



NE 112 *Linear algebra for nanotechnology engineering*

1.1 Multiplication tables

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Introduction

- In this topic, we will
 - Review the multiplication tables
 - Understand the need
 - Make some observations that may make it less boring





Multiplication tables

- A student once complained that the midterm was too difficult:
 - I pointed out the question required you to calculate 0.7×0.5
 - I asked “what is seven times five?”
 - The response:
“Seven is three plus four,
three times five is fifteen,
four times five is twenty,
so seven times five is fifteen plus twenty or thirty five.”
- Great answer for grade six...





Multiplication tables

- Why learn them now?
 - We will be working with systems of linear equations
 - You will see examples where you must calculate

$$\frac{5.6}{0.8} \quad - \frac{4.2}{0.7} \quad - \frac{6.3}{0.9}$$

- As we work through examples, you have the choice to:
 - Passively watch the example
 - Actively follow along and anticipate future steps
- Similarly, while doing homework, you can either:
 - Spend inordinate amounts of time using your calculator
 - Focus on the concepts being demonstrated, not the arithmetic





Multiplication tables

- Thus, take some time to memorize this:

×	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9
2	2	4	6	8	10	12	14	16	18
3	3	6	9	12	15	18	21	24	27
4	4	8	12	16	20	24	28	32	36
5	5	10	15	20	25	30	35	40	45
6	6	12	18	24	30	36	42	48	54
7	7	14	21	28	35	42	49	56	63
8	8	16	24	32	40	48	56	64	72
9	9	18	27	36	45	54	63	72	81

– Don't worry about 11- and 12-times tables...





Some observations

- Now, here are a few interesting observations:

$2 \times 2 = 4$	$1 \times 3 = 3 = 4 - 1$	$0 \times 4 = 0 = 4 - 4$
$3 \times 3 = 9$	$2 \times 4 = 8 = 9 - 1$	$1 \times 5 = 5 = 9 - 4$
$4 \times 4 = 16$	$3 \times 5 = 15 = 16 - 1$	$2 \times 6 = 12 = 16 - 4$
$5 \times 5 = 25$	$4 \times 6 = 24 = 25 - 1$	$3 \times 7 = 21 = 25 - 4$
$6 \times 6 = 36$	$5 \times 7 = 35 = 36 - 1$	$4 \times 8 = 32 = 36 - 4$
$7 \times 7 = 49$	$6 \times 8 = 48 = 49 - 1$	$5 \times 9 = 45 = 49 - 4$
$8 \times 8 = 64$	$7 \times 9 = 63 = 64 - 1$	$6 \times 10 = 60 = 64 - 4$
$9 \times 9 = 81$	$8 \times 10 = 80 = 81 - 1$	$7 \times 11 = 77 = 81 - 4$

- Do you see a pattern?





Some observations

- How about now?

$$\begin{aligned}7 \times 7 &= 49 \\6 \times 8 &= 48 = 49 - 1 \\5 \times 9 &= 45 = 49 - 4 \\4 \times 10 &= 40 = 49 - 9 \\3 \times 11 &= 33 = 49 - 16 \\2 \times 12 &= 24 = 49 - 25 \\1 \times 13 &= 13 = 49 - 36 \\0 \times 14 &= 0 = 49 - 49 \\-1 \times 15 &= -15 = 49 - 64\end{aligned}$$

$$\begin{aligned}8 \times 8 &= 64 \\7 \times 9 &= 63 = 64 - 1 \\6 \times 10 &= 60 = 64 - 4 \\5 \times 11 &= 55 = 64 - 9 \\4 \times 12 &= 48 = 64 - 16 \\3 \times 13 &= 39 = 64 - 25 \\2 \times 14 &= 28 = 64 - 36 \\1 \times 15 &= 15 = 64 - 49 \\0 \times 16 &= 0 = 64 - 64 \\-1 \times 17 &= -17 = 64 - 81\end{aligned}$$





Pattern matching

- Pause this video, and take a few seconds find the pattern
 - All we need note is:

$$(n + 1)(n - 1) = n^2 - 1$$

$$(n + 2)(n - 2) = n^2 - 4$$

- In general:

$$(n + k)(n - k) = n^2 - k^2$$





Summary

- In this topic, I've tried to stress the need to memorize the multiplication tables
 - It will allow you to focus on the mathematics and concepts
 - You won't need to concentrate on the arithmetic





References

- [1] https://en.wikipedia.org/wiki/Multiplication_table





Acknowledgments

None so far.





Colophon

These slides were prepared using the Cambria typeface. Mathematical equations use Times New Roman, and source code is presented using Consolas.

The photographs of flowers and a monarch butter appearing on the title slide and accenting the top of each other slide were taken at the Royal Botanical Gardens in October of 2017 by Douglas Wilhelm Harder. Please see

<https://www.rbg.ca/>

for more information.





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