P425/2
APPLIED MATHEMATICS
PAPER 2
JULY/AUGUST 2019
3HRS

WESTERN JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

PAPER 2

3HOURS

INSTRUCTIONS TO CANDIDATES:

- *Answer **all** the **eight** questions in section **A** and any **FIVE** from section **B***
- *All necessary working must be shown clearly*
- *Graph paper is provided*
- ***Any** additional question(s) answered will not be marked*
- *Silent non -programmable scientific calculators and mathematical tables with a list of formulae may be used.*
- *In numerical work use $g = 9.8ms^{-2}$*

SECTION A:(40 MARKS)

Answer **all** questions in this section

1. A particle P moves in a straight line so that at time t seconds, $t \geq 0$ the acceleration of P is $(2 + 4t)$ ms^{-2}. At time t = 0, P is at the point 0 and its speed is $3ms^{-1}$. Find
   (a) The speed of P when t = 3 (03 marks)
   (b) The distance covered by P between the instants t = 1 and t = 3 (02 marks

2. The random variable X is such that $x \sim B((n\,,p) and\ E(x) = 2,\ var(x) = \frac{24}{13}$. Find the values of $n\ and\ p, and\ \ p(x = 2)$ (05 marks)

3. The numbers $x = 4.2,\ y = 16.02\ \ and\ \ z = 25$ are rounded off with corresponding percentage errors of 0.5, 0.45 and 0.02
   Calculate the absolute relative error made in $\frac{xy}{z}$ (05 marks)

4. The probability distribution for the r.v.x is as shown in the table below.

x	1	2	3	4
$P(X = x)$	$^3/_8$	a	¼	¼

   Find (i) $E(x)$ and hence $E(2x + 3)$
   (ii) var (x)

5. The resultant of two forces is 8N and its direction is inclined at 60^0 to one of the forces whose magnitude is 4N. Find the magnitude and direction of the other force. (05 marks)

6. (a) The table below shows an Extract from table of $\cos x^0$

80^0	0′	10′	20′	30′	40′
$\cos x^0$	0.1736	0.1708	0.1679	0.1650	0.1622

   Use linear interpolation to determine
   (i) $\cos 80^0\ 36^1$
   (ii) $\cos^{-1}(0.1685)$ (03 marks)

   (b) On a certain sports day, a student runs 200m in 24s. If the distance is accurate to the nearest 10m and the time is accurate to 0.1s, Find to 3dps.
   (i) the greatest possible speed (01 mark)
   (ii) the slowest possible speed (01 mark)

7. Given the information in the table below

x	4	5	6	7	8	9	10	11	12
f	3	1	5	2	5	1	2	1	1

   Find the standard deviation using a working mean of 7. (05 marks)

8. A car of mass 1000kg is travelling along a level road against a constant resistance of magnitude 475N. The engine of the car is working at 4KW.

Calculate;

(a) the acceleration when the car is travelling at $5ms^{-1}$

(b) the maximum speed of the car (05 marks)

SECTION B:

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

9. A random variable x has the probability density function

$$f(x) = \begin{cases} \frac{2}{3a}(x+a); & -a < x \leq 0 \\ \frac{1}{3}a(2a-x); & 0 < x \leq 2a \\ 0 & otherwise \end{cases}$$

Determine;

(i) The value of constant a, (02 marks)

(ii) The median of x (03 marks)

(iii) $P(x < 1.5/ x > 0.1)$ (05 marks)

(iv) The F(x) and sketch it (02 marks)

10. (a) A parcel of mass 1kg is placed on a rough plane which is inclined at 30^0 to the horizontal. The coefficient offriction between the parcel and the plane is 0.25. Findthe force that must be appliedto the parcel in a direction parallel to the plane sothat;

(i) the parcel is just prevented from sliding down the plane (04marks)

(ii) the parcel moves up the plane with an acceleration of $1.5ms^{-2}$(04 marks)

(b) Two uniform small spheres, A and B of mass 0.1kg and 0.2kg respectively are moving towards each other with speeds of $3ms^{-1}$ and $1ms^{-1}$ respectively. They collide and move away from each other with the same speed Ums^{-1}. Find

