Physics of Engineer
Chapter 1: Motion

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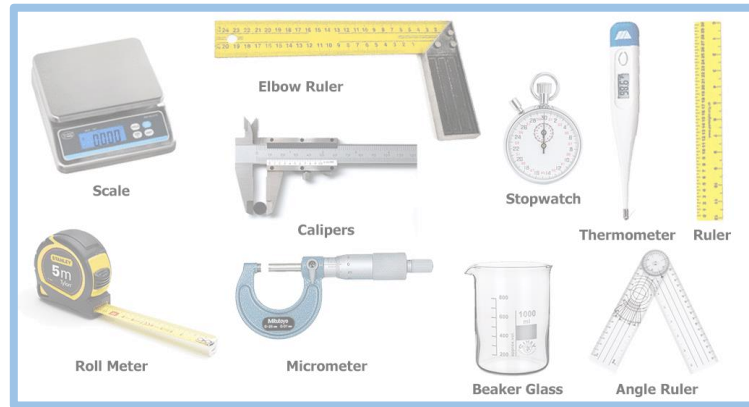
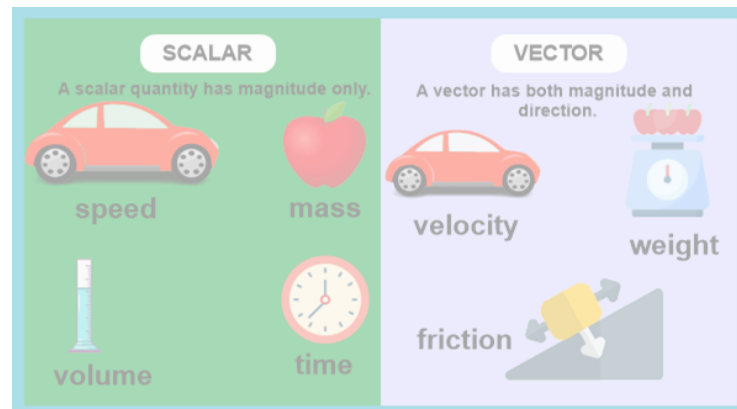Nakhon Pathom Rajabhat University

Topic 1.1: Scalar and Vector Quantities
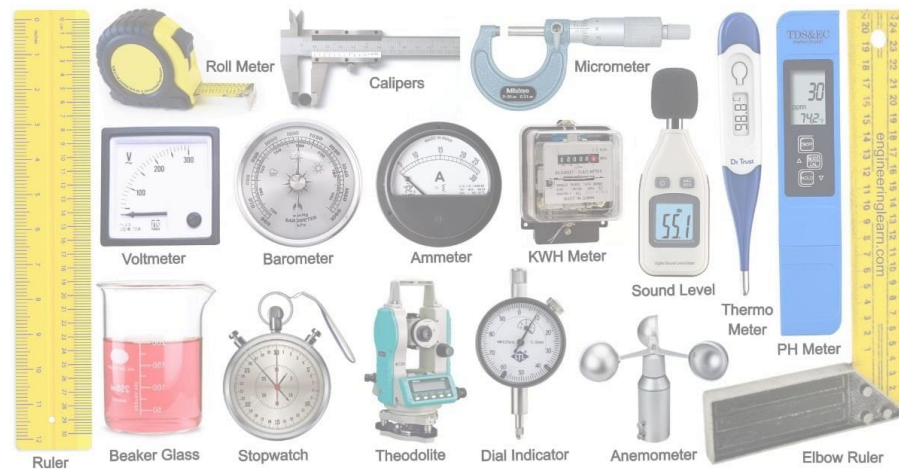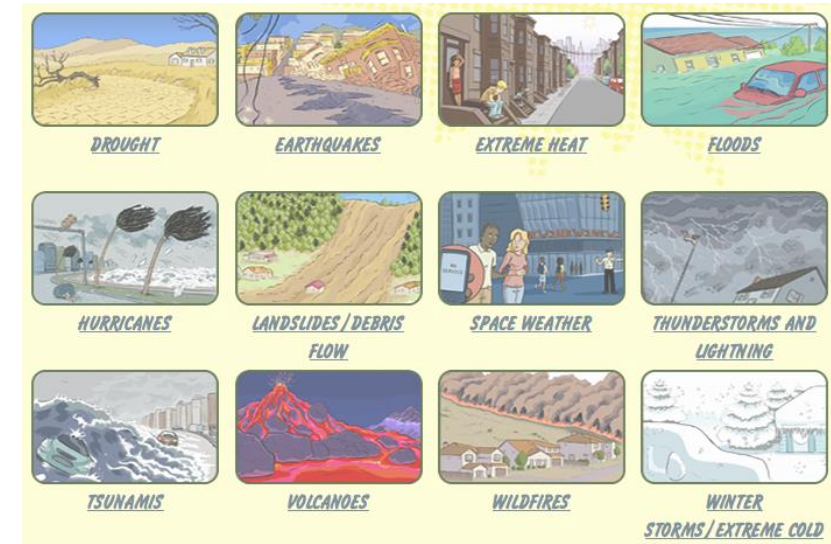
- Physics and Basic Measurement

