

# Mathematics Department

Course: A1MAA

Topic Title: Applications of Rates & Percentages, Matrices & Matrix Arithmetic

Test 1



Student Name: Solutions

Date: \_\_\_\_\_

Special Instructions: **Calculator Free**

Time Allowed: 30 minutes

Formula Sheet Allowed

Marks: / 32

## Question 1.

(½ each : 7 marks)

Complete the following conversions, simplifying fractions when possible.

Fraction	Decimal	Percent
$\frac{2}{5}$	0.4	40%
$\frac{7}{10}$	0.7	70%
$\frac{85}{100}$	0.85	85%
$\frac{125}{1000}$	0.125	12.5%
$\frac{1}{3}$	0.3	33.3%
$\frac{6}{100}$	0.06	6%
$\frac{25}{1000}$	0.025	2.5%

## Question 2.

(2 marks)

If 2% of an amount is \$18, how much is the original amount?

$$\begin{aligned} 1\% &= \$9 \\ 100\% &= \$900 \end{aligned}$$

Question 3.

(2, 1 : 3 marks)

Jenna's salary of \$45000 is to be increased by 15%.

a) How much is the pay rise?

$$\begin{array}{l} 10\% \text{ is } \$4500 \checkmark \\ 5\% \text{ is } \$2250 \checkmark \\ 15\% \text{ is } \$6750 \checkmark \end{array}$$

b) What will her new salary be?

$$6750 + 45000 = \$51750 \checkmark$$

Question 4.

(1, 2 : 3 marks)

John purchased a guitar for \$2000.00 and sold it for \$2200.00

a) How much profit did he make?

$$\$200 \checkmark$$

b) Calculate his percentage profit.

$$\frac{200}{2000} \times 100 = \frac{1}{10} \times 100 = 10\% \checkmark$$

Question 5.

(2 marks)

Penny, the plum seller, normally sells her plums for \$16.00/box. Penny decided to discount them by 25%.

Calculate the sale price.

$$\frac{16}{4} = \$4 \quad 16 - 4 = \$12 \checkmark$$

Question 6.

(1, 1, 1 : 3 marks)

If  $e_{mn}$  is the element situated in the  $m^{\text{th}}$  row and  $n^{\text{th}}$  column of matrix E determine

a)  $e_{33}$

12 ✓

b)  $e_{21}$

-4 ✓

c)  $f_{12}$

4 ✓

where matrices E and F are as given below.

$$E = \begin{bmatrix} 5 & 4 & 13 \\ -4 & 2 & 0 \\ 1 & -8 & 12 \end{bmatrix}$$

$$F = [1 \ 4 \ 3 \ 9]$$

Question 7.

(2, 2, 2, 2, 2, 2 : 12 marks)

If  $A = \begin{bmatrix} 2 & 3 \\ 5 & 7 \\ 1 & 8 \end{bmatrix}$   $B = \begin{bmatrix} 1 & 2 & 8 \\ 7 & 0 & 1 \end{bmatrix}$   $C = \begin{bmatrix} 4 \\ 1 \\ 3 \end{bmatrix}$   $D = \begin{bmatrix} 2 \\ 5 \\ 10 \end{bmatrix}$   $E = \begin{bmatrix} 7 & 4 \\ 3 & 3 \\ 2 & 5 \end{bmatrix}$

determine each of the following. If any cannot be determined state this clearly and explain why

a)  $E + A$

$$\begin{bmatrix} 9 & 7 \\ 8 & 10 \\ 3 & 13 \end{bmatrix}$$

b)  $3B$

$$\begin{bmatrix} 3 & 6 & 24 \\ 21 & 0 & 3 \end{bmatrix}$$

Correct values ✓  
brackets ✓

c)  $2D - C$

$$\begin{bmatrix} 0 \\ 9 \\ 17 \end{bmatrix}$$

d)  $BD$

$$\begin{bmatrix} 92 \\ 24 \end{bmatrix}$$

e)  $CE$

$$\begin{bmatrix} \text{not possible} \end{bmatrix} \quad \checkmark$$

$3 \times 1 \quad 3 \times 2 \quad \checkmark$

f)  $A^2$

$$3 \times 2 \quad 3 \times 2 \quad \checkmark$$

Not possible ✓

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Test 1

Student Name: Solutions

Date: \_\_\_\_\_

Special Instructions: **Calculator Allowed**, ,  
Formulae Sheet and 1 A4 page of notes allowed.

Time Allowed: 55 minutes

Marks: / 50

## Question 1.

(3 marks)

In shop A, the marked price of a dining table is \$840. The shop manager offers a 9.5% discount on cash sales.

In shop B, the same table is marked at \$870 and a 12% discount is offered. Which shop **offers a better deal**? **Show** sufficient working to support your claim.

