P425/2
Applied
Mathematics
PAPER TWO
April/May 2023
3 Hours

# POST PRIMARY KABALE DIOCESAN MOCK EXAMS

## UGANDA ADVANCED CERTIFICATE OF EDUCATION

## APPLIED MATHEMATICS
## (PRINCIPAL SUBJECT)

## PAPER 2

**Time: 3 Hours**

**INSTRUCTIONS TO CANDIDATES**

- ✓ *Answer **all** the eight questions in section A and only **five** questions from section B*
- ✓ *Any additional question(s) will **NOT** be marked.*
- ✓ *All necessary working **MUST** be clearly shown*
- ✓ *Graph paper is provided*
- ✓ *In numerical work, take $g = 9.8ms^{-2}$*

## SECTION A: (40 MARKS)

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

1. The probability that events A and B occur are $\frac{1}{3}$ and $\frac{1}{4}$ respectively. If the probability that only one of them occurs is $\frac{5}{12}$, find the,

   $P(A \cap B)$ **(3 Marks)**

   $P(A^1 \cap B^1)$ **(2 Marks)**

2. Given that for a function f(x), f(0.9)=0.2661, f(1.0)=0.2420, and f(1.1)=0.2179; use linear interpolation or extrapolation to estimate;

   i) $f(x) = (0.96)$ **(02 Marks)**

   ii) $f^{-1}(0.2082)$ **(3 Marks)**

3. A particle of weight 78.4N is released from rest at the top of a plane inclined at $30^0$ to the horizontal. If the coefficient of friction between the particle and the plane is 0.2, find the

   (i) Acceleration

   (ii) Velocity after covering 10 metres **(5 Marks)**

4. A random variable X has a probability density function,

   $$f(x) = \begin{cases} \frac{2^x}{k}; & x=1, 2, 3, 4. \\ 0, & \end{cases}$$

   *otherwise*

   Find; Value of K

   Mean of X **(05 Marks)**

5. A particle of mass 2kg resting on a rough horizontal plane is pulled by a force of magnitude of 11.3N inclined at an angle of $60^0$ to the horizontal. If the particle does not move, find the minimum value of the coefficient of friction between the particle and the place **(05 Marks)**

6. A particle moves such that its displacement at any time (t) is given by;

   $r = t^2(2\underset{\sim}{i} - 4\underset{\sim}{k}) - t^3\ (\ 3\underset{\sim}{j} - 2\underset{\sim}{i}\ ) + 2\sin 2t\ \underset{\sim}{k}$ metres. Find the magnitude of the acceleration of the particle at t = 3 seconds **(05 Marks)**

7. If P = 4.7, Q = 80.00 and R = 15.900 are rounded off with corresponding percentage errors of 0.5, 0.5 and 0.05. Calculate the absolute error in the express $\frac{pq}{r}$, giving your answer to 2 significant figures. **(05 Marks)**

8. The table below shows the ages of people who attended a certain function
   Calculate a cumulative frequency curve and use it to estimate the interquartile range

| Age (Years) | Frequency |
|---|---|
| 10-19 | 6 |
| 20-34 | 16 |
| 35-44 | 27 |
| 45-64 | 39 |
| 65-79 | 18 |
| 80-89 | 8 |

## SECTION B: (60 MARKS)

Answer only **FIVE** questions from this section

All questions carry equal marks

9. (a) Use the trapezium rule with 6 ordinates to find the approximate value of

$$\int_{0.5}^{1.5} \frac{3}{x} \sqrt{1+x^4}\, dx$$

Correct to 4 significant figures **(06 Marks)**

b) Calculate the exact value and hence find:

(i) Absolute error

(ii) Relative error

(iii) Percentage error. in your estimation in (a), Suggest how the error may be reduced **(06 Marks)**

10. Two particles A and B move with velocities $(\lambda\underset{\sim}{i} + 3\underset{\sim}{j} + 30\underset{\sim}{k})$ ms$^{-1}$ and $(4\underset{\sim}{i} - 2\underset{\sim}{j} - 15\underset{\sim}{k})$ms$^{-1}$ respectively where $\lambda$ is a constant. At $t = 0$, the particles are located at points (2, 1, -15) and (1, 4, 12) respectively

a) Find the value of $\lambda$ such that A and b will collide and find the value of t when collision occurs