- Scalar and Vector Quantities

Physics and Basic Measurment

Physics is one of nature science. The focusing of physics are based on natural phenomena.

Basic measurement is the first step to be the good scientist. Basic measurement instrument need good basic to make good results.

Physics and Basic Measurment

The basic and simple of measurement start from the eyes decision. The eyes level is the first basic to start to the advance step.
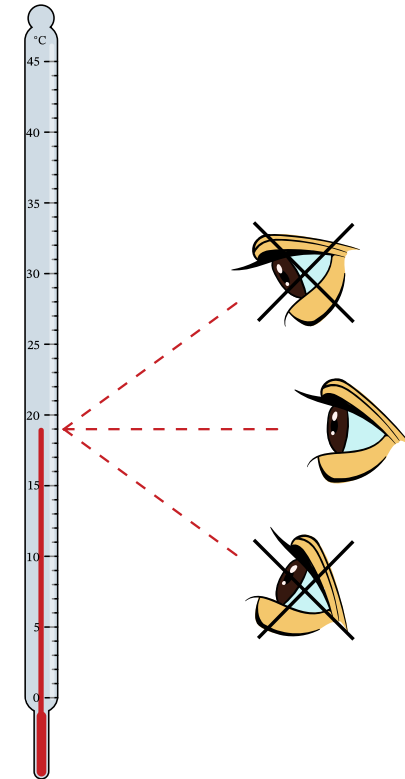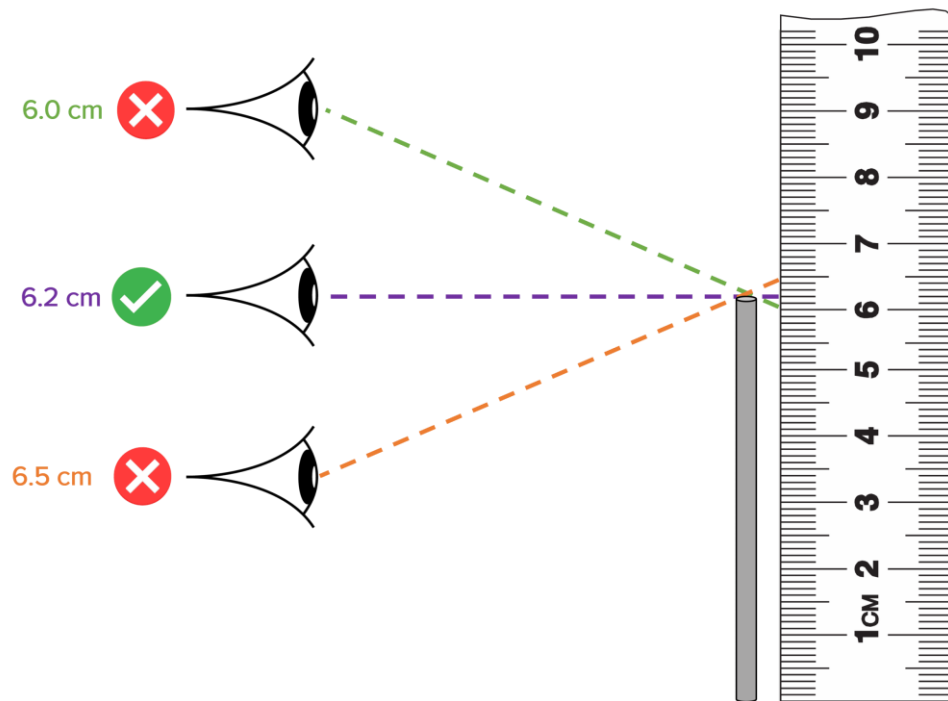
How fast is this F1 racing car moving ??
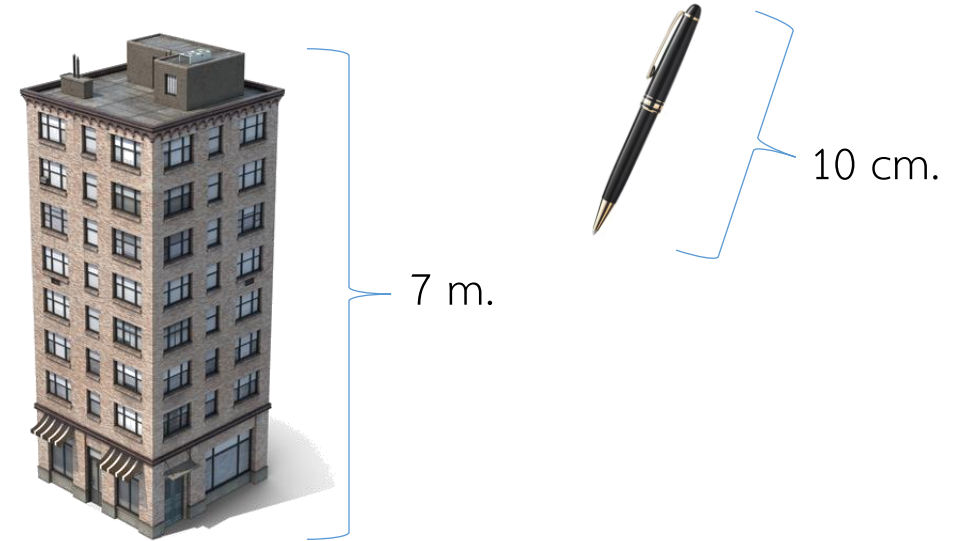
Scalar and Vector Quantities

