

Student Name: _____



GENERAL MATHEMATICS 2024

Unit 4

Key Topic Test 2 – Applications of Matrices

Recommended writing time*: 45 minutes

Total number of marks available: 25 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers, approved CAS calculator and one bound reference book.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 10 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A

- All questions are worth one mark.
- Answer all questions by circling the correct response.
- Marks are not deducted for incorrect answers.
- No marks will be awarded if more than one answer is completed for any question

Question 1

Four teams compete in a soccer tournament with the results shown below. There were no draws.

		A	B	C	D
Winner	A	0	1	1	1
	B	0	0	1	0
	C	0	0	0	0
	D	0	1	1	0

The team that finished second in the tournament is:

- A.** Team A **B.** Team B **C.** Team C
D. Team D **E.** Teams B & C finished equal 2nd

Question 2

Paul and Jacob took their families to the movies. Paul purchased 2 adult tickets and 2 children's tickets for \$61 and Jacob purchased 1 adult ticket and 3 children's tickets for \$54.50. Let a be the cost of an adult ticket and c be the cost of a child's ticket.

The matrix $\begin{bmatrix} a \\ c \end{bmatrix}$ is equal to:

- A. $\begin{bmatrix} 3 & -2 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} 61 \\ 54.50 \end{bmatrix}$
- B. $\frac{1}{4} \begin{bmatrix} 3 & -2 \\ -1 & 2 \end{bmatrix} \begin{bmatrix} 61 \\ 54.50 \end{bmatrix}$
- C. $\begin{bmatrix} 61 \\ 54.50 \end{bmatrix} \begin{bmatrix} \frac{3}{4} & -\frac{1}{2} \\ -\frac{1}{4} & \frac{1}{2} \end{bmatrix}$
- D. $\begin{bmatrix} 61 & 54.50 \end{bmatrix} \begin{bmatrix} \frac{3}{4} & -\frac{1}{2} \\ -\frac{1}{4} & \frac{1}{2} \end{bmatrix}$
- E. $\begin{bmatrix} \frac{3}{4} & -\frac{1}{2} \\ -\frac{1}{4} & \frac{1}{2} \end{bmatrix} \begin{bmatrix} 61 & 54.50 \end{bmatrix}$

Use the following information to answer Questions 3 and 4

The cost prices of three different items in a store are \$40, \$110 and \$65. The shopkeeper decides to mark up the price of the first item by 10%, mark down the price of the second item by 5% and mark up the price of the third item by 8%.

Question 3

The matrix product that calculates the new prices is:

A. $[40 \quad 110 \quad 65] \begin{bmatrix} 1.1 & 0 & 0 \\ 0 & 0.95 & 0 \\ 0 & 0 & 1.08 \end{bmatrix}$

B. $[40 \quad 110 \quad 65] \begin{bmatrix} 1.1 \\ 0.95 \\ 1.08 \end{bmatrix}$

C. $\begin{bmatrix} 1.1 \\ 0.95 \\ 1.08 \end{bmatrix} [40 \quad 110 \quad 65]$

D. $\begin{bmatrix} 1.1 & 0 & 0 \\ 0 & 0.95 & 0 \\ 0 & 0 & 1.08 \end{bmatrix} [40 \quad 110 \quad 65]$

E. $\begin{bmatrix} 40 & 0 & 0 \\ 0 & 110 & 0 \\ 0 & 0 & 65 \end{bmatrix} \begin{bmatrix} 1.1 & 0 & 0 \\ 0 & 0.95 & 0 \\ 0 & 0 & 1.08 \end{bmatrix}$

Question 4

If Jo purchases 1 of the first item, 5 of the second item and 3 of the third item at the new prices, the total cost of his purchase is:

A. \$777.10

B. \$785

C. \$792.50

D. \$788.20

E. \$795.40

Question 5

The words team and meat use the same letters in a different order.

The permutation matrix that can change $\begin{bmatrix} T \\ E \\ A \\ M \end{bmatrix}$ into $\begin{bmatrix} M \\ E \\ A \\ T \end{bmatrix}$ is:

A. $\begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$

B. $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$

C. $\begin{bmatrix} 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 1 \end{bmatrix}$

D. $\begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$

E. $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$

SECTION B - Short-answer questions**Instructions for Section B**

- Answer each question in the space provided.
- Please provide appropriate workings and use exact answers unless otherwise specified.

