

P425/2
APPLIED
MATHEMATICS
PAPER 2
Nov. / Dec. 2014
3 hours



UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES:

Answer all the eight questions in section A and five questions from section B.

Additional question(s) answered will not be marked.

All working must be shown clearly.

Begin each answer on a fresh 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 g to be 9.8 ms^{-2} .

SECTION A (40 MARKS)

Answer all questions in this section.

1. The daily number of patients visiting a certain hospital is uniformly distributed between 150 and 210.
- (a) Write down the probability distribution function (pdf) of the number of patients.
- (b) Find the probability that between 170 and 194 patients visit the hospital on a particular day. (05 marks)
2. A particle starts from rest at the origin (0, 0). Its acceleration in ms^{-2} at time t seconds is given by $\mathbf{a} = 6t\mathbf{i} - 4t\mathbf{j}$. Find its speed when $t = 2$ seconds. (05 marks)
3. Use the trapezium rule with four sub-intervals to estimate $\int_{0.2}^{1.0} \left(\frac{2x+1}{x^2+x} \right) dx$, correct to two decimal places. (05 marks)
4. Tom's chance of passing an examination is $\frac{2}{3}$. If he sits for four examinations, find the probability that he passes:
- (a) only two examinations.
- (b) more than half of the examinations (05 marks)
5. Forces of $\begin{pmatrix} 1 \\ -4 \end{pmatrix}$ N, $\begin{pmatrix} 3 \\ 6 \end{pmatrix}$ N, $\begin{pmatrix} -9 \\ 1 \end{pmatrix}$ N and $\begin{pmatrix} 5 \\ -3 \end{pmatrix}$ N act at the points having position vectors $(3\mathbf{i} - \mathbf{j})$ m, $(2\mathbf{i} + 2\mathbf{j})$ m, $(-\mathbf{i} - \mathbf{j})$ m and $(-3\mathbf{i} + 4\mathbf{j})$ m respectively. Show that the forces reduce to a couple. (05 marks)

6. Given the table below;

x	0	10	20	30
y	6.6	2.9	-0.1	-2.9

use linear interpolation to find;

- (a) y when $x = 16$.
(b) x when $y = -1$.

(05 marks)

7. The table below shows scores of students in Mathematics and English tests.

Mathematics	72	65	82	54	32	74	40	53
English	58	50	86	35	76	43	40	60

Calculate the rank correlation coefficient for the students performance in the two subjects.

(05 marks)

8. A bullet of mass 50 grammes travelling horizontally at 80 ms^{-1} hits a block of wood of mass 10 kg resting on a smooth horizontal plane. If the bullet emerges with a speed of 50 ms^{-1} , find the speed with which the block moves.

(05 marks)

SECTION B: (60 MARKS)

Answer any five questions from this section. All questions carry equal marks.

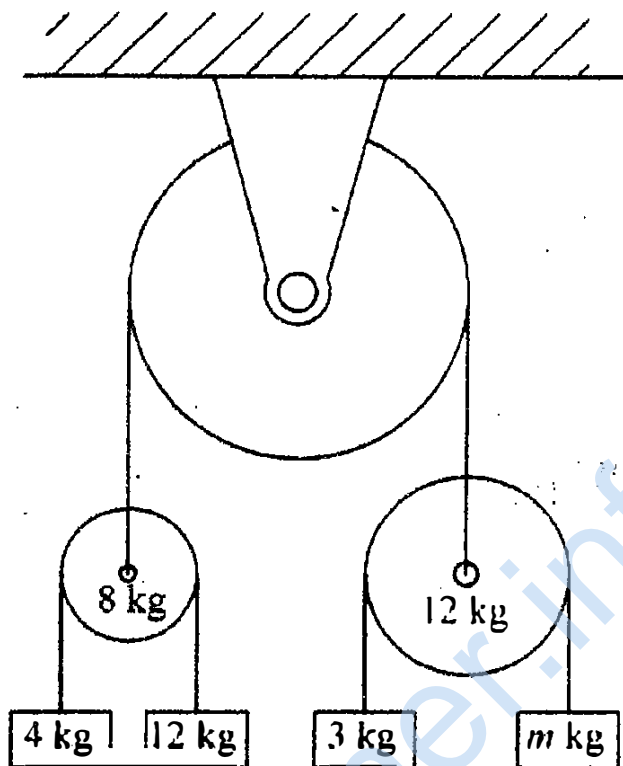
9. (a) A bag contains 30 white (W), 20 blue (B) and 20 red (R) balls. Three balls are drawn at random one after the other without replacement. Determine the probability that the first ball is white and the third ball is also white.
- (b) Events A and B are such that $P(A) = \frac{4}{7}$, $P(A \cap B') = \frac{1}{3}$ and $P(A|B) = \frac{5}{14}$.