A measurable attribute is referred to as a physical quantity.

An illustration of a physical quantity is length, which can be gauged using tools like a meter rule.

These quantities possess both a numerical magnitude and a specific unit of measurement.

For example, the length of a pen is 10 cm or the height of a building is 7 m.

7 m.

10 cm.

Scalar and Vector Quantities

Physics quantities

Scalar quantity

- Magnitude

Vector quantity

- Magnitude
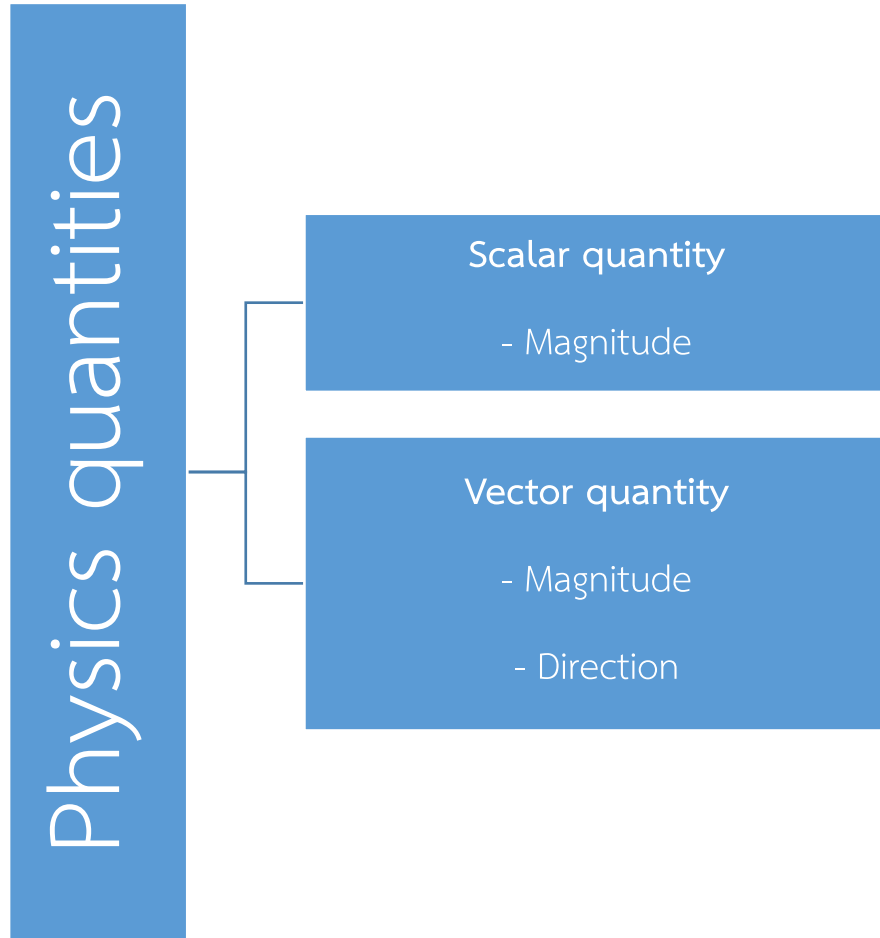
- Direction

Physical quantities encountered in science can be categorized as either scalar or vector quantities.

Scalar quantities possess only magnitude, whereas vector quantities possess both magnitude and direction.

Scalar and Vector Quantities

There's a bakery selling tasty pastries just 500 m away from the bus station. Let's go later.

What a hot day! I bet the temperature in the room is 30°C.

For temperature, just knowing the magnitude is enough, but for the location or displacement of the bakery from the bus station, we need to know the magnitude and the direction. That is because temperature is a scalar quantity while displacement is a vector quantity.
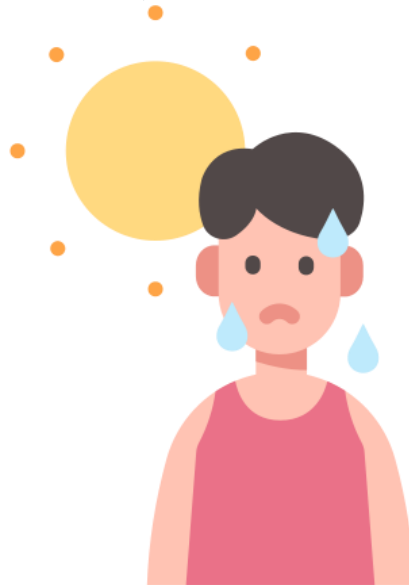
Scalar and Vector Quantities

Physical Quantity	
Scalar	Vector
Area	Acceleration
Density	Displacement
Energy	Force
Lenght	Momentum
