P425/2
APPLIED
MATHEMATICS
PAPER 2
3 HOURS

Uganda Advanced Certificate of Education
MOCK EXAMINATIONS
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 **g** to be* $\mathbf{9{\cdot}8ms^{-2}}$.
- *Silent, non-programmable scientific calculators and mathematical tables with a list of formulae may be used.*

SECTION A

1. The events A and B are such that $P(A) = \frac{2}{5}$, $P(B) = \frac{1}{6}$ *and* $P(A \cup B) = \frac{13}{30}$.Show that A and B are neither mutually exclusive nor independent. (5marks)

2. Particles of mass 3kg, 4kg and 2kg are placed at points A, B and C respectively of a rectangle ABCD, with $\overline{AB} = 10cm$ and $\overline{BC} = 4cm$. Find the mass that should be placed at D for the centre of gravity of the system to lie 4cm from AD. Hence find the distance of the centre of gravity from AB. (5marks)

3. Given the information in the table below;

θ(⁰)	30.4	34.6	42.8
Cosθ	0.8625	0.8231	0.7337

Use linear interpolation and extrapolation to find the value of;
i) $\cos 37.0^0$ ii) $\theta \; corresponding \; to \; cos^{-1}(0.7124)$ (5marks)

4. Given that $Y \sim B(9, x)$ and that the standard deviation of Y is $\frac{9}{10}$, find the possible values of x, hence find $P(Y = 4)$. (5marks)

5. A motorist of mass 90kg rides against resistance to motion of $(10 + KV^2)N$ where K is a constant and his speed is Vms^{-1}. The motorist has a maximum speed on the level road of $10ms^{-1}$ when the engine is working at a rate of 75W. Find his maximum speed when ascending a hill of inclination 1 in 2 with the engine working at the same rate. (5marks)

6. Forces of magnitude 5N, 3N, 2N and 7N act along the sides PQ, QR, SR and PS respectively of a square PQRS of side ***a***m in the direction indicated by the order of the letters. Show that the line of action of the resultant force cuts PQ at a distance $0.1\boldsymbol{a}$m from P. (5marks)

7. Seven recruits (A, B, … G) were given two separate aptitude tests. Their orders of merit in each test were;

Order of merit	***1st***	***2nd***	***3rd***	***4th***	***5th***	***6th***	***7th***
1st Test	G	F	A	D	B	C	E
2nd Test	D	F	E	B	G	C	A

Find spearman's coefficient of rank correlation between the two tests and comment on your results based on a 1% level of significance. (5marks)

8. Find the mean and standard deviation of the first ***n*** integers. (5marks)

SECTION B (60MARKS)

Attempt any five questions from this Section

9. A random variable X has acumulative distribution function, F, given by;

$$F(x) = \begin{cases} 0 & ; x \leq a \\ k(x-a)^2 & ; a \leq x \leq 2a \\ 1 & ; x \geq 2a \end{cases}$$

a) Find k in terms of ***a***

b) Given that $P(x > 2) = \frac{3}{4}$, find the;

i) Value of $\boldsymbol{a}$
ii) p.d.f $f(x)$
iii) Median of x.

10. a) Two particles are projected simultaneously from two points A and B on the level ground and a distance of 15m apart. The first particle is projected vertically upwards from A with an initial speed of ums^{-1} and the second particle is projected from B towards A with an angle of projection θ to the horizontal. If the particles collide when they are both at their greatest height above the level of AB, prove that $tan\theta = \frac{u^2}{15g}$. (6marks)

b) A body of mass 2.5kg is attached to the end B of light elastic string AB of natural length 2m and modulus 5gN. The mass is suspended vertically in equilibrium by the string whose other end A is attached to a fixed point. Find the;

i) Depth below A of B when the body is in equilibrium. (3marks)

ii) Distance through which the body must be pulled down vertically from its equilibrium position so that it will just reach A after release. (3marks)

11. a) The probability that a patient recovers from a delicate heart operation is 0.9. Of the next 100 patients having this operation, what is the probability that between 84 and 95 inclusive survive? (5marks)

b) The height in metres of a random sample of 5 policemen from a particular police station were as follows;

1.80, 1.76, 1.81, 1.83, 1.79

Assuming that the heights of policemen from the station are normally distributed with mean μ.

i) Determine the 95% confidence interval for the mean. (6marks)

ii) State the width of this interval. (1mark)

12. a) Show graphically that the root of the equation $e^x + 3x - 2 = 0$ lies in the interval $[0, 1]$ (4marks)

b) Draw a flow chart to determine the root of the equation $x = In(2 - 3x)$ to 3dps. Hence perform a dry run taking $x_0 = 0.5$ (8marks)

13. a) Use trapezium rule to estimate the $\int_1^{1.4}(x + tanx)dx$ using 5 subintervals. (5marks)

b) Determine the exact value of $\int_1^{1.4}(x + tanx)dx$ (5marks)

c) calculate the percentage error in your result and suggest how this error can be improved. (2marks)

14. Two uniform rods AB and BC of equal length and of Masses 4kg and 6kg respectively are smoothly jointed at B and rest in a vertical position with ends A and C on a smooth floor. A and C are connected by a rope and angle $ABC = 2\alpha$.
a) Find the reactions between the rods and the floor at A and C when the rope is taut. (5marks)
b) If now a body is attached to a point D on rod AB such that $AD = \frac{3}{5}AB$ and the reactions are equal, find the mass of the body. Hence show that the reaction at the joint is $\frac{g}{4}\sqrt{169tan^2\alpha + 1}$. (7marks)

15. The table below shows the time intervals between successive arrivals of telephone calls at an office.

Time (Minutes)	**Frequency**
$0 < x \leq 0.5$	23
$0.5 < x \leq 1.0$	39
$1.0 < x \leq 2.0$	23
$2.0 < x \leq 3.0$	9
$3.0 < x \leq 6.0$	6

a) Calculate the;
i) Mean (4marks)
ii) Standard deviation, of the time intervals (4marks)
b) Draw a histogram to illustrate the above information and use it to estimate the modal time interval. (4marks)

16. Ship A sails such that its position at any time t is $r = (-15 + 5t)i + (7 + 3t - 5t^2)jkm$. After sailing for 2hours, it maintains a constant velocity attained. At that time, ship B is said to be at point with position vector $(2i + 5j)km$ and travelling at a constant velocity of $(-i + 6j)kmh^{-1}$. If the two ships maintain these velocities, find the;
a) Shortest distance between the two ships and the time taken for them to be closest. (9marks)
b) Distance covered by ship B to closest approach. (3marks)

END