Find;

- (i) $P(B)$.
(ii) $P(A' \cap B')$.

(07 marks)

10. The diagram below shows two pulleys of masses 8 kg and 12 kg connected by a light inextensible string hanging over a fixed pulley.



The accelerations of 4 kg and 12 kg masses are $\frac{g}{2}$ upwards and $\frac{g}{2}$ downwards respectively. The accelerations of the 3 kg and m kg masses are $\frac{g}{3}$ upwards and $\frac{g}{3}$ downwards respectively. The hanging portions of the strings are vertical. Given that the string of the fixed pulley remains stationary, find the:

- (a) tensions in the strings, (09 marks)
- (b) value of m . (03 marks)
11. The numbers x and y are approximated with possible errors of Δx and Δy respectively.
- (a) Show that the maximum absolute error in the quotient $\frac{x}{y}$ is given by
- $$\frac{y\Delta x + x\Delta y}{y^2} \quad (05 \text{ marks})$$
- (b) Given that $x = 2.68$ and $y = 0.9$ are rounded to the given number of decimal places, find the interval within which the exact value of $\frac{x}{y}$ is expected to lie. (07 marks)

12. A lorry starts from a point A and moves along a straight horizontal road with a constant acceleration of 2 ms^{-2} . At the same time a car moving with a speed of 20 ms^{-1} and a constant acceleration of 3 ms^{-2} is 400 m behind the point A and moving in the same direction as the lorry. Find;
- (a) how far from A the car overtakes the lorry. (10 marks)
- (b) the speed of the lorry when it is being overtaken. (02 marks)

13. The cumulative frequency table below shows the ages in years of employees of a certain company.

Age (years)	<15	<20	<30	<40	<50	<60	<65
Cumulative frequency	0	17	39	69	87	92	98

- (a) (i) Use the data in the table to draw a cumulative frequency curve (Ogive).
(ii) Use the curve to estimate the semi-interquartile range. (06 marks)
- (b) Calculate the mean age of the employees. (06 marks)
14. (a) Show that the Newton-Raphson formula for finding the root of the equation $x = N^{1/5}$ is given by
- $$x_{n+1} = \frac{4x_n^5 + N}{5x_n^4}, \quad n = 0, 1, 2, \dots \quad (04 \text{ marks})$$
- (b) Construct a flow chart that
- (i) reads N and the first approximation x_0 ,
- (ii) computes the root to three decimal places,
- (iii) prints the root (x_n) and number of iterations (n) (05 marks)
- (c) Taking $N = 50$, $x_0 = 2.2$, perform a dry run for the flow chart. Give your root correct to three decimal places. (03 marks)

15. (a) A non-uniform plank AB of length 4 metres rests in horizontal position on vertical supports at A and B . The centre of gravity is at 1.5 m from A . The reaction at B is 37.5 N.
Determine the:
- (i) mass of the plank.
 - (ii) reaction at A . (05 marks)
- (b) Find the coordinates of the centre of gravity of a uniform lamina bounded by the curve $y^2 = 2x$ and the line $x = 4$. (07 marks)
16. The marks in an examination were normally distributed with mean μ and standard deviation σ . 20% of the candidates scored less than 40 marks and 10% scored more than 75 marks. Find the;
- (a) values of μ and σ . (08 marks)
 - (b) percentage of candidates who scored more than 50 marks. (04 marks)