Mass	Velocity

A list of some scalar and vector quantities.

Scalar and Vector Quantities

Physical Quantity	
Scalar	**Vector**
Speed	Torque
Temperature	Weight
Time	Magnetic field
Volume	Electric field

A list of some scalar and vector quantities.

Example 1

Study the description of events listed below. Decide which events specify magnitude, direction or both and tick (/) the respective columns.

Description of Event	Magnitude	Direction
The cup can hold 200 cm3 of beverage.		
Cat town is located 10 km east-west of Dog Town.		
The speed train is moving north at 600 km h-1.		
Robert heats some soup from 23°C to 100°C.		

Example 1: Solution

Study the description of events listed below. Decide which events specify magnitude, direction or both and tick (/) the respective columns.

Description of Event	Magnitude	Direction
The cup can hold 200 cm3 of beverage.	✓ .	
Cat town is located 10 km east-west of Dog Town.	✓ .	✓ .
The speed train is moving north at 600 km h-1.	✓ .	✓ .
Robert heats some soup from 23°C to 100°C.	✓ .	

Example 2

Consider the quantities listed below. Categorize each quantity as either a scalar or a vector.

Quantity	Scalar/Vector
32 m S^{-1}, West	
100 cm^3	
120 kg	
200 m, South	
5 km	
36°F	

Example 2 : Solution

Consider the quantities listed below. Categorize each quantity as either a scalar or a vector.

