P425/2
APPLIED MATHEMATICS
Paper 2
Oct. 2023
3 HOURS

UGANDA ADVANCED CERTIFICATE OF EDUCATION

APPLIED MATHEMATICS

(PRINCIPAL SUBJECT) Set 7

Paper 2

TIME: 3 HOURS

INSTRUCTIONS TO CANDIDATES:

Answer **all** *the* **Eight** *questions in Section* **A** *and* **Five** *questions from Section* **B**.

Any additional question(s) answered will **not** *be marked.*

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

Begin each answer on a fresh sheet of paper.

Graph paper is provided.

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

In numerical work, take $\mathrm{g}\ to\ be\ 9.8\ ms^{-2}$.

SECTION A: (40 MARKS)

Answer **all** *the questions in this section*

1. Given that A and B are independent events in a sample space that P(A)= $\frac{3}{5}$, P(AuB)= $\frac{4}{5}$. Find the;
   (i) P(B) (ii) P($A'uB'$)

2. A market gardener planted potatoes, after 90 days he took a sample and weighed potatoes obtained from each plot, the results in Newtons (N) were as follows: 8.5, 7.6, 8.9, 7.6, 8.9, 8.2, 9.1, 7.9 and 8.5, determine the;
   (i) mean (ii) variance

3. A particle starts from rest with a constant acceleration of 3ms^{-2} for 12 s, for the next 48 s, the acceleration is $\frac{1}{6}$ ms^{-2} and for the last 10 s it decelerates uniformly to rest. By drawing a velocity time graph, find the:
   (i) Velocities at different points (ii) Total distance travelled

4. A biased coin is tossed six times. The coin is such that the ratio of the tail to the head is 2:1. Find the probability of getting;
   (i) At least 4 heads (ii) Between 2 and 4 tails

5. Use the trapezium rule with 6 ordinates to estimate $\int_0^2 \frac{1}{\sqrt{1+x^2}}dx$ correct it to 3 decimal places.

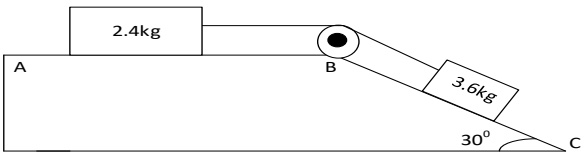
6. ABCD is a square of side 2m. Force of magnitude 9N, 5N and $3\sqrt{2}$N act along BC and BD respectively by taking AB and AD as the positive x and positive y axes and taking moments about A. Find the line of action

7. In an experiment the following observations were recorded

Time (T)	0	12	20	30
Temperature ($\theta°$)	6.6	2.9	-0.1	-2.9

   Use either linear interpolation or extrapolation to estimate;
   (i) θ when $T = 16$. (ii) T when $\theta = -3.5$

8. A particle of mass 2.4kg is held at rest on a rough horizontal surface AB with coefficient of friction of 0.5, it is connected by a light inextensible string passing over a smooth fixed pulley at B to a particle of mass 3.6kg. the slopping face BC is smooth and makes an angle of 30^0 to the horizontal



If the system is released from rest. Find the;

(i) Common acceleration (ii) Tension in the string

SECTION B: (60 MARKS)

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

9. The table below shows the marks obtained by 100 students of principal mathematics in a certain school

Marks	Number of students
$5 - < 25$	5
$25 - < 35$	10
$35 - < 40$	15
$40 - < 50$	8
$50 - < 60$	25
$60 - < 80$	10
$80 - < 90$	12
$90 - < 100$	15

(a) Draw a histogram for the data and use it to estimate the mode

(b) Calculate the;

(i) Mean mark (ii) Variance (iii) median

10. Ten students were given two separate tests and the following are the scores.

Test X	65	45	40	55	60	50	80	30	70	65
Test Y	60	60	55	70	80	40	85	50	70	80

(a) Plot a scatter diagram for the above data,

(b) Draw a line of best fit, use it to estimate x when y=72

(c) Calculate the rank correlation co-efficient and comment at 1% level of significance.

11. A particle is projected from a horizontal ground at an angle of elevation α, the horizontal range is x and full time of flight is T.

(a) Prove that the trajectory is connected by the equation $gT^2 = 2x\tan\alpha$

(b) Show that if the maximum horizontal distance is 160km then the full time of flight is about 3 minutes

(c) Hence determine the muzzle velocity and the maximum height of the trajectory

12. A random variable X has probability density function

$$f(x) = \begin{cases} A & 0 \le x \le 2 \\ A(2x-3) & 2 \le x \le 3 \\ 0 & else\ where \end{cases}$$

Where A is a constant, find the;

(a) Value of A

(b) Expected value and standard deviation

(c) Find the Cumulative distribution function F(x), hence evaluate the median

13. (a) The numbers X and Y are measured with errors Δx and Δy respectively. Show that the expression for maximum percentage error in calculating $Z = X\sqrt{Y}$ is

$$\left(\left|\frac{\Delta x}{X}\right| + \frac{1}{2}\left|\frac{\Delta y}{Y}\right|\right) 100\%$$

(b) Given that X=2.5 and Y=0.16 were estimated with percentage of 4 and 5 respectively, calculate the absolute error in evaluating $X\sqrt{Y}$

14. (a) Sketch the graph $y = e^{-3x} - cosx$ using the interval $[0.5(0.5)2.5]$ and show that it has a root. State it to 1 decimal place

(b) Hence using $x_0 = 1.5$ the first approximation and Newton Raphson method find the root correct it to 3 decimal places

15. A particle of mass 4kg starts from rest at position (2,3,4)m is acted on by a force $\boldsymbol{F = (2ti + 3t^2j + 5k)N}$, determine the;

(i) Acceleration at time, t (ii) Velocity at time, t

(iii) Position at time t. Hence work done by the force at t= 4 seconds

16. A jet fighter and a cruiser starts at 11:30 a.m and noon respectively with the following position and velocity vectors

	Position vectors	*Velocity vectors*
jet fighter	$\boldsymbol{(-6i + 12j)}$**km**	$\boldsymbol{(16i - 4j)}$**km/h**
cruiser	$\boldsymbol{(12i - 15j)km}$	$\boldsymbol{(8i + 16)}$**km/h**

If the velocities remain constant, determine the;

(a) Position of the jet fighter at noon

(b) Position of jet fighter relative to cruiser at time, t

(c) Hence show that they collide, state the time of collision