P425/2
APPLIED
MATHEMATICS
PAPER 2
3 HOURS

# 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.
- All necessary working must be shown clearly.
- Begin each answer on a fresh page.
- In numerical work, take $\boldsymbol{g}$ to be $\mathbf{9 . 8} \mathbf{m s}^{-\mathbf{2}}$.
- Silent, non-programmable scientific calculators and mathematical tables with a list of formulae may be used.


## - SECTION A: (40 MARKS)

Answer all the questions in this section.

1. A certain frequency distribution with standard deviation 2.5 has the following results: $\sum f=n, \sum f x=177$ and $\sum f x^{2}=5259$. Find the value of $n$
(05 marks)
2. ABCD is a square of side 2 a metres. Forces of magnitude $9 \mathrm{~N}, 5 \mathrm{~N}$ and $\mathbf{3} \sqrt{2} N$ act along $\overrightarrow{A B}, \overrightarrow{B C}$, and $\overrightarrow{B D}$ respectively. Find the equation of the line of action of the resultant force.
(05 marks)
3. Use the trapezium rule with 6 ordinates to estimate $\int_{1}^{2} \tan ^{-1} x d x$ correct to 4 decimal places. (05 marks)
4. Events A and B are such that $\mathbf{3 P} \boldsymbol{\operatorname { A } \boldsymbol { n } \boldsymbol { B } )}=\boldsymbol{2 P}(\overline{\boldsymbol{A}} \boldsymbol{n} \boldsymbol{B})=\boldsymbol{P}(\overline{\boldsymbol{A}} \boldsymbol{n} \overline{\boldsymbol{B}})=\boldsymbol{x}$ and $\boldsymbol{P}(\boldsymbol{A})=\frac{\mathbf{3}}{\mathbf{5}}$. Use a Venn diagram to find:
(i) the value of x
(ii) $\mathrm{P}(\mathrm{A}$ or B but not both A and B$) \quad$ (05 marks)
5. A ball projected from level ground with a speed of $25 \sqrt{2} \boldsymbol{m s} \boldsymbol{s}^{-1}$ at an elevation of $45^{\circ}$ passes just above the top of two vertical posts each of height 30 m . Find the distance between these posts.
[ Take $\mathrm{g}=\mathbf{1 0} \mathbf{m s}^{-2}$ ]
(05 marks)
6. The resistance of a wire at different temperatures is as follows:

| Resistance $(\Omega)$ | 24 | 42 |
| :---: | :---: | :---: |
| Temperature $\left({ }^{\circ} \mathrm{C}\right)$ | 15 | 51 |

Use linear interpolation or extrapolation to estimate the:
(i) temperature corresponding to $35 \Omega$.
(ii) resistance whose value is equal to that of the temperature.
(05 marks)
7. The masses of meat cans are normally distributed with a standard deviation of 18 g . A random sample of 25 cans had a mean mass of DOWNLOAD MORE RESOURCES LIKE THIS ON ECOLEBOOKS.COM

458 g . Find the $99 \%$ confidence interval for the mean mass of all the meat cans
8. A particle executes $\mathrm{S} \cdot \mathrm{H} \cdot \mathrm{M}$ about centre O , with amplitude 5 m and period $\frac{\pi}{2} s$. Find the distance it travels from O until when its speed is half the maximum value.
(05 marks)