Question 1 (9 marks)

A school canteen sells sandwiches (s), hotdogs (h) and noodles (n).

The number of each item sold over 3 days is shown below:

	s	h	n
Day 1	42	65	22
Day 2	33	46	12
Day 3	26	52	26

- a. State the number of hotdogs sold on Day 2.

1 mark

- b. Find the total number of noodles sold over the 3 days.

1 mark

Consider the matrix equation

$$\begin{bmatrix} 42 & 65 & 22 \\ 33 & 46 & 12 \\ 26 & 52 & 26 \end{bmatrix} \times \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 509.20 \\ 356.90 \\ 416 \end{bmatrix}$$

Where a equals the cost of one sandwich, b equals the cost of one hotdog and c equals the cost of one serve of noodles.

- c. Find the cost of one hotdog.

2 marks

- d. The matrix equation below shows the total value of all sandwiches, hotdogs and noodles sold over these three days.

$$L \times \begin{bmatrix} 509.20 \\ 356.90 \\ 416 \end{bmatrix} = [1282.10]$$

Matrix L in this equation is a 1×3 matrix.
Write down matrix L .

1 mark

The canteen management wishes to change the prices of the foods they sell.
They would like to:

- Increase the cost of sandwiches by 20%
- Decrease the cost of hotdogs by 10%
- Increase the cost of noodles by 5%

- e. State matrix D , such that $D \times \begin{bmatrix} a \\ b \\ c \end{bmatrix}$ will give the new price matrix.

2 marks

- f. Assuming sales remain the same numbers for 3 days after the prices are changed. Find the total difference in value of the good sold for the 3 days after prices are changed compared to the 3 days prior to the price change.

2 marks

Question 2 (5 marks)

Five Northern Territory teams take part in a round robin charity volleyball tournament.

- Uluru (U) beats Alice Springs (A)
- Alice Springs beats Kings Canyon (K) and Gunlom (G)
- Kings Canyon beats Uluru and Wycliffe Wells (W)
- Wycliffe Wells beats Uluru, Alice Springs and Gunlom
- Gunlom beats Uluru and Kings Canyon

a. Present this information in a one step dominance matrix D .

$$D = \begin{matrix} & \begin{matrix} U & A & K & W & G \end{matrix} \\ \begin{matrix} U \\ A \\ K \\ W \\ G \end{matrix} & \begin{bmatrix} & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \end{bmatrix} \end{matrix}$$

2 marks

b. Given that the two step dominance matrix $D^2 = \begin{matrix} & \begin{matrix} U & A & K & W & G \end{matrix} \\ \begin{matrix} U \\ A \\ K \\ W \\ G \end{matrix} & \begin{bmatrix} 0 & 0 & 1 & 0 & 1 \\ 2 & 0 & 1 & 1 & 0 \\ 1 & 2 & 0 & 0 & 1 \\ 1 & 1 & 2 & 0 & 1 \\ 1 & 1 & 0 & 1 & 0 \end{bmatrix} \end{matrix}$, explain the meaning

of the sum of the elements in the third row of D^2 .

1 mark

- c. Find $D + D^2$ and hence state the team that finished fourth in the tournament.

2 marks

Question 3 (6 marks)

Three families attend an AFL game in the 2024 season to see Fremantle play Carlton. The table below shows how many tickets they purchased and the total price paid:

	Number of tickets purchased			Total price paid (\$)
	Adult	Student	Child	
Family 1	2	0	2	73
Family 2	2	1	1	79
Family 3	1	1	4	90.50

- a. State the total number of child tickets purchased.

1 mark

- b. Using the variables a to represent the price of an adult ticket, s to represent the price of a student ticket and c to represent the price of a child ticket, write the information from the table above in the form of three simultaneous equations.

2 marks

- c. Convert these three simultaneous equations into a matrix equation.

1 mark

- d. Solve this equation, using the matrix method, and state the price of an Adult, Student and Child ticket.

2 marks

END OF KEY TOPIC TEST