

## Exercises for Chapter 0

### 0.1.1

Given points  $A = (m, n)$  and  $B = (s, t)$ , and the vectors  $\vec{a} = [m, n]$  and  $\vec{b} = [s, t]$ . Show that the midpoint of the line segment  $AB$  is given by the expression

$$(0, 0) + \frac{1}{2}(\vec{u} + \vec{v})$$

### 0.1.2

Given  $\vec{v} = [ca, cb]$ . Show that

$$|\vec{v}| = c\sqrt{a^2 + b^2}$$

### 0.1.3

- a) Given a vector  $\vec{v}$ . Show that the length of the vector  $\frac{\vec{v}}{|\vec{v}|}$  is 1.
- b) Determine the expression for the vector that is parallel to the vector  $[3, 4]$ , and has a length of 10.

### 0.1.4

Determine the length of each of the vectors.

$$\vec{a} = [3, 4]$$

$$\vec{b} = [-1, 7]$$

$$\vec{c} = [-8, 6]$$

$$\vec{d} = [4, -3]$$

### 0.1.5

Check if any of the vectors from [Exercise 0.1.4](#) are perpendicular to each other.

### 0.1.6

Check if any of the vectors from [Exercise 0.1.4](#) are parallel.

### 0.1.7 (R1V22D1)

For the vectors  $\vec{a}$  and  $\vec{b}$ ,  $|\vec{a}| = 2$ ,  $|\vec{b}| = 3$  and  $\vec{a} \cdot \vec{b} = -3$ .

We let  $\vec{u} = \vec{a} + \vec{b}$  and  $\vec{v} = \vec{a} - 6\vec{b}$ .

- Determine the length of  $\vec{u}$  and  $\vec{v}$ .
- Determine the angle between  $\vec{u}$  and  $\vec{v}$ .

### 0.1.8

Given  $\vec{u} = [a, b]$  and  $\vec{v} = [c, d]$  Show that if  $\angle(\vec{u}, \vec{v}) = 0^\circ$ , (??) gives that

$$ad - bc = 0$$

### 0.1.9 (R1V23D1)

Given three points  $A = (1, 3)$ ,  $B = (4, 0)$ , and  $C = (9, 4)$ .

- Use vector calculations to determine if  $\angle CBA$  is less than, equal to, or greater than  $90^\circ$ .

A point  $P$  lies on the line that goes through  $B$  and  $C$ .

- Use vector calculations to determine the coordinates of the point  $P$  so that  $AB \perp AP$ .

### 0.1.10 (R1H23D1)

In the triangle  $\triangle ABC$ ,  $A = (-3, -1)$ ,  $B = (2, -2)$ , and  $C = (5, 2)$ .

- Determine using vector calculations which side of the triangle is the shortest.
- Determine using vector calculations if any of the angles in the triangle are  $90^\circ$ .