Quantity	Scalar/Vector
32 m S^{-1}, West	Vector
100 cm^3	Scalar
120 kg	Scalar
200 m, South	Vector
5 km	Scalar
36°F	Scalar

Scalar and Vector Quantities

A scaled vector diagram can be used to represent a vector quantity. We can use an arrow with a tail and a head. The length of the arrow is proportional to the magnitude of the quantity and the direction of the arrow is the direction of the quantity.
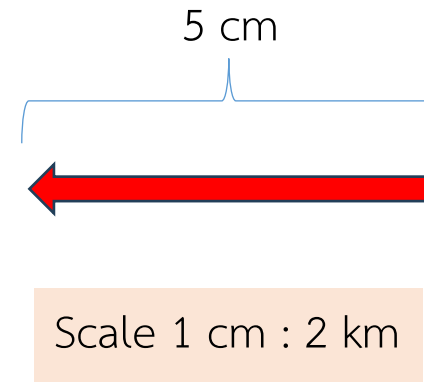
Magnitude

Head

Tail
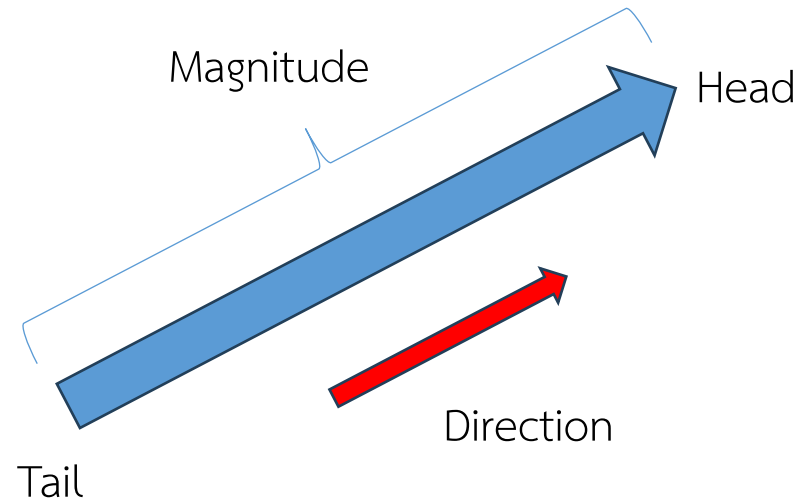
Direction

We can use right and left or the four cardinal directions (North, East, South and West) for the direction.

Example 3

Determine the magnitude and direction of this vector.

5 cm

Scale 1 cm : 2 km

Example 3: Solution

Determine the magnitude and direction of this vector.

5 cm

Scale 1 cm : 2 km

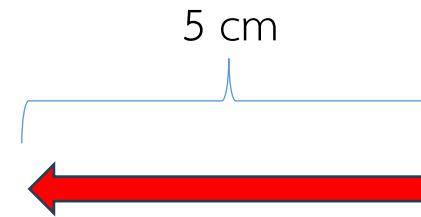**Solution**

The length of the arrow is 5 cm.

5x2 = 10 km

The arrow is pointing to the left.

Therefore, the magnitude of the vector is 10 km and its direction is to the left.

Example 4

Draw a scaled vector diagram to represent a quantity that has a magnitude of 50 m s-1 heading South using a scale of 1 cm: 10 m s^{-1}

Example 4: Solution
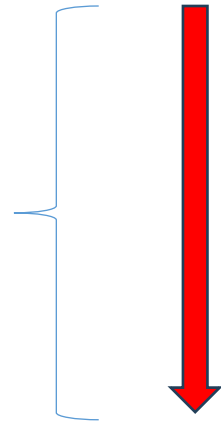
Draw a scaled vector diagram to represent a quantity that has a magnitude of 50 m s-1 heading South using a scale of 1 cm: 10 m s^{-1}

