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P4252
APPLIED MATHEMATICS
PAPER 2
JULY/AUGUST 2024
3 HOURS

ASSHU BUSHENYI DISTRICT MOCK EXAMINATIONS 2024
UGANDA ADVANCED CERTIFICATE OF EDUCATION
APPLIED MATHEMATICS
PAPER 2
3 HOURS

INSTRUCTIONS TO CANDIDATES

- Attempt all the eight questions in section A and only five questions from section B.
- Any additional question answered(s) will not be marked.
- All necessary working must be shown clearly.
- Any graphical number should fully be attempted on a graph paper.
- Silent non-programmable scientific calculator and mathematical tables with a list of formulae may be used.
- In numerical work take acceleration due to gravity (g) to be 9.8 m s^{-2} .

SECTION A: (40 MARKS)

Answer all the questions in this section.

1. A particle P is observed to execute S.H.M with amplitude 2m and period 2 seconds. If P is initially moving at maximum speed, determine the;
- (a) Distance moved by the particle until its half the maximum speed, (5marks)
- (b) Time taken by the particle to travel the distance in (i) above.

2. The table below is an extract from tables of X^0 and $\sin X^0$

X^0	0.0^0	0.2^0	0.4^0	0.6^0	0.8^0
$\sin X^0$	0.1736	0.1771	0.1805	0.1840	0.1891

Use linear interpolation or extrapolation method to estimate.

- (a) $\sin(10.27^0)$, (5marks)
- (b) $\sin^{-1}(0.1899)$.
3. Independent events A and B are such that $P(A \cup B) = \frac{3}{5}$ and $P(A) = \frac{2}{5}$. Find;
- (a) $P(B)$ (5marks)
- (b) $P(A \cap B)$
4. A uniform ladder AB of length 4m and mass 10kg rests with ends A on a rough horizontal ground and B on smooth vertical wall. If B is 2m above the ground and the co-efficient of friction between the ground and ladder is 0.27, find the maximum horizontal force that can be applied at A before motion occurs. (5marks)

5. Given that $x = 12.7654$ and $y = 13.80$. State the maximum possible errors in x and y, determine the maximum value and minimum value and hence the absolute error in the expression $\frac{(x+y)}{xy}$. (5marks)

6. The table below shows the marks awarded to students A, B, C, D, E and F by two judges I and II during a certain competition.

Students	A	B	C	D	E	F
Judge I	40	58	84	58	63	77
Judge II	58	71	83	65	71	53

Calculate the rank correlation co-efficient and give a comment at 5% level of significance. (5marks)

7. A particle starts from rest moving with a constant acceleration of 3 ms^{-2} for 12 seconds, for the next 48s the acceleration is $\frac{1}{6} \text{ ms}^{-2}$ and for the last 10s it decelerates uniformly to rest, by drawing the velocity-time graph. Find the;
- (a) Velocities at different points, (5marks)
- (b) Total distance travelled.

8. A biased coin is tossed six times. The coin is such that the ratio of that tail to the head is 2:1. Find the probability of getting;
- (a) At least 4 heads (5marks)
- (b) Between 3 and 5 tails.

SECTION B (60 MARKS)
Answer any five questions from this section.
All questions carry equal marks

9. A lorry of mass 2,000kg travels around a circle of radius 500m at 48kmhr^{-1} . The distance between the wheels is 2m and the centre of gravity of the lorry is 2.5m above the ground level, determine the;
- Horizontal and vertical pressure, if the wheels are at the same level.
 - Height at which the outer tyre should be raised to avoid pressure on the wheels.
- (12marks)

10. (a) Derive the simplest iterative formulae based on newton Raphson method for the equation $10(1-\cos x)=2-3x$ and show that it's given by: $x_{n+1} = \frac{10x_n \sin x_n + 10 \cos x_n - 2}{10 \sin x_n + 3}$; $x=0,1,2,\dots$

- (b) Construct a flow chart that:

- Reads initial approximation (x_0).
- Computes and limits the error to a number corrected to 3 decimal places.
- Prints the root (x_{n+1}) and number of iterations (n).

