**P425/2**
**APPLIED**
**MATHEMATICS**
**PAPER 2**
**August. 2017**
3 hour

**Uganda Advanced Certificate of Education**
**MOCK SET 4 EXAMINATIONS 2017**
APPLIED MATHEMATICS
**Paper 2**
3 hours

**INSRUCTIONS TO CANDIDATES:**

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

Additional question(s) answered will **not** be marked.

**All** working **must** be shown clearly.

Graph paper is provided.

Where necessary, take acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$.

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

## SECTION A (40 MARKS)

(Answer **all** questions in this section.)

**Qn 1:** Events A and B are such that $P(A) = \frac{8}{15}$, $P(B) = \frac{1}{3}$ and $P(A/B) = \frac{1}{5}$. find the probability that:

(i). neither A nor B occurs. [3]

(ii). Event B does not happen if event A has occurred. [2]

**Qn 2:** The velocity of a particle of mass 3 kg at any time, $t$, is given by $\underset{\sim}{\boldsymbol{v}} = \left(6\underset{\sim}{\boldsymbol{i}} + 4\underset{\sim}{\boldsymbol{j}}\right)t + t^2(2\underset{\sim}{\boldsymbol{j}} - \sin 2t\,\underset{\sim}{\boldsymbol{k}})$ metres. Find the rate of doing work after two seconds. [5]

**Qn 3:** Points $A$ and $B$ are 22.5 km apart. A body is timed as it moves from A to B and it takes 0.426 hours. Determine the maximum possible error made in calculating the speed of the body. [5]

**Qn 4:** A discrete random variable X has a cumulative distribution function (c.d.f) given below.

| $x$ | 1 | 2 | 3 |
|---|---|---|---|
| $F(x)$ | $\lambda$ | $4\lambda$ | $9\lambda$ |

Find the:

(a). value of $\lambda$. [2]

(b). mean of X. [3]

**Qn 5:** A bullet of mass 150 g moving at a speed of 215 km $h^{-1}$ penetrates 10 cm into a fixed wooden rectangular block before coming to rest. Find the:

(a). resistance due to the block. [3]

(b). velocity of the bullet when it penetrates 4 cm into the block. [2]

**Qn 6:** The table below is an extract from a table of tangents.

| $\theta$ | $24'$ | $30'$ | $36'$ | $42'$ |
|---|---|---|---|---|
| $\tan 25°\theta'$ | 0.4748 | 0.4770 | 0.4791 | 0.4813 |

Use linear interpolation or extrapolation to find:

(i). $\tan 25°18'$. [3]

(ii). $\tan^{-1}(0.4775)$. [2]

**Qn 7:** Forces of magnitudes 10 N, 15 N and 12 N act in the directions 040°, $W\ 30°\ N$ and North-East respectively. Find the magnitude and direction of the resultant force. [5]

**Qn 8:** The following grades were obtained by 8 candidates in Mathematics in General Paper.

| Mathematics | A | O | B | F | E | C | D | B |
|---|---|---|---|---|---|---|---|---|
| General Paper | $C_3$ | $D_2$ | $D_1$ | $P_8$ | $P_8$ | $D_2$ | $C_3$ | $D_2$ |

(a). Calculate the rank correlation coefficient for the grades. [4]
(b). Comment on your result at 1% level of significance. [1]

## SECTION B (60 MARKS)

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

### Question 9:

(a). Use the trapezium rule with 5 strips to estimate $\int_1^3 \sin^2 x\, dx$, correct to 3 decimal places. [5]
(b). Calculate the relative error in your estimation in (a) above and suggest how the error can be reduced. [7]

### Question 10:

The table below shows the weights (W) in kg of 150 patients who visited a certain health unit during a certain week.

| Weight (kg) | Number of patients |
|---|---|
| $0 \leq W \leq 19$ | 30 |
| $20 \leq W \leq 29$ | 46 |
| $30 \leq W \leq 39$ | 70 |
| $40 \leq W \leq 49$ | 102 |
| $50 \leq W \leq 59$ | 130 |
| $60 \leq W \leq 69$ | 142 |
| $70 \leq W \leq 79$ | 150 |

(a). Draw a cumulative frequency curve and use it to estimate the number of patients who weigh between 13 kg and 53 kg who visited the health unit. [6]

(b). Calculate the:

(i). mean weight.