Solution

The length of the arrow = 50 ÷ 10

= 5 cm

N

5 cm

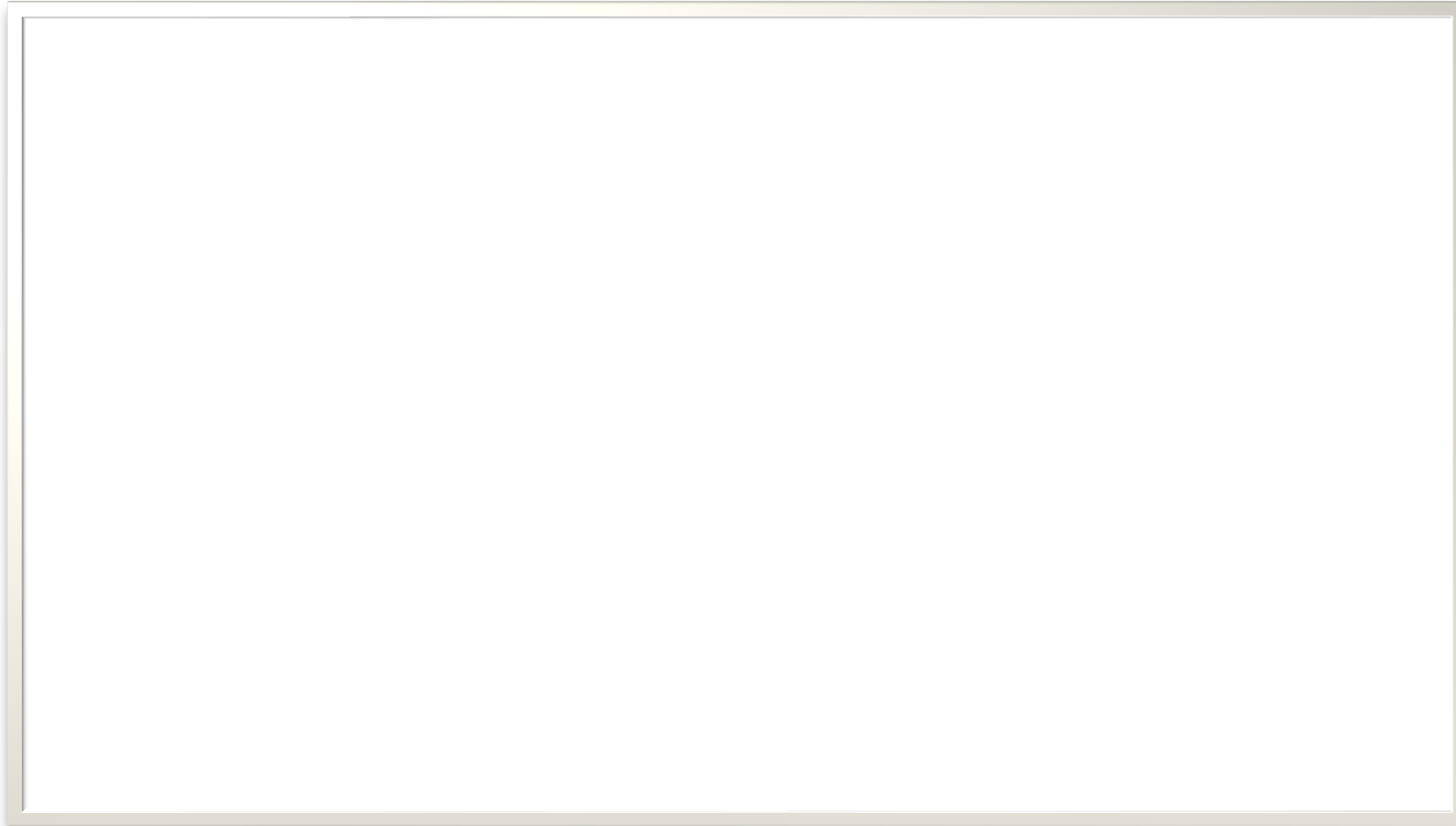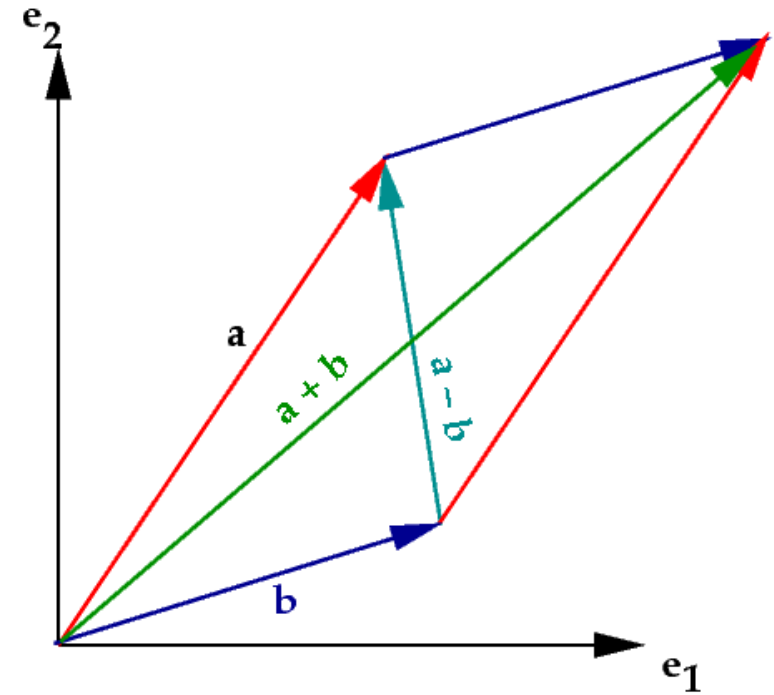# Scalar and Vector Quantities