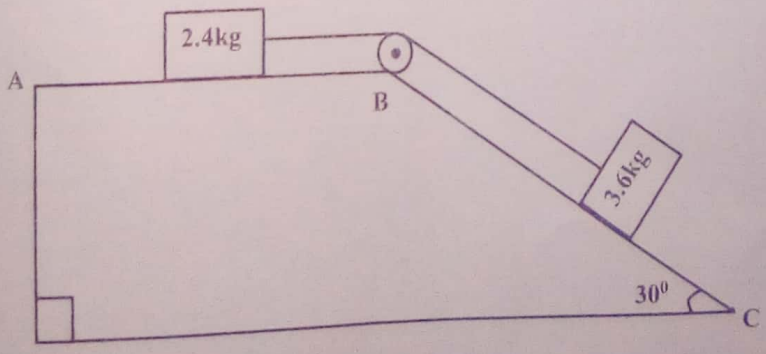
b) When $\lambda$=2, find the time after which the particles will be nearest to each other. **(12 Marks)**

11. a) Use graphical method to show that the equation $e^x + x - 4 = 0$ has a root between 1 and 2, correct to 1 decimal place.

b) Show that the Newton Raphson formula for finding the root of the equation in (i) above is $x_{n+1} = \frac{e^{xn}(x_n - 1) + 4}{1 + e^{xn}}$; n=0, 1, 2, .....

c) Hence use the initial approximation $X_0$ obtained in (a) above to find the root of the equation giving your answer to 3 decimal places **(12 Marks)**

12. 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 alight inextensible string passing over a smooth fixed pulley at B to particle of mass 3.6kg. The sloping face BC is smooth and makes an angle of $30^0$ to the horizontal.



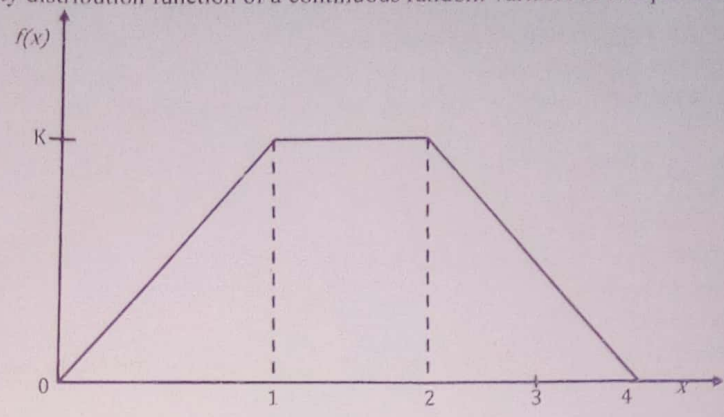

If the system is released from rest, find the;

a) Acceleration of the system and tension in the string **(06 Marks)**

b) Force exerted on the pulley at B **(03 Marks)**

c) Velocity of the 3.6kg mass after 2 seconds **(03 Marks)**

13. The probability distribution function of a continuous random variable X is represented as shopwn.




Find the;

i) Value of k

ii) Expression for the distribution

iii) $P(2.5 < x < 3)$

iv) Mean of $x$

14. A uniform plank of length 8 metres and mass 100kg rests in limiting equilibrium with the end A on a horizontal ground and the end B against vertical wall. If the coefficient of friction at each end of the plank is 0.3. Find the;

a) Angle the plank makes with the vertical.

b) The plank is now placed at an angle of $\beta$ to the horizontal where ta $\beta = 2$ and a body of mass M kg is attached to the plank at B causing the plank to slip. Find the maximum value of M and the magnitude of the corresponding normal reaction at A **(12 Marks)**

15. The number of cows owned by residents in a village of Rwahinda is assumed to be normally distributed. 15% of the residents have less than 60 cows while 90% of the residents have less than 100 cows

a. Determine the value of the mean, $\mu$ and standard deviation, $\sigma$ of the cows. **(08 Marks)**

b. If there are 200 residents, find how many have more than 80 cows **(04 Marks)**

16. The masses (X) in kilograms of 50 students were as follows

| Masses (X) | Number of students |
|---|---|
| X<40 | 0 |
| X<45 | 3 |
| X<50 | 5 |
| X<60 | 25 |
| X<65 | 43 |
| X<70 | 46 |
| X<75 | 50 |

*a) Calculate*

The standard deviation **(06 Marks)**

Median mass **(02 Marks)**

b) Construct a histogram to represent the above data. Use it to estimate the modal mass **(04 Marks)**

***END***