

P425/2
APPLIED
MATHEMATICS
Paper 2
AUGUST 2019
3 HOURS



JINJA JOINT EXAMINATIONS BOARD
Uganda Advanced Certificate of Education
APPLIED MATHEMATICS
AUGUST 2019
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INSTRUCTIONS TO CANDIDATES:

- Answer **all** the **eight** questions in section **A** and any **five** from section **B**.
- Any additional question (s) answered will not be marked
- All necessary working **must** be shown clearly
- 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 g to be 9.8 ms^{-2} .

SECTION A (40)

1. A bag contains 6 red, 3 green and 1 blue discs. If three discs are picked at random from the bag without replacement, find the probability that 2 red discs and 1 green disc are picked. (05 marks)
2. A car of mass 1000kg accelerates uniformly from rest to a maximum speed of 90kmh^{-1} up a smooth inclined plane. If the plane is inclined at 30° to the horizontal, calculate the maximum power of the car. (05 marks)

3. The table below shows the values of x and their corresponding natural logarithm

x	5.0	5.2	5.4	5.7	6.0
In x	1.609	1.647	1.686	1.740	1.792

Use linear interpolation / extrapolation to find

- (a) In (5.56) (03 marks)
 - (b) $e^{1.575}$ (02 marks)
4. The probability that a student chosen at random from a certain school is left handed is 0.25. If 80 students are chosen at random from the school. Calculate the probability that between 14 to 18 students are left-handed. (05 marks)
 5. Town A is 763 km from town B on a bearing of 080° . A plane whose speed in still air is 400kmh^{-1} flies directly from A to B. Given that there is a constant wind blowing from North at 70.5kmh^{-1} , find the direction in which the pilot should steer the plane. (05 marks)
 6. Evaluate $\frac{0.38}{4.28} - \frac{0.30}{2.14}$, given that all the numbers have been rounded to the given number of decimal places. (05 marks)
 7. The table below shows awarded to nine candidates in English (x) and History (y)

x	13	15	15	29	20	20	21	21	24
y	65	60	76	62	70	75	76	80	70

- (i) Calculate the rank correlation coefficient for the data. (04 marks)
 - (ii) Comment on your results (01 mk)
8. A particle of mass 10kg rests on a rough horizontal plane and is pulled by a force of magnitude $98/\sqrt{3}$ N inclined at an angle 60° to the horizontal. If the particle does not move, determine the minimum value of the coefficient of friction between the particle and the plane. (05 marks)

SECTION B (60)

9. The obtained by 1000 students in a district mock examination were normally distributed with a mean of 55 and standard deviation 8.
- (a) If a mark of 71 or more is required for an A pass, estimate the number of A- passes awarded. (05 marks)
 - (b) (i) If 15% of the candidates failed the examination, estimate the minimum mark required for a pass. (04 marks)
 - (ii) Calculate the probability that 2 candidates chosen at random both passed the examination. (03 marks)
10. (a) Two particles of masses 4kg and 3 kg respectively are attached one to each end of a light inextensible string which passes over a small smooth pulley. If the particles move in a vertical plane with both hanging parts of the string vertical, determine the
- (i) acceleration of the system
 - (ii) tension in the string (06 marks)
- (b) When the particle of mass 3 kg is moving upwards with a speed of 9ms^{-1} it picks up from at a point A an additional mass of 2kg so as to form a composite particle Q of mass 5kg.
- Calculate the
- (i) initial speed of the system
 - (ii) height above A to which Q rises. (06 marks)
11. (a) (i) On the same axes, draw graphs of $y = x^2$ and $y = \sin 2x$ for $0 \leq x \leq \frac{\pi}{2}$
- (ii) From your graphs, obtain to one decimal place, an appropriate root of the equation $x^2 - \sin 2x = 0$ (06 marks)

(b) Using the Newton – Raphson method, find the root of the equation $x^2 - \sin 2x = 0$ taking the appropriate root in (a) as an initial approximation. Give your answer correct to two decimal places. (06 marks)

12. A continuous random variable x takes values between 2 and 5, and for $2 \leq x \leq 5$,
 $\frac{b}{a} \frac{d}{dx} \left(\frac{1}{x} \right)$ the probability that $X \leq x$ is $\frac{ax - b}{a(5-2)}$ where a and b are constants. Find the

- (i) constants a and b (05 marks)
- (ii) $P(3 < x < 4)$ (02 marks)
- (iii) Pdf of X (02 marks)
- (iv) Mean of x (03 marks)

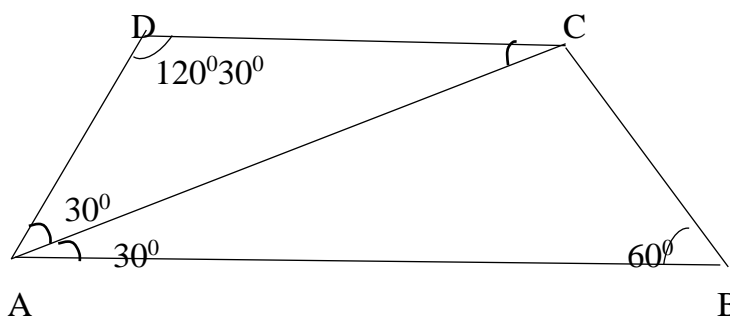
13. (a) Show that the iterative formula based on Newton Raphson's method for solving the equation $e^{2x} + 4x - 5 = 0$ is given by

$$x_{n+1} = \frac{e^{2x_n}(2x_n - 1) + 5}{2e^{2x_n} + 4}, n = 0, 2, 3... \quad (03 \text{ marks})$$

(b) (i) construct a flow chart that;

- reads the initial approximation x_0
- computes, using the iterative formula in (a) and prints the root of the equation $e^{2x} + 4x - 5 = 0$, and the number of iterations when the error is less than 1.0×10^{-4} . (05 marks)
- (ii) perform a dry run of the flow chart when $x_0 = 0.5$ (04 marks)

14. The diagram below shows an isosceles trapezium ABCD where $AD = DC = CB = 1\text{m}$ and $AB = 2\text{m}$. Five forces of magnitudes 1, 3, 5, 6 and $2\sqrt{3}$ N act along AD, DC, CB, BA and AC respectively, the direction of each force being shown by the order of the letters



If the resultant force and its line of action cuts AB produced at X. Find the

- (a) magnitude and direction of the resultant force, (09 marks)
 (b) distance AX (03 marks)

15. The table below is the distribution of the distance run during training by members of an athletics club in a particular week.

Distance (km)	Frequency
31 – 40	10
41 – 45	15
46 – 50	20
51 – 55	70
56 – 57	64
58 – 60	24
61 – 70	20
71 - 90	10

- (a) Estimate the standard deviation of the athletics (06 marks)
 (b) Plot an Ogive and use it to estimate the
 (i) semi-interquartile range
 (ii) number of athletics who ran between 50.0 and 66.0km. (06 marks)

16. A ball is hit at a point O, which is at a height of 2m above the ground and at a horizontal distance 4m from the wall, the initial speed being in a direction of 45° above the horizontal. If the ball just clears the wall which is 1m high,

- (a) show that the equation of path of the ball is $16y = 16x - 5x^2$. (04 marks) (b) calculate the;

- (i) distance from the net at which the ball strikes the ground. (04 marks)
- (ii) magnitude and direction of the velocity with which the ball strikes the ground. (04 marks)