P425/2
APPLIED
MATHEMATICS
Paper 2
31 July 2024
3 hours

EJEB

ENTEBBE JOINT EXAMINATION BUREAU

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

Answer **all** *the* **eight** *questions in* Section A *and* only five *from Section B.*

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

Begin each question on a fresh page.

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}.

Answer all questions in this Section.

1. Events A and B are such that $P(A \cup B) = \frac{19}{25}$, $P(A) = \frac{14}{25}$ and $P(A/B) = \frac{5}{9}$

    Find: (i) $P(A \cap B)$

    (ii) $P(A/\overline{B})$ *(05 marks)*

2. A particle of weight 10N is suspended by two strings. If these strings make angles of 30^0 and 40^0 to the horizontal, find the tensions in the strings.   *(05 marks)*

3. The table below shows the extension (x) of an elastic string when mass (m) is placed at its end.

Mass m(g)	0.6	0.95	1.32	1.46
Extension X(cm)	6.8	11.4	17.5	19.7

    Use linear interpolation or extrapolation to estimate the:

    (i)   mass when extension is 18.3 cm,

    (ii)   extension when mass is 1.51 kg.

                                                                                                                              (05 marks)

4. Use the trapezium rule with 6 sub - intervals to estimate correct to 3 significant figures the value of;

    $$\int_{2}^{3} \frac{2x}{(x+1)} \, dx$$ *(05 marks)*

5. The table below shows the relationship between Mathematics (x) and Physics (y).

Mathematics (x)	15	27	27	36	45	57	63
Physics (y)	50	69	65	74	82	79	87

    Calculate the rank correlation coefficient and comment at 5% level of significance.

                                                                                                                              (05 marks)

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6. Four forces of $ai + (a - 1)j$, $(3i + 2aj)$, $(5i - 6j)$ and $(-i - 2j)$ N act on a particle. The resultant force makes an angle of 45^0 with the horizontal. Determine the

    (i) value of a

    (ii) resultant force .   *(05 marks)*

7. The mean number of students who like Matooke in a certain school is 4. If a random sample of 16 students is taken, find the probability that

    (i) exactly 7 like Matooke;

    (ii) between 8 and 11 like Matooke.   *(05 marks)*

8. A particle of mass 0.2 kg with velocity of $5i + 7j$ collides with a particle of mass 0.3 kg with velocity $2i - 3j$, if the particles couple together, determine the:

                                                                (05 marks)

    (i) common velocity

    (ii) loss in kinetic energy.

SECTION B   (60 marks)

*Answer any **five** questions from this Section.*

9. The cumulative distribution function (F(x)) of a continuous random variable X is given by

$$F(x) = \begin{cases} 0 & ; \quad x \leq 0 \\ \frac{1}{3}x^2 & ; \quad 0 \leq x \leq a \\ x - \frac{x^2}{6} - \frac{1}{2} & ; \quad a \leq x \leq b \\ 1 & , \quad x \geq b \end{cases}$$

Find (i)   the values of constants a and b

      (ii)   hence $p(0.5 < x < 2.3)$ *(12 marks)*

      (iii)   mean (E(x))

10. (a) A particle is executing simple harmonic motion with amplitude 2 meters and period 12 seconds. Calculate the maximum speed of the particle.

(b) If initially, the particle was moving at maximum speed, find the

   (i) distance moved by the particle until its speed is half the maximum value.

   (ii) time taken by the particle to travel this distance.

   (12 marks)

11. The numbers $a = 19.67$, $b = 4.934$, $c = 13.8822$ and $d = 47.1300$ are each rounded off to the given number of decimal places. Calculate the:

(a) limits within which the exact value of $a - \frac{d}{(c-b)}$ lies correct to 4 decimal places.

(b) percentage error in $ad - (c + b)$ correct to 3 decimal places.

   (12 marks)

12. Given that X is a continuous random variable which is normally distributed with mean (μ) and standard deviation (δ) such that $P(X > 55) = 0.2$ and $P(35 < X < 55) = 0.5$, find the

(a) values of μ and δ.

(b) percentage of those with $P(X > 45)$

   (12 marks)

13. (a) A particle of mass (m) at the top of a smooth sphere of radius (a) is projected with a speed (u) and does not leave the surface of the sphere. If θ is the angle that the radius of the particle makes with the vertical, show that the reaction (R) between the particle and the sphere is given by $R = mg(3\cos\theta - 2) - \frac{mu^2}{a}$

(b) When the particle is just displaced from rest at the top of the sphere, show that it leaves the surface when $\cos\theta = \frac{2}{3}$
Hence find the angle and speed at that instant.

   (12 marks)

14. (a) Show that the simplest iterative formulae based on Newton – Raphson method for solving the equation $x^2 - 4x + 2 = 0$ is $\frac{x_n^2 - 2}{2x_n - 4}$; $n = 0, 1, 2 \ldots$

(b) Construct a flow chart that:

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(i)   reads the initial approximation (x_0)

(ii)   computes and corrects the root to 3 decimal places.

(iii)   prints the root

(c)   Using $x_0 = 3$ as the initial approximation, perform a dry run for the flow chart above.

(12 marks)

15.   The table below shows the distribution of the heights of students in a certain school.

Height (cm)	Frequency
120 —	7
130 —	8
135 —	36
145 —	39
155 —	17
170 —	3
175 —	5
190 —	0

(a)   Calculate the mean and standard deviation;

(b)   Construct the ogive and estimate the median.

(12 marks)

16.   A rectangle ABCD has forces of 5N, 10 N, 15 N, 20 N and 25 N acting along the sides $\overrightarrow{BA}$, $\overrightarrow{CB}$, $\overrightarrow{DC}$, $\overrightarrow{AD}$ and $\overrightarrow{CA}$ respectively. If $AB = 4m$ and $AD = 2m$ are the positive x and positive y axes respectively.

$\rightarrow$

Determine the:

(a)   magnitude of the resultant force and its direction.

(b)   line of action and the point at which the resultant force crosses $\overrightarrow{AB}$ by taking moments about point A.

(12 marks)

END