- (c) Using $x_0 = 0.55$ and the flow chart in (b) above perform a dry run for the flow chart above.
- (12marks)

11. (a) Box P contains 3 white and 4 blue beads while box Q contains 5 white and 3 blue beads. A bead is drawn at random from P and put into Q and then a bead is taken from Q and put into P. find the probability that the bead drawn from P is white.
- (5marks)

- (b) Bag X contains 4 red and 3 blue pens, while bag Y contains 3 red and 2 blue pens. A bag is selected at random and two pens are drawn from it without replacement. Find the probability of picking:

- Pens of different colours.
 - Bag Y given that the pens drawn are of the same colour.
- (4marks)
(3marks)

12. (a) Find the centre of gravity of a semicircular lamina of radius (r) from the base which is the diameter and show that it's given by $\frac{4r}{3\pi}$.

- (b) A semi-circular lamina of radius (r = OA) and base (OB) is cut from a large semi-circular lamina of radius (2r = OB), with diameter base (OC), determine the centre of gravity of the remainder from base (OC).
- (12marks)

13. The table below shows the distribution of the height of students in a certain school

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

- Calculate the;
 - mean
 - Standard deviation
 - Draw a cumulative frequency curve and use it to estimate the
 - Median
 - Number less than height 150cm
- (12marks)

14. (a) Show graphically that the equation $e^x + x - 4 = 0$ has a root between $x=0.5$ and $x=2$ correct the initial approximation (x_0) to one decimal place.

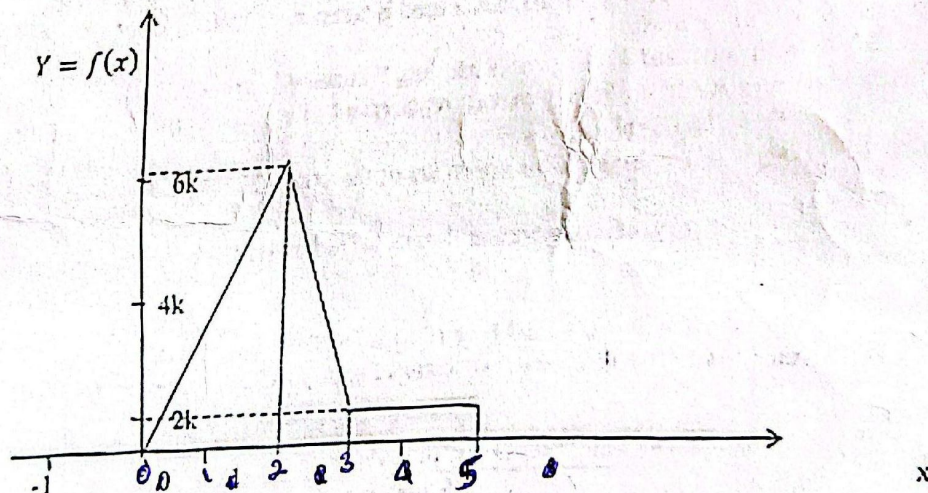
(b) Using the initial approximation (x_0) above and the Newton Raphson method, find the root correct to 3 decimal places. (12marks)

15. At 12.00 noon the position vector (r) for two objects P and Q are as follows.

Objects	Position vector (r)	Velocity vector (v)
P	$r_p = \begin{pmatrix} 5 \\ -3 \\ 4 \end{pmatrix} km$	$v_p = \begin{pmatrix} 2 \\ 5 \\ 3 \end{pmatrix} kmh^{-1}$
Q	$r_q = \begin{pmatrix} 7 \\ 5 \\ -2 \end{pmatrix} km$	$v_q = \begin{pmatrix} -3 \\ -15 \\ 18 \end{pmatrix} kmh^{-1}$

- (a) Find the position vector of P relative to Q at any time (t).
 (b) Show that if the velocities remain constant, a collision between P and Q will occur and find the time of collision. (12marks)
 (c) Find the position of collision.

16. The probability distribution of a continuous random variable X is represented graphically as shown below.



- (a) From the sketch above, find the value of k .
 (b) Obtain the equation for $f(x)$.
 (c) Calculate the mean ($E(x)$). (12marks)

END