P425/2
Applied Mathematics
Paper 2
July /August 2023
3 hours

KAYUNGA SECONDARY SCHOOLS EXAMINATIONS COMMITTEE (KASSEC)

JOINT MOCK EXAMINATION 2023

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

PAPER 2

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 working **Must** be shown clearly*
- *Begin each question on a fresh page*
- *Silent, non-programmable scientific calculators and mathematical tables with a list of formulae may be used.*

Turn over

SECTION A (40 MARKS)

1. A rough plane is inclined at an angle of $\sin^{-1}\left(\frac{3}{5}\right)$ to the horizontal. A car of mass 1500kg moves up the plane with a steady speed. The coefficient of friction between the car and the plane is ¼. Calculate the driving force exerted by the engine of the car.

(05 marks)

2. Use the trapezium rule with 5 sub-intervals to estimate $\int_0^1 \frac{1}{1+cosx}\,dx$. Correct to three decimal places.

(05 marks)

3. A machine used for filling bags with ground coffee can be set to dispense any weight of coffee per bag which is approximately normally distributed with a standard deviation of 1.95g. If only 6.2% of bags contain less than 125g of coffee, calculate the mean weight of coffee in the bags.

(05 marks)

4. The average price for bananas, milk and meat were as follows for 2017 and 2018.

Item	Prices		Weight
	2017	2018	
Banana	Shs. 20,000 per bunch	Shs. 25,000 per bunch	2
Milk	Shs. 1,000 per litre	Shs. 1500 per litre	1
Meat	Shs. 10,000 per kg	Shs. 12,000 per kg	3

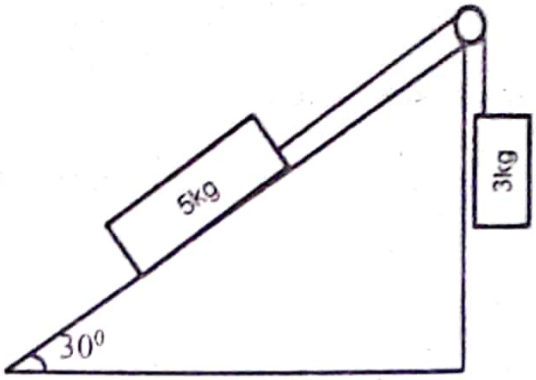
(a) Calculate the weighted aggregate price index for these commodities for 2018 taking 2017 as the base year.

(03 marks)

(b) Given that a kilogram of meat costs shs 13,000 in 2018, find its likely cost in 2017.

(02 marks)

5. The diagram below shows a mass of 5kg lying on a rough plane inclined at 30^0 to the horizontal. From the 5kg mass, a light inextensible string passes up the line of greatest slope and over a smooth fixed pulley carrying a mass of 3kg hanging freely. The tension in the string is just sufficient to prevent the 5kg mass from sliding down the slope.



Determine the coefficient of friction between the 5kg mass and the rough plane.
(05 marks)

6. Given the table below.

x	-1.1	-0.7	0.3	1.4
$f(x)$	0.250	0.340	0.568	0.818

Use linear interpolation / extrapolation to find the value of;

(i) $f(x)$ when x = 1.9

(ii) $f^{-1}(0.306)$

(05 marks)

7. A river which is 50m wide flows with a speed of $3ms^{-1}$. A boat must be set to cross the river to a point directly opposite the starting point. The speed of the boat in still water is $4ms^{-1}$. Determine the; ***(05 marks)***

(a) Course that the boat must set off with to cross the river.

(b) The time taken by the boat to cross the river.

8. Bag A contains 7 red balls and 4 blue balls. Bag B contains 5 red balls and 8 blue balls. A ball is randomly transferred from A to B. A ball is then randomly removed from bag B. find the probability that;

(a) A red ball was removed from bag B. ***(03 marks)***

(b) The transferred ball is blue given that a red ball is removed from B.
(02 marks)

$f = ma$

SECTION B (60MARKS)

9. The frequency distribution table below shows the ages of 240 students admitted to a certain University.

Age (years)	Number of students
18 - <19	24
19- < 20	70
20- < 24	76
24- < 26	48
26- < 30	16
30- < 32	6

(a) Calculate the mean age of the students. ***(04 marks)***

(b) (i) Draw a histogram for the given data. ***(03 marks)***
(ii) Use the histogram to estimate the modal age. ***(01 marks)***

(c) Calculate the middle 60 percentile range. ***(04marks)***

10. A particle of mass 8kg is initially at rest at the point A(2, -2, 3) metres. The particle is acted upon by a force of $F = \begin{pmatrix} 4t \\ t^2 \\ 5 \end{pmatrix}$ newtons, where t is time in seconds. Find the;

(a) Acceleration at time t. ***(02 marks)***
(b) Speed of the particle after 3 seconds. ***(05 marks)***
(c) Displacement of the particle after 3 seconds. ***(05 marks)***

11. (a) Two numbers x and y are approximated by X and Y with errors Δx and Δy respectively. Show that the relative error in approximating $\frac{x}{y}$ by $\frac{X}{Y}$ is $\left|\frac{\Delta x}{X}\right| + \left|\frac{\Delta y}{Y}\right|$ ***(06 marks)***

(b) The values in the expression $T = \frac{673.16}{40.345}$ are rounded off correct to the given decimal places. Determine the interval within which the exact value of T can be expected to lie. ***(06 marks)***

12. A random variable X has a probability density function given by;

$$f(x) = \begin{cases} kx(6-x)^2; & 0 \leq x \leq 6 \\ 0, & otherwise \end{cases}$$

Where k is a constant. Find the;

(a) Value of k *(04 marks)*

(b) Mode of x *(04 marks)*

(c) Mean of x *(04 marks)*

13. Forces of magnitude 2N, 5N, 3N, 4N, $2\sqrt{2}$ N and $\sqrt{2}$N act along sides $\overrightarrow{AB}$, $\overrightarrow{BC}$, $\overrightarrow{DC}$, $\overrightarrow{AD}$, $\overrightarrow{AC}$ and $\overrightarrow{DB}$ respectively. Where ABCD is a square of side 2m. find the;

(a) Resultant force. *(09 marks)*

(b) Equation of the line of action of the resultant force. *(03 marks)*

14. (a) Draw on the same axes the graphs of the curves $y = 2 - e^{-x}$ and $y = \sqrt{x}$ for $2 \leq x \leq 5$. *(05 marks)*

(b) Determine from your graphs the interval within which the root of the equation $e^{-x} + \sqrt{x} - 2 = 0$ lies. Hence, use Newton Raphson's method to find the root of the equation correct to three decimal places. *(07 marks)*

15. The masses of packets of tea leaves are normally distributed with mean mass 600g and standard deviation 20g.

(a) If a packet of tea leaves is chosen at random, find the mass exceeded by 7% of the packets. *(05 marks)*

(b) If 1000 packets of tea leaves were sold, find the number of packets that weighed less than 545g. *(07 marks)*

16. Two points A and B are on the same horizontal ground. A particle P is projected from point A towards point B with an initial speed of $49ms^{-1}$ at an angle of 30^0 to the horizontal. Two seconds later, another particle Q is projected from point B towards A with the same speed and at the same angle of elevation as P.

If the particles collide at a height h above the ground, determine the;

(a) Value of h *(06 marks)*

(b) Distance between the points A and B. *(06 marks)*

END

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