Edukamer

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}.

Turn Over

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

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

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°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 $F = (2t\,i + j - 3t\,k)$ N acts on a particle of mass 2 kg. The particle is initially at a point $(0, 0, 0)$ and moving with a velocity $(i + 2j - k)$ 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

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

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 $2\sqrt{3}$ N act in the directions AD, DC, CB, BA and AC respectively.
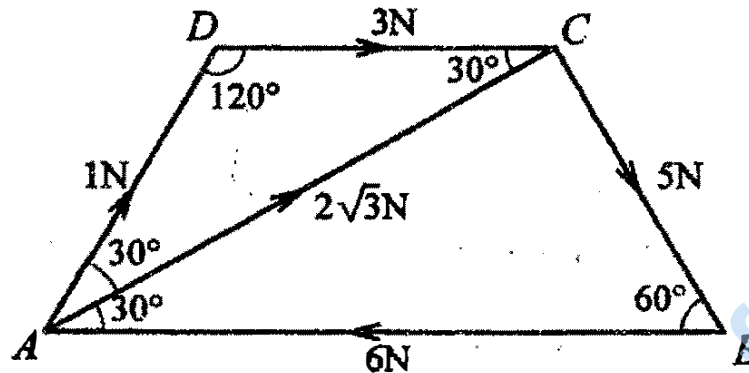
(a) Calculate the magnitude of the resultant force and the angle it makes with side AB. *(09 marks)*

(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)*