(i) the value of U,

(ii) the loss in kinetic energy due to the collision (04 marks)

11. Using the graphical method, show that the equation $3x^2 + x - 4 = 0$ has a root between 0 and 2. Hence using Newton Raphson's method, find the root correct to three decimalplaces. (12 marks)

12. (a) A particle is projected at $t = 0$ with a velocity $5\underset{\sim}{i}$ ms^{-1} from a print with position vector $6\underset{\sim}{i} + 50\underset{\sim}{j}$)m relative to a fixed origin 0

Find the position vector of the particle 3 seconds later. (04 marks)

(b) A foot of a uniform ladder of mass M and length 2a rests on a horizontal ground where the coefficient of friction between the ladder and the ground is 0.65. The top of the ladder rests against a smooth vertical wall. Given that the equilibrium is limiting when a body of mass 2M is hung from the top of the ladder and the inclination of the ladder to the horizontal is θ,

Find;
(i) the magnitude of the force exerted on the ladder by the wall in terms of M and g (04 marks)
(ii) the size of θ to the nearest degree (04 marks)

13. The mock examination and average final examination marks of a certain school are given in the following table.

Mock marks(x)	28	34	36	42	48	52	54	60
Av. Marks final (y)	54	62	68	70	76	66	76	74

(a) (i) Plot the marks on the scatter diagram and comment on the relationship between the two marks.
(ii) Draw a line of best fit and useit to predict the average final mark of a student whose mock is 50 (06 marks)

(b) Calculate the rank correlation coefficient between the marks and comment on your result (06 marks)

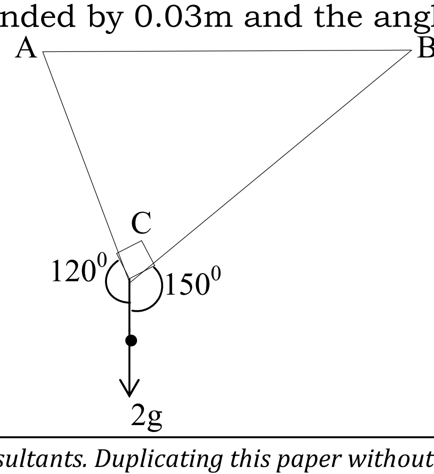
14. (a) (i) Using 5 sub-intervals, find the value of $\int_0^1 x^2 e^x dx$ correct to 2dps

(ii) Find the percentage error in your result. (09 marks)

(b) Given the following iterative formular
(i) $x_{n+1} = 5 - \frac{3}{x_n}$ (ii) $x_{n+1} = \frac{1}{5}(x_n^2 + 3)$

Taking $x_0 = 5$ deduce a more suitable iterative formula for solving the equation. Deduce also the possible original equation. (03 marks)

15. In the diagram, AC, BC and CD are 3 elastic strings with the same modulus of elasticity.
The ends A and B are attached to a horizontal support and the end D of the string CD carries a particle of mass 2kg hanging freely under gravity. The natural length of the strings AC and CD are 0.24 and 0.18m respectively, and in the equilibrium position AC is extended by 0.03m and the angles ACD and BCD are 120^0 and 150^0 respectively.



Calculate;

(a) The modulus of elasticity of the string (05 marks)

(b) The natural length of BC (05 marks)

(c) The depth of D below AB (02 marks)

16.(a) A random sample of 100 observations from a Normal population with mean μ gave the following data;

$$\sum x = 8200,\ \sum x^2 = 686{,}800$$

Find a 98% confidence interval for μ (04 marks)

(b) The distribution of the random variable X is N(25, 340). The mean of the random sample of size n drawn from this distribution is $\bar{x}$. find the value of n given that $P(\bar{x} > 28)$ is approx. 0.005(03 marks)

(c) The continuous random distribution X is uniformly distributed in the interval $a < x < b$. The lower quartile is 5 and the upper quartile is 9.

Find; the values of a and b (05 marks)

END