kmh^{-1} in direction E 30° N while aircraft Q sets off with a velocity of 250 kmh^{-1} in direction N 20°W. Find the velocity of P relative to Q. (05 *marks*)

6. The data below show marks obtained in a mathematics test.

Marks	10–< 20	20–< 25	25–< 35	35–< 55	55–< 70	70–< 80
Frequency	10	20	15	40	10	5

Draw a histogram and estimate the mode. (05 *marks*)

Study the flow chart below and



(a) Perform a dry run for the flow chart (03 *marks*)

(b) What does X and Z represent? (02 *marks*)

A uniform beam AB of mass 5kg and length 4m rests in limiting equilibrium on a rough ground at A. The beam rests at an angle of 20° to horizontal by means of a string at B making 50° with the beam.

Determine the:

(a) tension in string, (03 *marks*)

(b) frictional force on ground. (02 *marks*)

SECTION B (60 *marks*)

Attempt only five questions from this section.

9. A continuous random variable X has a p.d.f given as;

$$f(x) = \begin{cases} \lambda(x+2) & : \quad -2 \leq x < 0 \\ 2\lambda & : \quad 0 \leq x < 2 \\ 0 & : \quad Otherwise \end{cases}$$

where λ is a constant.

(a) Sketch the graph of $y = f(x)$. Hence find the value of λ. (06 *marks*)

(b) Find the variance of X. (06 *marks*)

10. Point O is on a level ground and A is 40m vertically above O. A particle is projected horizontally from A with a speed $28ms^{-1}$. At the same time another particle is projected from O. If the particles collide on ground, find the,

(a) time for which the particles are in motion, (04 *marks*)

(b) angle and speed of projection of particle from O. (08 *marks*)

11. (a) Use the trapezium rule with 6 ordinates to estimate the area between the curve $y = xe^{-2x}$ and the x-axis from $x = 1$ to $x = 2$, correct to three significant figures. (06 *marks*)

(b) Find the exact value of the area in (a) above. Hence find the error made in your calculation in (a) above. (06 *marks*)

12. The table below shows marks obtained by 8 candidates in physics and mathematics.

Candidate	A	B	C	D	E	F	G	H
Mathematics (X)	52	75	41	60	81	31	65	52
Physics (Y)	50	60	35	65	66	35	69	48

(a) Draw a scatter diagram for the data. Hence;

(i) draw the line of best fit,

(ii) comment on your graph,

(iii) find X when Y = 40,

(iv) find Y when X = 55.

(07 *marks*)

(b) Calculate the rank correlation coefficient for the data. Hence comment on the significance at 1% level. (05 *marks*)

13. A particle of mass 2kg rests on a rough horizontal table with edges A and B. The particle is connected to two other particles, one of mass 8kg hanging freely in air connected by a light inextensible string which passes on a smooth pulley at A and another of mass 3kg hanging freely in air by a string which passes over pulley at

B. If the coefficient of friction between the 2kg and the table is $\frac{1}{4}$ and the system is released from rest, determine the;

(a) acceleration of the system, (08 *marks*)

(b) tensions in the strings. (04 *marks*)

14. (a) Locate each of the roots of the equation $x^3 + 4 = 4x^2$ in the interval $|x| \leq 4$. Hence use linear interpolation to estimate the largest root to one decimal place. (07 *marks*)

(b) Show that the Newton Raphson formula for calculating the reciprocal of a number α is $x_{n+1} = x_n\,(2 - \alpha\, x_n)$ $n = 0, 1, 2 \ldots$ Hence taking $x_o = 1$, find the second approximation of the reciprocal of 1.3. (05 *marks*)

15. The life of electrical components is normally distributed with mean 160 hours and standard deviation 30 hours.

(a) Find the probability that an electrical component chosen at random will run for at least 135 hours. (03 *marks*)

(b) If 40% of the components run for less than H hours. Find H. (04 *marks*)

(c) Determine the 75% central limits for the life time of the components. (05 *marks*)

16. A force has a magnitude F and acts in direction $a\boldsymbol{i} + 3\boldsymbol{j}$. Another force has magnitude $8\sqrt{5}$ N and acts in direction $\boldsymbol{i} - 2\boldsymbol{j}$. If the resultant of the two forces has magnitude 50 N and acts in direction $24\boldsymbol{i} - 7\boldsymbol{j}$, find the;

(a) value of F, (07 *marks*)

(b) two possible values of a. (05 *marks*)

*** END ***