

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

INSTRUCTIONS 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 $\vec{v} = (6\vec{i} + 4\vec{j})t + t^2(2\vec{j} - \sin 2t\vec{k})$ 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
$F(x)$	λ	4λ	9λ

Find the:

- (a). value of λ . [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.

θ	$24'$	$30'$	$36'$	$42'$
$\tan 25^\circ\theta'$	0.4748	0.4770	0.4791	0.4813

Use linear interpolation or extrapolation to find:

- (i). $\tan 25^\circ 18'$. [3]
- (ii). $\tan^{-1}(0.4775)$. [2]

Qn 7: Forces of magnitudes 10 N, 15 N and 12 N act in the directions 040° , $W 30^\circ N$ 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 $2\mathbf{i} + 20\mathbf{j} + 18\mathbf{k}$ kilometres and velocities of A and B by then are $4\mathbf{i} + \mathbf{j} - 2\mathbf{k}$ km h⁻¹ and $6\mathbf{i} + 3\mathbf{k}$ 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:

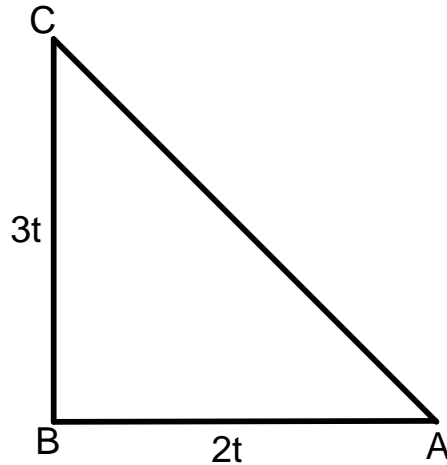
$$f(x) = \begin{cases} \frac{x^2}{27} & ; 0 \leq x \leq \beta, \\ \frac{1}{3} & ; \beta \leq x \leq \alpha, \\ 0 & ; \textit{elsewhere}. \end{cases}$$

Where α and β are integers.

- (a). Find the values of α and β , 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 g².

- (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]

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