

P425/2
PURE MATHEMATICS
Paper 2
July/Aug, 2017
3 HOURS



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BUSOGA REGION JOINT EXAMINATION BOARD

Uganda Advanced Certificate of Education

MOCK EXAMINATION 2017

APPLIED MATHEMATICS

Paper 2

3 hours

TUESDAY: 07TH/08/2017

MORNING: 9:00AM – 12:00PM

INSTRUCTIONS TO CANDIDATES

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

All working must be shown clearly

Begin each answer on a fresh sheet of paper

In numerical work, take g to be 9.8 ms^{-2}

$\begin{array}{c|c|c} A & A & \\ \hline B & A \cap B & A \cap B \\ \hline B & A \cap B & A \cap B \end{array}$

SECTION A (40 MARKS)

1. The probabilities that events A and B occur are $\frac{1}{3}$ and $\frac{1}{4}$ respectively. If the probability that only one of them occurs is $\frac{5}{12}$, find

i) $P(A \cap B)$ ii) $P(\bar{A} \cap \bar{B})$ (5 marks)

2. A particle starts from rest at the origin and moves along the x- axis with acceleration given by $a = (6 - 2t) \text{ ms}^{-2}$. Find the maximum speed of the particle and the distance travelled upon reaching maximum speed. (5 marks)

3. Find the maximum possible error made in the expression

$$6 \cdot 23 - 3 \cdot 1 - \frac{2 \cdot 5 \times 4 \cdot 1}{5} \quad (5 \text{ marks})$$

4. The table shows the speeds in ms^{-1} for vehicles crossing a certain bridge

Speed	20 -	30 -	40 -	60 -	80 - 100
frequency	2	7	20	16	5

Calculate the

- i) 40th percentile
 ii) number of vehicles whose speed exceeds the 40th percentile
 (5 marks)

5. A particle of mass 2 kg resting on a rough horizontal plane is pulled by a force of magnitude 11.3 N inclined at an angle of 60° to the horizontal. If the particle does not move, find the minimum value of the coefficient of friction between the particle and the plane (5 marks)

6. A function $f(x)$ is such that $f(0.9) = 0.226$, $f(1.0) = 0.242$, $f(1.1) = 0.218$ and $f(1.2) = 0.192$. Use linear interpolation to find,

- i) $f(1.04)$
 ii) Value of x for which $f(x) = 0.25$ (5 marks)

7. A water pump raises a volume of 1 m^3 of water through a vertical height of 4 m in one minute, discharging it at a speed of 20 ms^{-1} . If the density of water is 1000 kgm^{-3} , find the power developed by the pump (5 marks)
8. A biased coin is twice likely to show a head than a tail. Find the probability of getting
- at least 4 heads
 - between 2 and 4 tails
- (5 marks)

SECTION B(60 MARKS)

9. a) A uniformly accelerating body starts with speed $u \text{ ms}^{-1}$ and in successive times of t seconds, travels distances n and $2n$ metres respectively. Show that the acceleration is $\frac{4u^2}{n}$ (5 marks)
- b) A car moving with uniform acceleration in a straight line travels 29 m in the fifth second and a distance 76 m in the sixth second of its motion. Determine the initial velocity and acceleration of the body (7 marks)
10. a) Use the trapezium rule with 5 strips to estimate $\int_{0.5}^{1.5} \left(x^3 + \frac{3}{x} \right) dx$ Correct to 4 significant figures. (6 marks)
- b) Find the exact value in the calculation in a) above (3 marks)
- c) Calculate the relative error in the estimation in a) above and state how you can reduce such a relative error. (3 marks)
11. a) The probability that a patient recovers from an illness is 0.9. Find the probability that between 84 and 95 inclusive of the next 100 patients will recover from the illness. (5 marks)

$$3n = 4\left(\frac{n}{2n}\right) = \frac{1}{2}(n)$$

$$S = ut + \frac{1}{2}at^2$$

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$$u = \frac{2S}{t} - \frac{1}{2}at$$

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b) The lengths of nails are normally distributed with mean 50 cm and standard deviation 0.25 cm. Find the length range of the middle 70 % of the nails (7 marks)

12. a) By drawing a graph of $y = 2e^x$ and $y = 4 - x^2$ on the same axes, show the two real roots of the equation $2e^x + x^2 = 4$ (6 marks)

b) Using Newton Raphson formula thrice, find the positive root of the equation $2e^x + x^2 = 4$ (6 marks)

13. The random variable X has a probability density function given by

$$f(x) = \begin{cases} kx(1-x^2) & 0 \leq x \leq 1 \\ 0 & \text{otherwise} \end{cases} \quad \text{Where } k \text{ is a constant}$$

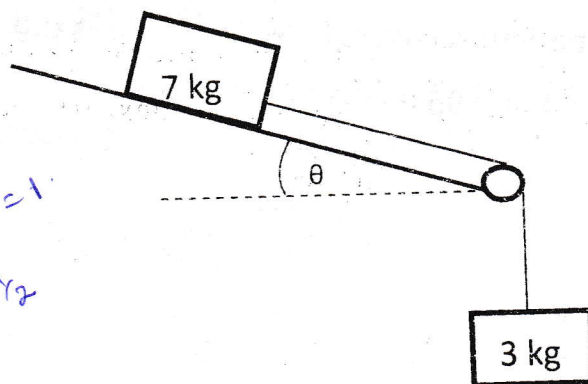
a) Determine the cumulative distribution function F(x) and use it to find
i) k

ii) Median of X

b) Calculate the mean of X

(12 marks)

14. In the figure below, a particle A of mass 7 kg rests on a rough plane of inclination θ to the horizontal where $\theta = \tan^{-1}\left(\frac{3}{4}\right)$ and with coefficient of friction 0.6. Particle A is connected to particle B of mass 3 kg hanging freely by means of a light inextensible string passing over a smooth pulley fixed at the bottom of the incline as shown



$2h^2(3-m) = 1$
 $m = 1/2$

If the system is released from rest so that A slides downwards, find the

i) acceleration of the system and the tension in the string

ii) force on the pulley

iii) velocity of the 3 kg mass after 2 seconds

(12 marks)

- ✓15. The table below shows the scores in two subjects Maths (X) and Economics (Y) for ten students.

X	82 ₅	78 ₇	86 ₄	72 _{9.5}	91 ₂	80 ₆	95 ₁	72 _{9.5}	89 ₃	74 ₈
Y	75 ₇	80 ₅	93 ₂	65 ₁₀	87 ₃	71 ₈	98 ₁	68 ₉	84 ₄	77 ₆

(a) Plot a scatter diagram and draw the line of best fit. Use your graph to predict the maths score if a student scored 92 in Economics

(b) Calculate the rank correlation coefficient between X and Y. Comment on the significance of maths on Economics.

(Spearman's rank coefficient, $\rho = 0.79$ based on ten students at 1 % level of significance)

(12 Marks)

16. a) A body of weight 50 N is placed on a smooth plane of inclination $\sin^{-1}\left(\frac{1}{2}\right)$

to the horizontal. Find the size of the horizontal force required to keep the body in equilibrium and the normal reaction (5 marks)

b) A light inextensible string of length 170 cm is attached at its ends to two points on the same horizontal level 130 cm apart. The string carries a mass of 2 kg which slides freely on the string. A horizontal force is applied to the mass until the two sections of the string are at right angles. Find the horizontal force and tension in the string. (7 marks)

END