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

   $$\int_{0}^{3} [(1.2)^x - 1]^{\frac{1}{2}} \, dx \quad \text{correct to 2 decimal places.} \quad \textit{(05 marks)}$$

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 30ºE 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)*

Turn Over

(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

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

   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) $P(A/\overline{B})$. *(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)*

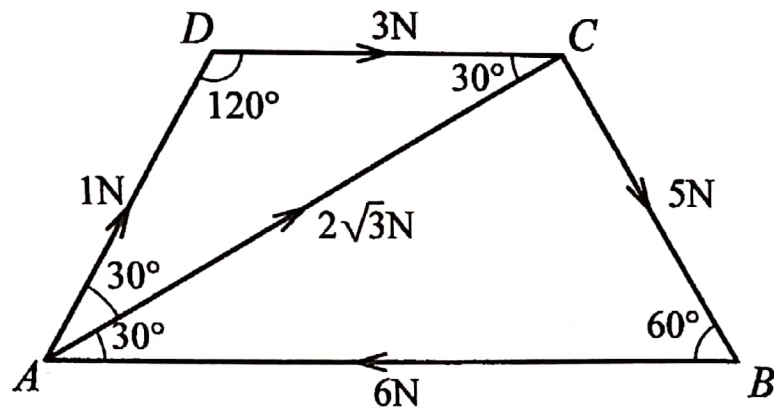   (b) Show that the maximum possible relative error in $y \sin^2 x$ is

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

   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)

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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)*

END