Shop A

$$840 \times 0.905 = \$760.20 \checkmark$$

Shop B

$$870 \times 0.88 = \$765.60 \checkmark$$

Shop A is offering the better deal  $\checkmark$

## Question 2.

(2 marks)

Assuming that the annual rate of inflation remains steady at 2.9%, what would the value of an item be in three years' time if it costs \$90.00 now?

$$90 \times 1.029^3 = \$98.06 \checkmark$$

$\checkmark$

## Question 3.

(6 marks)

Complete the following table:

Cost of item	Selling Price	Profit / Loss?	What was the percentage profit or loss?
\$450	\$510	Profit	13.3% ✓
\$1200	\$1272 ✓	Profit	6%
\$1066.67 ✓	\$800	Loss	25%

Show any necessary working below:

$$\frac{510 - 450}{450} \times 100 =$$

$$1200 \times 1.06 =$$

$$\frac{800}{0.75} =$$

## Question 4.

(2, 1, 1, 2: 6 marks)

Tom's annual salary was \$82 000. This year he received a 5.5 % pay rise.

- i) a) How much more money did Tom receive from the pay rise?

$$82000 \times 0.055 = \$4510$$

- b) What was Tom's new annual salary after the pay rise?

$$82000 + 4510 = \$86510$$

- c) Determine Tom's new weekly salary after the pay rise?

$$\frac{86510}{52} = \$1663.65$$

- ii) Frank, Tom's brother, runs a hardware store. To sell a lawn mower that he has had in the store for 2 years he decides to sell it at a  $12\frac{1}{2}\%$  loss. Thomas sells the lawn mower for \$262.50. What was the original price for the mower?

$$\frac{262.50}{0.875} = \$300$$



## Question 5.

(1, 1, 3: 5 marks)

An electronics store increased the prices of all laptops by 8%. A laptop originally cost \$995.

- i) What was the new price of the laptop after the price increase?

$$995 \times 1.08 = \$1074.60 \quad \checkmark$$

During the end of year sales, all stock was now discounted by 10%.

- ii) What is the price of the laptop during the end of year sales?

$$1074.60 \times 0.9 = \$967.14$$

- iii) Calculate the overall **percentage change** in price from the original price.

$$\frac{995 - 967.14}{995} \times 100 = 2.8\% \quad \checkmark \quad \checkmark$$

(3, 4, 3: 10 marks)

## Question 6.

- a) Find the value of x and y if

$$\begin{bmatrix} 1 & -2 \\ 2x & 3 \end{bmatrix} + \begin{bmatrix} y & 7 \\ -5 & -1 \end{bmatrix} = \begin{bmatrix} 8 & 5 \\ 3 & 2 \end{bmatrix}$$

$$\begin{aligned} 2x - 5 &= 3 \\ 2x &= 8 \quad \checkmark \\ x &= 4 \quad \checkmark \end{aligned}$$

$$\begin{aligned} 1 + y &= 8 \\ y &= 7 \quad \checkmark \end{aligned}$$

- b) Find the values of a and b if  $P = \begin{bmatrix} a \\ 2 \\ -1 \end{bmatrix}$   $Q = \begin{bmatrix} -3 \\ 0 \\ 5 \end{bmatrix}$   $R = \begin{bmatrix} -2 \\ 2 \\ b \end{bmatrix}$  and  $P + 2Q = R$

$$\begin{aligned} a + (-6) &= -2 \quad \checkmark \\ a - 6 &= -2 \\ a &= 4 \quad \checkmark \end{aligned}$$

$$\begin{aligned} -1 + 2(5) &= b \quad \checkmark \\ -1 + 10 &= b \\ b &= 9 \quad \checkmark \end{aligned}$$

- c) Find the values of m and n if

$$\begin{bmatrix} 2 & m \\ n & 4 \end{bmatrix} \times \begin{bmatrix} 5 & -1 \\ 10 & 3 \end{bmatrix} = \begin{bmatrix} 40 & 7 \\ 45 & 11 \end{bmatrix}$$

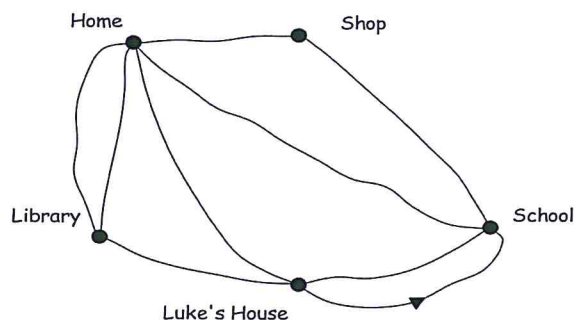
$$\begin{aligned} 2 \times 5 + 10m &= 40 \\ 10 + 10m &= 40 \quad \checkmark \\ 10m &= 30 \\ m &= 3 \quad \checkmark \end{aligned}$$

$$\begin{aligned} 5n + 40 &= 45 \\ n &= 1 \quad \checkmark \end{aligned}$$

Question 7.

