

**P425/2**

**APPLIED MATHEMATICS**

**PAPER 2**

**JULY/AUGUST 2022**

**3 HOURS**



**UNNASE JOINT MOCK EXAMINATIONS 2022**

**UGANDA ADVANCED CERTIFICATE OF EDUCATION**

**APPLIED MATHEMATICS**

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**INSTRUCTIONS TO CANDIDATES**

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

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

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

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

### SECTION A: (40 MARKS)

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

1. Given that  $P(A \cup B) = \frac{9}{10}$ ,  $P(A/B) = \frac{1}{3}$  and  $6P(A) = 5P(B)$ , find:

(i)  $P(B)$

(ii)  $P(A \cap B)$

(05 marks)

2. A ship moving with constant velocity  $(-3\mathbf{i} + 2\mathbf{j})\text{ms}^{-1}$  has a position vector of  $(-4\mathbf{i} - 7\mathbf{j})\text{m}$  at time  $t = 6\text{s}$ . Find the distance of the ship from the origin at time  $t = 2\text{s}$ .

(05 marks)

3. Use the trapezium rule with 6 ordinates to estimate  $\int_0^{\frac{\pi}{4}} (2x + \sec^2 x) dx$

correct to 4 decimal places

(05 marks)

4. The table below shows the weights in kg of 80 boys:

Weights	50–59	60–74	75–79	80–89	90–94
Frequency Density	2.2	1.8	3	1.2	0.8

(a) State the modal class

(b) Determine the median class

(05 marks)

5. Show that the equation  $\cos(x^2) = x - 3$  has a root between 2.5 and 3. Hence use linear interpolation to find the root correct to **three** decimal places

(05 marks)

6. A car of mass  $500\text{kg}$  is moving up a hill inclined at  $\sin^{-1}\left(\frac{1}{7}\right)$  to the horizontal.

The resistance to motion of the car is  $300\text{N}$ . If the power output of the car is  $84\text{kW}$ , find the acceleration of the car when its speed is  $35\text{ms}^{-1}$  (05 marks)

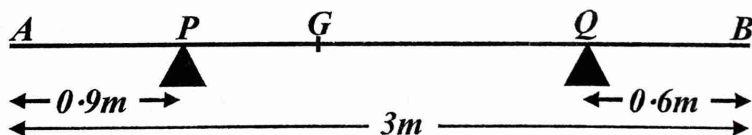
7. A r.v  $X$  has the following cumulative distribution function:

$$F(x) = \begin{cases} 0 & , x < 1 \\ \frac{1}{4}(x-1)^2 & , 1 \leq x \leq 3 \\ 1 & , x > 3 \end{cases}$$

(i) Sketch  $F(x)$  (02 marks)

(ii) Find  $P(2 < X < 2.6)$  (03 marks)

8. A non uniform rod  $AB$  of length  $3\text{m}$  and mass  $4.5\text{kg}$  rests in equilibrium in a horizontal position on two smooth supports at  $P$  and  $Q$ , where  $AP = 0.9\text{m}$  and  $QB = 0.6\text{m}$  as shown below



The centre of mass of the rod is at  $G$ . Given that the magnitude of the reaction on the rod at  $P$  is twice the magnitude of the reaction on the rod at  $Q$ , find the:

(i) magnitude of the reaction on the rod at  $Q$

(ii) distance  $AG$  (05 marks)

### SECTION B (60 Marks)

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

9. The marks of 8 students in **UNEB**, **pre mock** and **post mock** were as follows:

<b>UNEB</b>	72	80	50	64	72	56	50	60
<b>Pre Mock</b>	60	67	60	63	70	52	55	58
<b>Post Mock</b>	78	79	65	60	85	67	54	65

(a) Calculate the rank correlation coefficient between the scores of:

(i) **UNEB** and **Pre Mock**

(ii) **UNEB** and **Post Mock**

(b) Which of the two mocks had a better correlation with **UNEB**? Give a reason

(12 marks)

10. A car is moving on a straight horizontal road. At time  $t = 0$ , the car is at point **P** and moving with a speed of  $20\text{ms}^{-1}$ . The car maintains this speed for 25s and then moves with a constant deceleration of  $0.4\text{ms}^{-2}$  until its speed reduces to  $8\text{ms}^{-1}$ . The car then maintains this speed for 60s and then moves with a constant acceleration until its speed is  $20\text{ms}^{-1}$  at point **Q**.