## SECTION B: (60 MARKS)

Answer any five questions from this section.
All questions carry equal marks.
9. Given that $\boldsymbol{P}(\boldsymbol{A})=\frac{\mathbf{3}}{\mathbf{5}}, \boldsymbol{P}(\boldsymbol{A} / \boldsymbol{B})=\frac{5}{7}$ and $\boldsymbol{P}(\boldsymbol{B} / \boldsymbol{A})=\frac{2}{\mathbf{3}}$,
(a) State with reasons whether A and B are:
(i) independent events
(02 marks)
(ii) mutually exclusive events
(02 marks)
(b) Find:
(i) $\mathrm{P}(\mathrm{A} \cap \mathrm{B})$
(02 marks)
(ii) $\mathrm{P}(\mathrm{B})$ (02 marks)
(iii) $\boldsymbol{P}(\boldsymbol{A} / \overline{\boldsymbol{B}})$
(04 marks)
10. (i) The quantities a and b were measured with errors $\boldsymbol{\Delta a}$ and $\boldsymbol{\Delta b}$ respectively. Show that the maximum relative error in calculating $z=\boldsymbol{a} \sqrt{\boldsymbol{b}}$ is $\left|\frac{\boldsymbol{a} a}{\boldsymbol{a}}\right|+\frac{\boldsymbol{1}}{\mathbf{2}}\left|\frac{\boldsymbol{\Delta} \boldsymbol{b}}{\boldsymbol{b}}\right|$
(08 marks)
(ii) Given that $\mathrm{a}=2.5$ and $\mathrm{b}=0.16$ were estimated with percentage errors of 4 and 5 respectively. Calculate the absolute error in evaluating $\boldsymbol{a} \sqrt{\boldsymbol{b}}$
(04 marks)
11. Two cyclists P and Q are 11 km apart with Q on a bearing of $110^{\circ}$ from P. Cyclist P is riding at $\mathbf{5} \boldsymbol{k} \boldsymbol{m} \boldsymbol{h}^{-\boldsymbol{1}}$ due North-East and Q is riding due $\mathrm{N} 15^{\circ} \mathrm{W}$ at $\boldsymbol{8} \boldsymbol{k} \boldsymbol{m} \boldsymbol{h}^{-\boldsymbol{1}}$. Find the:
(i) closest distance between them in the subsequent motion
(ii) time that elapses before they are closest to each other.
12. The lengths in cm of 40 metal rods were as follows:

| Lengths | Frequency |
| :---: | :---: |
| $30-<35$ | 8 |
| $35-<40$ | 5 |
| $40-<55$ | 12 |
| $55-<60$ | 9 |
| $60-<65$ | 6 |

(a) Calculate the:
(i) mean length
(03 marks)
(ii) upper quartile
(03 marks)
(b) Display the data on a histogram and use it to estimate the mode
(06 marks)
13. (i) Show graphically that the equation $2 \boldsymbol{\operatorname { s i n }} \boldsymbol{x}-\operatorname{In} \boldsymbol{x}=\mathbf{0}$ has a root between 2 and 3.
(06 marks)
(ii) Use Newton Raphson's method to find the root of the equation in (i) above correct to 4 significant figures.
(06 marks)
14. (a) A car of mass 2000 kg has a maximum speed of $\mathbf{7 2} \mathbf{k m}^{-\boldsymbol{1}}$ up a hill inclined at $\sin ^{-1}\left(\frac{1}{7}\right)$ to the horizontal when the engine is working at 64 kW . Find the resistance to motion of the car.
(05 marks)
(b) A car of mass 500 kg tows a van of mass 300 kg up a hill inclined at $30^{\circ}$ to the horizontal. The resistances to motion of the car and the van are 200 N and 180 N respectively. If the power output of the car is 196 kW , find the acceleration of the vehicles and the tension in the tow rope at the instant when the speed of the car is $40 \mathrm{~ms}^{-1}$.
(07 marks)
15. The distribution function of a continuous $\mathrm{r} \cdot \mathrm{v} \mathrm{X}$ is as follows:

$$
F(x)=\left\{\begin{array}{cll}
0 & , & x \leq 1 \\
\frac{1}{12}(x-1)^{2} & , & 1<x \leq 3 \\
\frac{1}{24}\left(\beta x+\lambda-x^{2}\right) & , & 3<x \leq 7 \\
1 & , & x>7
\end{array}\right.
$$

Find the:
$\begin{array}{lr}\text { (i) values of } \boldsymbol{\beta} \text { and } \boldsymbol{\lambda} & \text { (05 marks) } \\ \text { (ii) } p \cdot d \cdot f \text { of } X & (03 \mathrm{marks}) \\ \text { (iii) mean, } \mu \text { of the distribution } & (04 \mathrm{marks})\end{array}$
16. (a) $A B C D$ is a square of side 4 m . Forces of magnitude $7 \mathrm{~N}, 3 \mathrm{~N}$, $5 \sqrt{2} N$ and $2 \sqrt{2} N$ act along $\overrightarrow{A B}, \overrightarrow{B C}, \overrightarrow{C A}$ and $\overrightarrow{B D}$ respectively. Show that the system of these forces reduce to a couple (04 marks)
(b) A non uniform ladder AB of length 6 m and mass 10 kg has its centre of gravity at $G$, where $A G=4 \mathrm{~m}$. The ladder is inclined at $45^{\circ}$ to the horizontal with its end B resting against a rough vertical wall and end A on a rough horizontal ground with which the coefficients of friction at each point of contact is $\mu$.. If a boy of mass 40 kg can safely ascend 2 m up this ladder before it slips, find the value of $\mu$..
(08 marks)
**END **

