

P425/2
APPLIED MATHEMATICS
Paper 2
Nov. / Dec. 2019
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 any five from section B.

Any additional question(s) answered will not be marked.

All necessary working must be shown clearly.

Begin each answer on a fresh sheet of paper.

Squared paper is provided.

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

In numerical work, take acceleration due to gravity g , to be 9.8 ms^{-2} .

SECTION A: (40 MARKS)
Answer all questions in this section.

1. The table below shows the masses of bolts bought by a carpenter .

Mass (grams)	98	99	100	101	102	103	104
Number of bolts	8	11	14	20	17	6	4

Calculate the;

- (a) median mass,
 (b) mean mass of the bolts. (05 marks)
2. A uniform rod AB of length 3 m and mass 8 kg is freely hinged to a vertical wall at A . A string BC of length 4 m attached to B and to a point C on the wall, keeps the rod in equilibrium. If C is 5 m vertically above A , find the;
- (a) tension in the string. (03 marks)
 (b) magnitude of the normal reaction at A . (02 marks)
3. Use the trapezium rule with seven ordinates to estimate

$$\int_0^3 [(1.2)^x - 1]^{1/2} dx \quad \text{correct to 2 decimal places.} \quad (05 \text{ marks})$$

4. A discrete random variable X has the following probability distribution:

x	0	1	2	3	4	5
$P(X=x)$	0.11	0.17	0.2	0.13	p	0.09

Find the;

- (a) value of p . (02 marks)
 (b) expected value of X . (03 marks)
5. A stone is thrown vertically upwards with velocity 16 ms^{-1} from a point H metres above the ground level. The stone hits the ground 4 seconds later. Calculate the;
- (a) value of H . (03 marks)
 (b) velocity of the stone as it hits the ground. (02 marks)

6. The table below shows the commuter bus fares from stage A to stages B , C , D and E .

Stage	A	B	C	D	E
Distance (km)	0	12	16	19	23
Fare (Shs)	0	1300	1700	2200	2500

- (a) Jane boarded from A and stopped at a place 2 km after E . How much did she pay? (03 marks)
- (b) Okello paid Shs 2000. How far from A did the bus leave him? (02 marks)
7. The amount of meat sold by a butcher is normally distributed with mean 43 kg and standard deviation 4 kg. Determine the probability that the amount of meat sold is between 40 kg and 50 kg. (05 marks)
8. A particle is moving with Simple Harmonic Motion (SHM). When the particle is 15 m from the equilibrium, its speed is 6 ms^{-1} . When the particle is 13 m from the equilibrium, its speed is 9 ms^{-1} . Find the amplitude of the motion. (05 marks)

SECTION B: (60 MARKS)

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

9. Car A is 80 m North West of point O . Car B is 50 m $N 30^\circ E$ of O . Car A is moving at 20 ms^{-1} on a straight road towards O . Car B is also moving at 10 ms^{-1} on another straight road towards O . Determine the;
- (a) initial distance between the two cars. (03 marks)
- (b) velocity of A relative to B . (05 marks)
- (c) shortest distance between the two cars as they approach O . (04 marks)
10. The table below shows the marks obtained in a Mathematics test by a group of students.

Marks	5 – <15	15 – <25	25 – <35	35 – <45	45 – <55	55 – <65	65 – <75	75 – <85
Number of students	5	7	19	17	7	4	2	3

- (a) Construct a cumulative frequency curve (Ogive) for the data. (05 marks)

- (b) Use your Ogive to find the;
- (i) range between the 10th and 70th percentiles.
- (ii) probability that a student selected at random scored below 50 marks. (07 marks)
11. (a) Show that the equation $x - 3 \sin x = 0$ has a root between 2 and 3. (03 marks)

- (b) Show that the Newton-Raphson iterative formula for estimating the root of the equation in (a) is given by

$$x_{n+1} = \frac{3(\sin x_n - x_n \cos x_n)}{1 - 3 \cos x_n}, \quad n = 0, 1, 2, \dots$$

Hence find the root of the equation correct to 2 decimal places.

(09 marks)

12. A force $F = (2t \mathbf{i} + \mathbf{j} - 3t \mathbf{k}) \text{ N}$ acts on a particle of mass 2 kg. The particle is initially at a point (0, 0, 0) and moving with a velocity $(\mathbf{i} + 2\mathbf{j} - \mathbf{k}) \text{ ms}^{-1}$. Determine the;

- (a) magnitude of the acceleration of the particle after 2 seconds. (04 marks)
- (b) velocity of the particle after 2 seconds. (04 marks)
- (c) displacement of the particle after 2 seconds. (04 marks)

13. Two events A and B are such that $P(B) = \frac{1}{8}$, $P(A \cap B) = \frac{1}{10}$ and $P(B|A) = \frac{1}{3}$. Determine the;

- (a) $P(A)$. (03 marks)
- (b) $P(A \cup B)$. (03 marks)
- (c) $P(A|\bar{B})$. (06 marks)

14. (a) Given that $y = e^x$ and $x = 0.62$ correct to two decimal places, find the interval within which the exact value of y lies. (05 marks)

- (b) Show that the maximum possible relative error in $y \sin^2 x$ is

$$\left| \frac{\Delta y}{y} \right| + 2 \cot x |\Delta x|, \text{ where } \Delta x \text{ and } \Delta y \text{ are errors in } x \text{ and } y$$

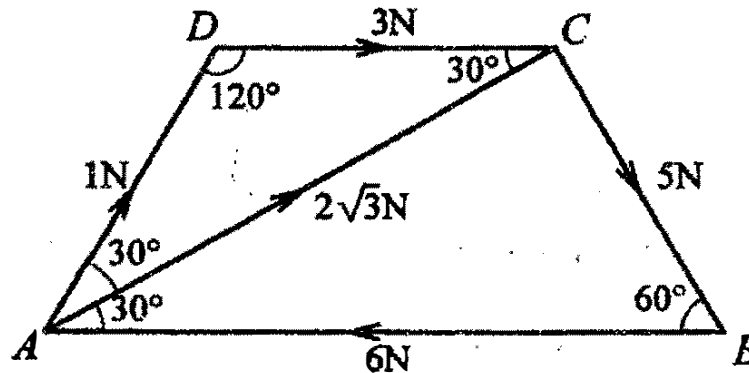
respectively.

Hence find the percentage error in calculating $y \sin^2 x$ if $y = 5.2 \pm 0.05$

and $x = \frac{\pi}{6} \pm \frac{\pi}{360}$.

(07 marks)

15. The diagram below shows a trapezium $ABCD$. $AD = DC = CB = 1$ metre and $AB = 2$ metres. Forces of magnitude 1N , 3N , 5N , 6N and $2\sqrt{3}\text{N}$ act in the directions AD , DC , CB , BA and AC respectively.



- (a) Calculate the magnitude of the resultant force and the angle it makes with side AB . (09 marks)
- (b) Given that the line of action of the resultant force meets AB at X , find the distance AX . (03 marks)
16. A biased die with faces labelled 1, 2, 2, 3, 5 and 6 is tossed 45 times. Calculate the probability that 2 will appear;
- (a) more than 18 times. (07 marks)
- (b) exactly 11 times. (05 marks)