(a) Sketch a velocity–time graph for the motion of the car from **P** to **Q**

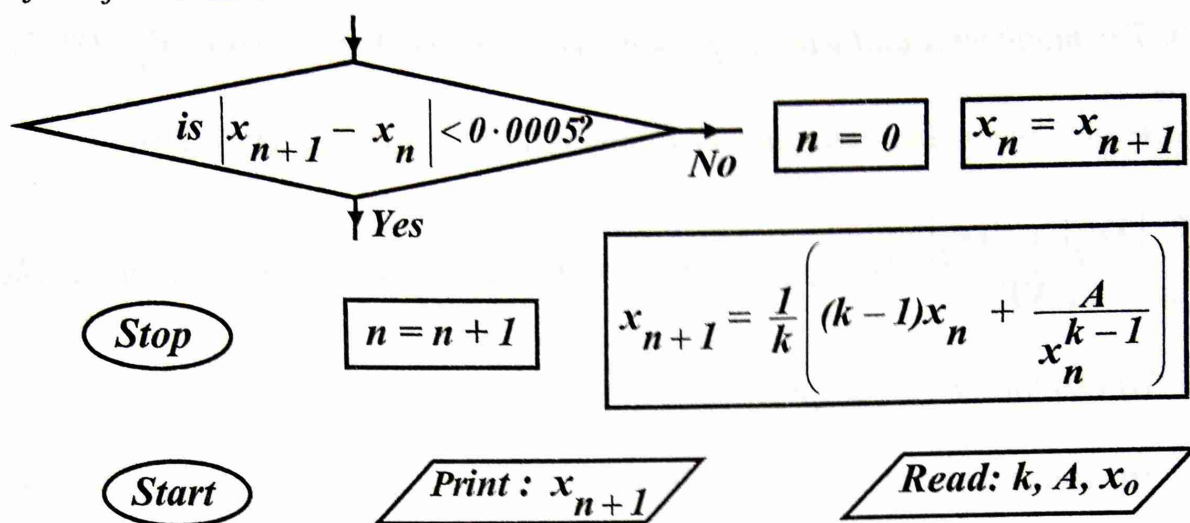
(b) Find the time for which the car is decelerating

(c) Given that the distance from **A** to **B** is 1960m, find the time taken for the car to move from **P** to **Q**

(12 marks)



11. The iterative method for solving an equation is described by the following parts of the flowchart:



(i) By rearranging the given parts, draw a flowchart that shows the algorithm for the described method

(ii) Using  $x_0 = 1.7$ ,  $A = 28$  and  $k = 6$ , perform a dry run for the flow chart

(iii) Write down in simplified form the equation that yielded the formula described in this flowchart and then use it to state the purpose of the flow chart

(12 marks)

12. In a sequence of 72 trials, the probability of success for each trial is  $\frac{2}{3}$ .

Find the:

(i) mean number of success and standard deviation

(ii) probability of getting more than 40 successes

(iii) probability of getting at least 49 successes but less than 57 (12 marks)

13. The numbers  $x$  and  $y$  are approximated by  $X$  and  $Y$  with errors  $e_1$  and  $e_2$  respectively. Show that the maximum relative error in  $\sqrt{xy}$  is given by

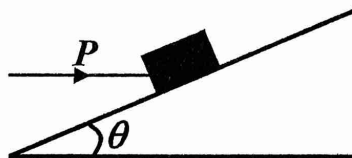
$\frac{|Xe_2| + |Ye_1|}{2|XY|}$ . Hence if  $x = 2.56 \pm 0.4$  and  $y = 6.25 \pm 0.45$ , calculate the:

(i) absolute error in  $\sqrt{xy}$

(ii) lower limit of the interval in which  $\sqrt{xy}$  is expected to lie, correct to 3 decimal places

(12 marks)

14. A box of weight  $49.4\text{N}$  lies on a rough plane inclined to the horizontal at an angle  $\theta$ , where  $\tan\theta = \frac{5}{12}$ . A horizontal force  $P$  acts on the box as shown



The box is in equilibrium and on the point of slipping up the plane. The normal reaction of the plane on the box is  $67.6\text{N}$ . The coefficient of friction between the box and the plane is  $\mu$ .

(a) Find the:

(i) value of  $P$

(ii) value of  $\mu$

(b) Show that when the horizontal force  $P$  is removed, the box remains in equilibrium on the plane

(12 marks)

15. The chance of Tom going to work by bus, by train or on foot is 0.3, 0.45 and 0.25 respectively. If he uses these methods of travel, the chance that he will be late is 0.4, 0.65 and 0.8 respectively.

(a) Draw a tree diagram to represent this information (02 marks)

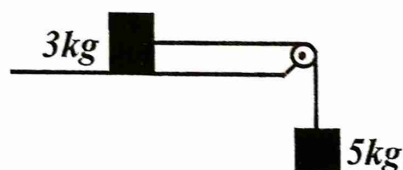
(b) Find the chance that Tom will:

(i) be late on a particular day (04 marks)

(ii) use a bus given that he is not late (03 marks)

(iii) not go on foot given that he is late (03 marks)

16. A 3kg mass rests on a rough table and is connected by an inelastic string to a 5kg hanging mass as shown



If the system is released from rest and the coefficient of friction between the 3kg mass and the table is 0.4,

(a) Write down the equation of motion for each mass

(b) find the:

(i) acceleration of the system and the tension in the string

(ii) magnitude of the force exerted on the pulley by the string

(c) When the masses are moving with a speed of  $4.9 \text{ ms}^{-1}$ , the string breaks.

Find the further time that elapses until the 3kg mass comes to rest (12 marks)

**END**