(2, 1, 1, 1, 1, 3: 9 marks)

a) Construct a one stage route matrix **R** for the following network showing Ben's trip to school.



	H	L	S	LH	SC
H	0	2	1	1	1
L	2	0	0	1	0
S	1	0	0	0	1
LH	1	1	0	0	2
SC	1	0	1	1	0

0	2	1	1	1
2	0	0	1	0
1	0	0	0	1
1	1	0	0	2
1	0	1	1	0

✓✓

b) The two stage route matrix can be obtained by doing what to the original route matrix?

Squaring ✓

c) Give the two stage route matrix for Ben's trip to school.

7	1	1	3	3
1	5	2	2	4
1	2	2	2	1
4	2	3	4	1
2	3	1	1	4

✓

d) How many ways can Ben get to school if he makes one stop on the way?

3 ways ✓

e) How many ways can Ben get home from school if he makes one stop on the way?

1 way ✓

f) On the way home from school today Ben needs to make two stops.

i) What needs to be done to matrix **R** to show these paths?

Cubed ✓

ii) Show this matrix

9	17	10	11	14
18	4	5	10	7
9	4	2	4	7
12	12	5	7	15
12	5	6	9	5

✓

iii) How many ways can Ben get home if he stops at Luke's house and the library?

2 ways ✓

Question 8.

(2, 3, 2, 2: 9 marks)

Lucy has invented a new method for scoring points in the game of Tins. Each participant can score in any of four ways (M, S, T & G) and their scores are added to form a grand total.

There are as follows:

- 10 points for a match (M)
- 7 points for a set (S)
- 3 points for a touch (T)
- 1 point for each game (G).

The number of matches, sets, touches and games for 5 different players (P1, P2, P3, P4, P5) are provided in the matrix below.

	M	S	T	G
P1	2	10	5	20
P2	1	6	2	10
P3	2	10	4	20
P4	3	15	2	30
P5	0	3	1	15

- a) Write the **column matrix**, with rows representing in order M, S, T and G, that represents the points for each way of scoring.

$$\begin{bmatrix} 10 \\ 7 \\ 3 \\ 1 \end{bmatrix}$$

- b) Show the matrix calculation needed to multiply the column matrix (from part a) by the matrix provided for Question 8. Calculate this product.

$$\begin{bmatrix} 2 & 10 & 5 & 20 \\ 1 & 6 & 2 & 10 \\ 2 & 10 & 4 & 20 \\ 3 & 15 & 2 & 30 \\ 0 & 3 & 1 & 15 \end{bmatrix} \begin{bmatrix} 10 \\ 7 \\ 3 \\ 1 \end{bmatrix} = \begin{bmatrix} 125 \\ 68 \\ 122 \\ 171 \\ 39 \end{bmatrix}$$

- c) What is the total score for P1? Where in the matrix from part b) is this score located?

125 / row 1  
column 1

- d) Describe the data stored in the matrix generated in part b).

The total points for each player.



Question 9.

(1, 1, 1, 3: 6 marks)

Three friends went on a trip overseas and brought back some unspent foreign currency which they need to exchange back to Australian dollars (AUD).

They have made a table showing the amounts of each currency they each have.

	Bali (Indonesia)	Singapore	Hong Kong
Kate	190 000 IDR	200 SGD	500 HKD
Guy	175 000 IDR	350 SGD	250 HKD
Alex	85 000 IDR	75 SGD	100 HKD

The exchange rates when they convert their money are as follows:

10 000 IDR (Indonesian rupiah) = 0.9700 AUD

1 SGD (Singapore dollars) = 0.8666 AUD

1 HKD (Hong Kong dollars) = 0.1410 AUD

- a) How much in Australian dollars (to the nearest ten cents) will Kate get for her Indonesian rupiah (assuming she pays no commission fees)?

$$19 \times 0.97 = \$18.43 \quad \checkmark$$

- b) How much in Australian dollars (to the nearest ten cents) will Guy get for his Singapore dollars (assuming he pays no commission fees)?

$$350 \times 0.8666 = \$303.31 \quad \checkmark$$

- c) Using the same exchange rates as given in the table for Question 9, what is one Australian dollar worth (to the nearest cent) in Singapore dollars?

$$\frac{1}{0.8666} = 1.15 \text{ SGD} \quad \checkmark$$

- d) Write a matrix operation to calculate the amount of Australian currency that each person will receive when their foreign currencies (as shown in the table for Question 9) are converted.

$$\begin{bmatrix} 19 & 200 & 500 \\ 17.5 & 350 & 250 \\ 8.5 & 75 & 100 \end{bmatrix} \begin{bmatrix} 0.97 \\ 0.8666 \\ 0.141 \end{bmatrix}$$

$\uparrow$   $\checkmark$   $\checkmark$   $\checkmark$