Vector Math Challenge

Module 1 – C01

# Prelude to the Challenge

Before starting this challenge, take 10 minutes and watch [this video on Vectors in physics, math, and computer science](https://www.youtube.com/watch?v=fNk_zzaMoSs).

# Show Your Work

For each question, be sure to show all your work and provide a diagram visually demonstrating the work on a Cartesian grid. The diagrams can be hand-drawn or made using tools like [Epic Pen](https://epic-pen.com) and/or [GeoGebra](https://www.geogebra.org/).

# Example of Showing Work

[Here’s an example video demonstrating how you might show your work for a vector addition problem](https://youtu.be/F3ZuwqRkgZs). You do not need to make a video of your work. You can use [the same GeoGebra Workbook shown in the video](https://www.geogebra.org/m/Adc44ZZq), or use [the newer graphing workbook](https://www.geogebra.org/calculator). If you use the newer graphing workbook, you can use the “Tools” menu on the left to switch the pointer between “Move” (click and drag the grid to move around) and “Vector” (draw vectors on the grid).

# Challenge Questions

## Part 1 – Vector Addition and Subtractions

1. Provide two examples of performing vector addition by hand.

A graph of a line with points and dots

Description automatically generated

U + V = W

(1, 2) + (1, 0) = (2, 2)

A graph of a triangle with lines and dots

Description automatically generated

U + V = W

(-2, 2) + (3, 0) = (1, 2)

1. Provide two examples of performing vector subtraction by hand.

A graph of a triangle with lines and dots

Description automatically generated

U – V = W

(2, 1) – (1, 3) = (1, -2)

A graph of a line with points and a point on it

Description automatically generated with medium confidence

U – V = W

(3, 1) – (4, 4) = (3, 1) + (-4, -4) = (1, -3)

## Part 2 – Vector Multiplication and Magnitude

1. Provide two examples of performing vector multiplication by hand.

A graph of a line with a point

Description automatically generated

U \* 2 = UV

(1, 2)\*2 = (2, 4)

A graph of a line with dots and numbers

Description automatically generated  
U \* 3 =UVW

(3, 2) \* 3 = (9, 6)

1. Provide two examples of calculating a vector’s magnitude using the Pythagorean Theorem.

A graph of a triangle with points and lines

Description automatically generated

U^2 + V^2 = F^2

Sqrt(U^2 + V^2) = sqrt(F^2)

Sqrt(4^2 + 2^2) = 4.472

A graph of a triangle with points and numbers

Description automatically generated

V^2 + U^2 = F^2

Sqrt(5^2 + 4^2) = 5.744

## Part 3 – Vector Normalization and Dot Product

1. Provide two examples of performing vector normalization by hand.

A graph of a line with numbers and letters

Description automatically generated

F^2 + G^2 = sqrt(U^2) (magnitude)

(2, 0)^2 + (2, 6)^2 = sqrt(U^2)

Normalized = B(6/magnitude, 2/magnitude)

A graph of a line with a point

Description automatically generated

F^2 + G^2 = sqrt(U^2) (magnitude)

(8, 0)^2 + (8, 2)^2 = sqrt(U^2)

Normalized = B(2/magnitude, 8/magnitude)

1. Provide two examples of calculating the dot product of two vectors by hand.

A = (8, 2)  
B = (8, 0)

AB = 8 \* 8 + 2 \* 0

AB = 64

A = (7, -1)

B = (3, 4)

AB = 7\*3+4\*-1

AB = 17

# Marking Rubric

Each of this challenge’s three parts will be assigned a mark out of 1, for a total of 3 marks.

You will get full marks on each part if you’ve shown that you’ve made a valiant effort to complete the requested work and explained your any failures you encountered.

For each part:

* 1 out of 1 means you made a valiant effort to complete the requested work. (Even wrong answers will receive a 1 if it looks like you’ve put in sufficient effort to solve the problem!)
* 0 out of 1 means you either did not submit the requested work or the amount of work you submitted was minimal.