(ii). Modal weight. [6]

**Question 11:**

(a). At 12:00 noon, the position vector of particle A relative to particle B is $2\underset{\sim}{\boldsymbol{i}} + 20\underset{\sim}{\boldsymbol{j}} + 18\underset{\sim}{\boldsymbol{k}}$ kilometres and velocities of A and B by then are $4\underset{\sim}{\boldsymbol{i}} + \underset{\sim}{\boldsymbol{j}} - 2\underset{\sim}{\boldsymbol{k}}$ km $h^{-1}$ and $6\underset{\sim}{\boldsymbol{i}} + 3\underset{\sim}{\boldsymbol{k}}$ km $h^{-1}$ respectively. Find the:

(i). time when they are nearest to each other. [4]

(ii). Closest distance between them. [3]

(b). To a girl running at 6 m $s^{-1}$ on a bearing of 155°, a low flying bird appears to be moving at 7 m $s^{-1}$ on a bearing of 250°. Find the true velocity of the bird. [5]

**Question 12:**

A continuous random variable X has the probability density function given below:

$$f(x) = \begin{cases} \frac{x^2}{27} & ; \quad 0 \leq x \leq \beta, \\ \frac{1}{3} & ; \quad \beta \leq x \leq \alpha, \\ 0 & ; \quad elsewhere. \end{cases}$$

Where $\alpha$ and $\beta$ are integers.

(a). Find the values of $\alpha$ and $\beta$, hence sketch $f(x)$. [6]

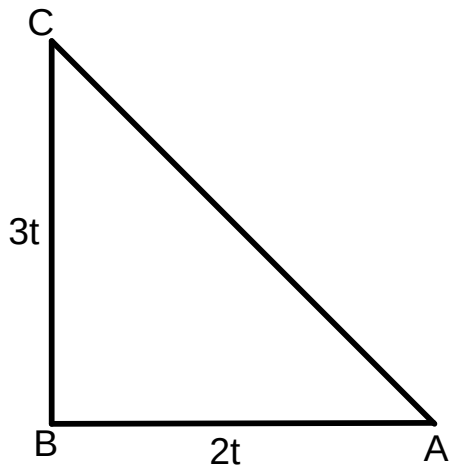
(b). Calculate the:

(i). median of X,

(ii). Mean of X. [6]

**Question 13:**

ABCD is a uniform triangular lamina right angled at B where $AB = 2t$ and $BC = 3t$.




The midpoints P and Q of BC and CA respectively are joined and the portion PQC cut off.

(a). Find in terms of $t$, the distance from AB and BC of the centre of gravity of the lamina ABPQ. [8]

(b). When the lamina ABPQ is suspended freely from vertex A, find the angle AB makes with the vertical. [4]

**Question 14:**

The error $X$ grammes made by a certain type of weighing scale is normally distributed with mean $-5$ g and variance 9 $g^2$.

(a). Find the probability that a randomly chosen scale will have a positive error. [4]

(b). Out of 75 scales chosen at random, determine how many will have an error magnitude of less than 3. [5]

(c). Find the probability that out ten scales chosen at random, exactly four will have a positive error. [3]

**Question 15:**

(a). Show graphically that the equation $2e^x + x^2 - 4 = 0$ has two real roots. Hence obtain the negative root from your graph to 1 d.p. [5]

(b). Use Newton Raphson's method to find the negative root of the equation, correct to three significant figures. [7]

**Question 16:**

A light inextensible string of length 0.72 m is attached to two points A and B where A is vertically above B and $AB = 0.48$ m. If a smooth ring of mass 50 g is threaded on the string and made to move in a horizontal circle about B, find the:

(a). Tension in the string. [9]

(b). Angular speed of the ring. [3]

*****END*****