P425/2
APPLIED MATHEMATICS
PAPER 2
JULY/AUGUST 2024
3 HOURS

ASSHU BUSHENYI DISTRICT MOCK EXAMINATIONS 2024
UGANDA ADVANCED CERTIFICATE OF EDUCATION
APPLIED MATHEMATICS
PAPER 2
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INSTRUCTIONS TO CANDIDATES

- *Attempt all the **eight** questions in section A and only **five** questions from section **B**.*
- *Any additional question answered(s) answered 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 9.8ms⁻².*

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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.
   (b)   Time taken by the particle to travel the distance in (i) above.   (5marks)

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

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

   Use linear interpolation or extrapolation method to estimate.

   (a) $Sin(10.27^0)$,
   (b) $Sin^{-1}(0.1899)$.   (5marks)

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)
   (b) $P(A \cap \bar{B})$ (5marks)

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

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
   (b)   Between 3 and 5 tails.   (5marks)

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:
   (a) Horizontal and vertical pressure, if the wheels are at the same level.
   (b) Height at which the outer tyre should be raised to avoid pressure on the wheels. **(12 marks)**

10. (a) Derive the simplest iterative formulae based on newton Raphson method for the equation 10(1-Cosx)=2-3x and show that it's given by: $x_{n+1} = \frac{10x_n \sin x_n + 10\cos x_n - 8}{10\sin x_n + 3}$: x=0,1,2,...

    (b) Construct a flow chart that:

       (i) Reads initial approximation (x_0).
       (ii) Computes and limits the error to a number corrected to 3 decimal places.
       (iii) 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.
    (12 marks)

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. **(5 marks)**
    (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:
       (i) Pens of different colours. **(4 marks)**
       (ii) Bag Y given that the pens drawn are of the same colour. **(3 marks)**

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).
    (12 marks)

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

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

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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.

(c) Find the position of collision. **(12marks)**

16. The probability distribution of a continuous random variable X is represented graphically as shown below.
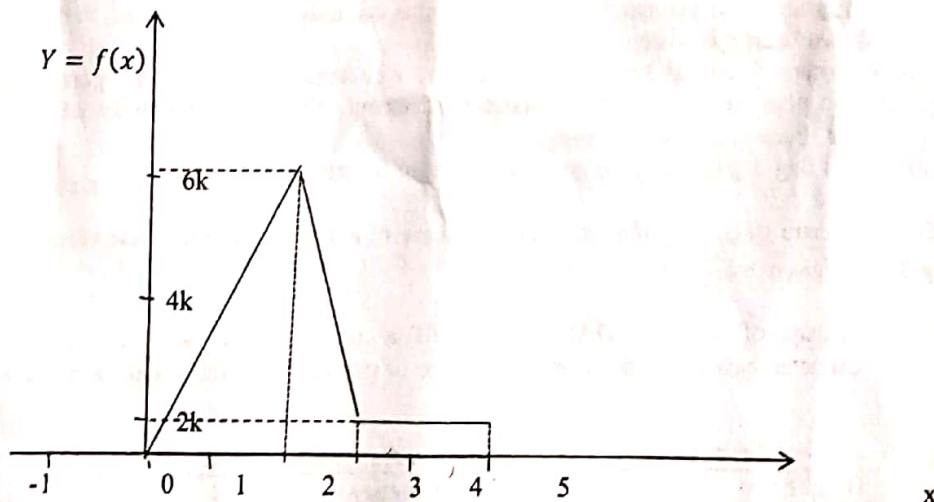
(a) From the sketch above, find the value of k.

(b) Obtain the equation for f(x).

(c) Calculate the mean (E(x)). **(12marks)**

END