P425/2
Mathematics
(Applied mathematics)
Paper 2
Oct. 2023
3 hrs

Uganda advanced Certificate of Education

FORM 6 MOCK EXAMINATION 2023

Mathematics

Paper 2
(Applied Mathematics)

3 hours

INSTRUCTIONS

Attempt **all** *questions in Section* **A** *and any* **five** *questions from Section* ***B***

Any additional questions (s) will **not** *be marked*

All necessary calculations must be shown clearly.

Graph paper is provided

Silent, non- programmable scientific calculators and mathematical tables with a list of formulae may be used

SECTION A

1. The random variable X has the following probability distribution:

X:	1	5	9
P(X=x)	a	b	c

where **a**, **b** and **c** are coordinates.
It is known that P(X<4) = P(X>4) and P(X≤5) = 2P(X>5)
Find the values of **a**, **b** and **c** *(05 marks)*

2. A stone is dropped from the top of a tower. One second later another stone is thrown vertically downwards from the same point with a velocity of 14m/s . If they hit the ground together, Find the height of the tower. *(05 marks)*

3. By use of the trapezium rule, find the approximate value of

$$\int_0^{\frac{\pi}{2}} x \sin x \, dx$$

Using five ordinates, correct your answer to 4 decimal places. *(05 marks)*

4. A small box of mass 5kg is to be pulled across a rough horizontal floor at a constant speed of by a string inclined at 30^0 above the horizontal. The tension in the string is 20N, Find the frictional force exerted by the floor on the box and the normal reaction of the floor on the box. *(05 marks)*

5. Given the following results:

X	10	10.1	10.34	10.4
Y	0.6484	0.8008	1.3003	1.4757

Using linear interpolation/ extrapolation, find:
(a) the value of x when y = 0.99
(b) the value of y when x is 9.9

(05 marks)

6. Forces $F_1 = (9\boldsymbol{i} + 3\boldsymbol{j})$N, $F_2 = (7\boldsymbol{i} + 3\boldsymbol{j})$N and $F_3 = (a\boldsymbol{i} + b\boldsymbol{j})$N, where a and b are constantans act on a particle of mass 2000g. Given that the acceleration produced is $(10\boldsymbol{i} + 2\boldsymbol{j})ms^{-2}$.
Find the values of a and b. *(05 marks)*

7. It is estimated that 1 in 20 people are deaf.

(a) What size should be taken to ensure that the expected number of deaf people in the sample is 2?

(b) What is the standard deviation of the number of deaf people in the sample case?

(05 marks)

8. A teacher calculates that if a student regularly completes their homework, the probability that they will pass the examination is 0.8; and if the student does not do the homework, the probability of passing is only 0.4. Given that only 75% of the students do their homework regularly, calculate the probability that a randomly selected student:

(a) does not do the homework regularly and pass the examination

(b) passes the examination

(05 marks)

SECTION B

9. The following grouped frequency distribution summarizes the orders of vaccines taken to health centers by government.

Delivered orders	Frequency
0-	80
100-	250
200-	500
300-	800
500-	100
550-	40
600-	25
650-	15
800-	10
850-	0

(a) Calculate the:

(i) mean

(ii) variance of the doses

(b) Draw a histogram and use it to estimate the mode of the doses.

(12 marks)

10. A ball is projected from a point at the top of a cliff with a speed of *u*m/s at an angle of 30^0 above the horizontal. The greatest height reached above the horizontal plane through **O** is 0.9.

(a) Find the speed *u*

(b) Given that **O** is 60m above the surface of the sea, find

(i) the time taken for the ball to travel from **O** to the sea

(ii) the horizontal distance from the cliff to the point at the sea where the ball strikes

(12 marks)

11. (a) Show that the root exists between the *x* values of 1 and 2 for the function $-\frac{\cos x}{x}$.

(03 marks)

(b) By using the Newton- Raphson formula, find the root of the function in (a) above. Correct your answer to 3 decimal places *(09 marks)*

12. A car of mass 800kg is travelling at a speed of 43.2kkm/hr along a straight horizontal road against a constant resistance of magnitude of 400m. The engine of the car is working at a rate of 36kW.

(a) Calculate the acceleration of the car.

(b) The car then climbs a hill at an angle of 5^0 to the horizontal and reaches the peak after travelling a distance of 120m. Calculate:

(i) the new acceleration

(ii) the potential energy at the peak of the hill

(12 marks)

13. Given the probability distribution density *f(x)* where and are constants.

$$f(x) = \begin{cases} \alpha x\,, & 0 \le x \le 3 \\ \frac{\beta}{9}(6-x)\,, & 3 \le x \le 6 \\ 0, & otherwise \end{cases}$$

where α and β are constants.

(a) Find the values of α and β

(b) Determine the cumulative distribution function of *f(x)*, hence, determine the median

(c) Sketch the graph in (b) above

(12 marks)

14. **P** and **Q** are two motor boats, **P** is travelling at a constant speed of 20km/hr on a bearing of 060^0 and **Q** is travelling at a constant speed of 18km/hr. At 2p.m. A man in **Q** sees **P** 4km away to the west. Find :

(a) the course that **Q** must set in order to pass as close as possible to P

(b) the shortest distance between **P** and **Q** in the subsequent motion

(c) the time to the nearest minute when the distance between the two boats is least.

(12 marks)

15. (a) The number X is approximated by **x** with an error in Δx and the error in θ is $\Delta\theta$.
Show that the maximum relative error in approximating $X^2 \sin\theta$ by $x^2 \sin\theta$ is

$$2\left|\frac{\Delta x}{x}\right| + \Delta\theta \cot\theta$$

State any assumptions made.

(b) Find the percentage error in the approximated function if **x** is measured with error 4.1 ± 0.05 and $= 30^0 \pm 0.5$

Find the maximum and minimum values of the given expression where *x* and *y* are approximated to the given number of decimal places. $\frac{1}{x} - \frac{1}{y}$ when *x*= 0.479 and *y* = 3.1. Correct your answer to 5 decimal places. *(12 marks)*

16. In a veterinary shop, there are four varieties of seeds, namely Bazooka, Hybrid, Longe H and Traditional in the ratio 4:3:2:1.
Their flowering rates are 30^0, 70^0, 60^0 and 50^0 respectively.

(a) Find the probability that a seed chosen at random from the shop will flower.

(b) Given that 200 seeds are chosen at random from the shop, find the probability that less than 170 of them will flower.

(12 marks)

End