Student Name: _____

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GENERAL MATHEMATICS 2024

Unit 4
Key Topic Test 1 – Matrix Arithmetic

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 8 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

The matrix $\begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix}$ is an example of a:

A. Permutation matrix

B. Diagonal matrix

C. Row matrix

D. Column matrix

E. Diagonal matrix

Question 2

In the matrix $A = \begin{bmatrix} -4 & 2 & 0 \\ 1 & 5 & -6 \\ 2 & 8 & 12 \end{bmatrix}$, $a_{21} - a_{23}$ is equal to:

A. -3
B. -6
C. -5
D. 7
E. -4

Use the following information to answer Questions 3 and 4

Let $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ *and* $B = \begin{bmatrix} -5 & 2 \\ 2 & 1 \\ 4 & -1 \end{bmatrix}$

The matrix $P = B \times A$ and the element in row i and column j of matrix P is given by p_{ij}.

Question 3

If $p_{11} = -18$ and $p_{21} = 9$, then $a + c$ is equal to:

A. 1

B. 5

C. 0

D. 4

E. 2

Question 4

Which of the following are not possible:

A. A^{-1}

B. $3B \times A$

C. B^T

D. $B \times A^{-1}$

E. $2A + B$

Question 5

Let $A = \begin{bmatrix} 1 & -2 & 5 \\ -3 & 10 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 2 & 3 \\ -1 & -1 & 0 \\ 8 & 0 & 10 \end{bmatrix}$ and $C = \begin{bmatrix} 0 & 4 & 6 \\ -2 & \frac{1}{2} & 3 \end{bmatrix}$

Which of the following matrices are defined?

A. $A(BC)$

B. $B(AC)$

C. B^2C

D. $(A + C)B^{-1}$

E. $AC + B$

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 (10 marks)

$A = \begin{bmatrix} -1 & 1 \\ 2 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 4 & 2 & 1 \\ -2 & 1 & 8 \end{bmatrix}$, $C = \begin{bmatrix} 5 & 2 \\ 1 & -2 \\ 0 & 10 \end{bmatrix}$

a. Explain why the matrix product $A \times C$ is not possible.

_____

_____

1 mark

b. State the element b_{22}

_____

1 mark

c. Calculate A^{-1}

_____

_____

1 mark

d. Find $2A \times B$

_____

_____

1 mark

e. Find A^T

_____

_____

1 mark

Let $P = (AB)C$

f. State the order of the matrix P

_____

1 mark

g. Find P^{-1}

_____

_____

_____

2 marks

h. If $G = 3C \times 2B$, state the order of G and the element g_{21}

_____

_____

_____

2 marks

Question 2 (4 marks)

Consider the following system of linear equations:

$$\begin{aligned} 2x + y + 7z &= 9556 \\ 3x + y + 4z &= 5899 \\ 5x + 2y + z &= 3155 \end{aligned}$$

a. Write this system of simultaneous linear equations in matrix form $AX = B$.

1 mark

a. State the inverse matrix A^{-1} that can be used to solve this system of simultaneous linear equations.

1 mark

b. Solve the system of simultaneous linear equations for x, y and x

2 marks

Question 3 (6 marks)

Consider the matrix $T = \begin{bmatrix} 1 \\ 8 \\ 20 \\ 16 \end{bmatrix}$

a. State the matrix T^T

1 mark

b. State matrix B, such that the matrix multiplication $B \times T$ increases each element in T by 10%.

2 marks

Consider the matrix $S = \begin{bmatrix} t \\ f \\ u \\ r \\ i \end{bmatrix}$

c. State matrix P, such that $PS = \begin{bmatrix} f \\ r \\ u \\ i \\ t \end{bmatrix}$

2 marks

d. Describe the order and type of matrix for matrix P

_____

1 mark

END OF KEY TOPIC TEST