P425/2
APPLIED
MATHEMATICS
Paper 2
Jul/Aug. 2022
3 hours

RESOURCE MOCK EXAMINATIONS 2022

Uganda Advanced Certificate of Education

APPLIED MATHEMATICS

Paper 2

3 hours

INSTRUCTIONS TO CANDIDATES;

*Answer **ALL** the eight questions in Section **A** and any **FIVE** from Section **B**.*

Any additional question will not be marked.

All necessary working must be shown clearly.

Begineach 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 acceleration due to gravity g to be 9.8ms^{-}

SECTION A

1. A stone is thrown vertically upwards with a speed of 15ms-1 from the top of a cliff. If it hits the bottom of the cliff with a velocity of $45ms^{-1}$, find the:
   i) Height of the cliff above the ground level
   ii) Time the stone takes to reach the maximum height. (05 marks)

2. A biased coin is such that the chance of a head appearing upper most when tossed is twice the chance of a tail appearing uppermost. If the coin is tossed 10 times. Find the probability that;
   (i) Exactly 6 heads will appear
   (ii) Between 5 and 8 heads will appear. (05 marks)

3. The table below shows the variation of temperature (°C) with time in a certain laboratory experiment.

Time(s)	0	120	240	360	480	600
Temperature (°C)	100	80	75	65	56	48

   Use linear interpolation or extrapolation to estimate;
   (a) Time when temperature is 76°C.
   (b) Temperature when time is 620s.

4. A mass of 12kg lies on a smooth inclined plane which is 6m long and 1m high is tied on one end of a light inextensible string passing over a smooth pulley at the vertex of the plane to a mass of 4kg held vertically downwards. If the particles are in equilibrium, find the tension in the string. (05 marks)

5. The table below shows the grades of six candidates in two examinations.

Mathematics	E	C	B	F	D	A
English	F	A	D	E	C	C

   Calculate the rank correlation coefficient and comment at 5% level of significance. (05 marks)

6. Given that $x = 1.5$ and $y = 3.25$ state the limits within which $\frac{x+y}{xy}$ lies correct to three decimal places. (05 marks)

7. A car of mass 1000kg is working at a steady rate of 15kW on a level road. If it has a constant resistance of 200N, Determine the;
   (i) Acceleration when speed is $10ms^{-1}$

(ii) Maximum speed of the car.

(05 marks)

8. A discrete random variable x has probability distribution function given by;

$$P(X = x) = \begin{cases} K|x| & ; \quad x = -3, -2, -1, 0, 1, 2, 3 \\ 0 & ; \quad otherwise \end{cases}$$

Where k is a constant, Determine the;

(i) Value of k

(ii) Mean, $E(x)$

(05 marks)

SECTION B (60 MARKS)

Attempt any FIVE questions in this section. All questions carry equal marks.

9. Ship A and B have position vectors $(\boldsymbol{r})$. Velocity vectors $(\boldsymbol{v})$ and time (t) as indicated below.

Position vectors $(\boldsymbol{r})$	Velocity vectors $(\boldsymbol{v})$	Time (t)
$\boldsymbol{r}_A = \begin{pmatrix} 5 \\ 1 \end{pmatrix} km$	$\boldsymbol{VA} = \begin{pmatrix} 7 \\ 3 \end{pmatrix} kmhr^{-1}$	11:00 am
$\boldsymbol{r}_B = \begin{pmatrix} 8 \\ 7 \end{pmatrix}$ km	$\boldsymbol{V}_B = \begin{pmatrix} 2 \\ -1 \end{pmatrix} kmhr^{-1}$	12:00 noon

Determine the;

a) Position of A at 12:00 noon

b) Time when A and B are nearest each other

c) Nearest distance.

(12 marks)

10. A continuous random variable has probability density function given by;

$$f(x) = \begin{cases} cx\,(1 - x^2) & ; \quad 0 \leq x \leq 1 \\ 0 & ; \quad otherwise \end{cases}$$

Where **c** is a constant; determine the;

a) Value of **c**

b) Mean, $E(x)$

c) Variance, $var(x)$

(12 marks)

11. (a) Draw on the same axes the graphs of $y = e^x$ *and* $y = 3 - x$ and show that they have a root between $x = 0$ *and* $x = 1$ correct to 1 decimal place.

(b) Using the initial approximation from the sketch in (a) above and the Newton Raphson method, find the root correct to 3 decimal places.

(12 marks)

12. A man of mass 50kg rests on a rough plane inclined at 60° to the horizontal. If the coefficient of friction between the mass and the plane is $\frac{\sqrt{3}}{5}$, Find the force, P that will keep the mass in equilibrium when it is;
    (i) Parallel to the line of greatest slope
    (ii) Horizontal force. (12 marks)

13. The speeds of cars passing a certain express highway are normally distributed such that 95% of the cars travel at less than 85m/s and 10% travel at less than 55m/s. Determine the;
    (i) Mean and standard deviation of the speeds of the cars.
    (ii) Percentage of the cars that travel at more than 70m/s. (12 marks)

14. (a) Use the trapezium rule with six ordinates to estimate $\int_1^2 \ln\,(1 + x)dx$ correct to 3 decimal places.
    (b) Calculate the exact value correct to 3 decimal places hence find the percentage error.
    (c) State how the error may be reduced. (12 marks)

15. A particle moves such that displacement(s) is given by;

$$S = \begin{pmatrix} \sin 2t \\ t + 1 \\ t + sint \end{pmatrix} metres$$

Determine the;
    (a) Velocity when $t = {}^{\pi}/_{2}\, s$
    (b) Acceleration where $t = \pi s$
    (c) Maximum value of the z coordinate of s. (12 marks)

16. In a certain constituency by election, 50% of the voters voted Mutebi, 30% voted Opio and 20% voted Mugisha. A survey revealed that 50%, 82% and 65% of those who voted Mutebi, Opio and Mugisha respectively were bribed. If a voter is selected at random. Determine the probably that the;
    (i) Was bribed.
    (ii) Voted for Opio, given he was not bribed.
    (iii) Did not vote for Mutebi, given that he was bribed. (12 marks)

END