Scalar and Vector Quantities

Operations on vectors refer to manipulations specifically carried out on vector quantities, which exhibit both magnitude and direction. Applying standard mathematical rules directly to these vector quantities is not viable. Instead, various specialized vector operations are employed to handle these quantities include,

- Addition of Two Vectors
- Subtraction of Two Vectors
- Multiplication of Vector with Scalar

Scalar and Vector Quantities

Addition of Two Vectors

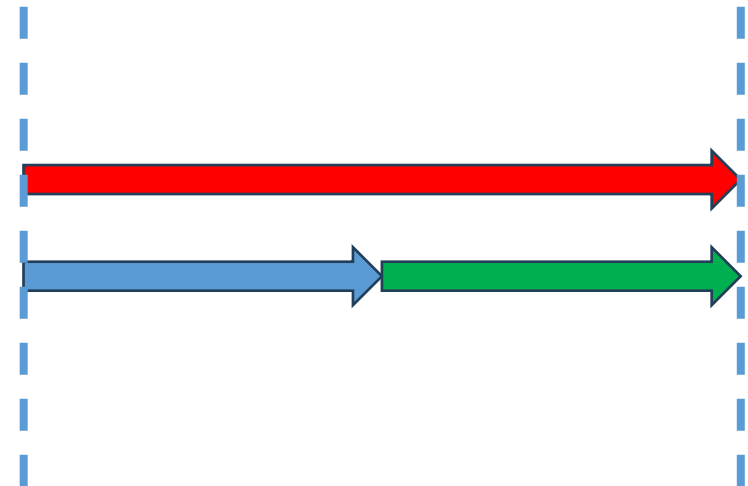The basic of vector adding is focus on head and tail of vector.

    A. First, draw the vector(blue) with magnitude and direction.

    B. Second, place the adding vector(green) with connecting the tail of it to head of the first vector.

    C. Third, the resultance of vector(red) is the line that start from the tail of first vector to the head of second one.

Scalar and Vector Quantities

Subtraction of Two Vectors

The basic of vector subtracting is focus on head and tail of vector.

    A. First, draw the vector(blue) with magnitude and direction.

    B. Second, reverse the direction into the opposite site then place the subtracting vector(green) with connecting the tail of it to head of the first vector.

    C. Third, the resultance of vector(red) is the line that start from the tail of first vector to the head of second one.
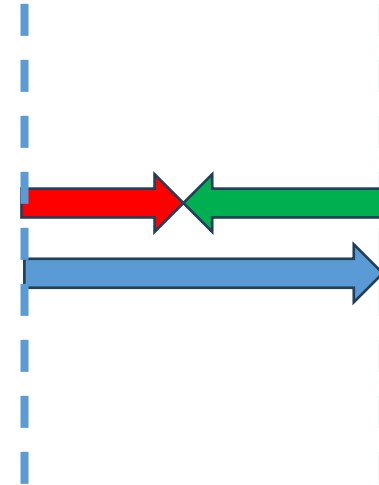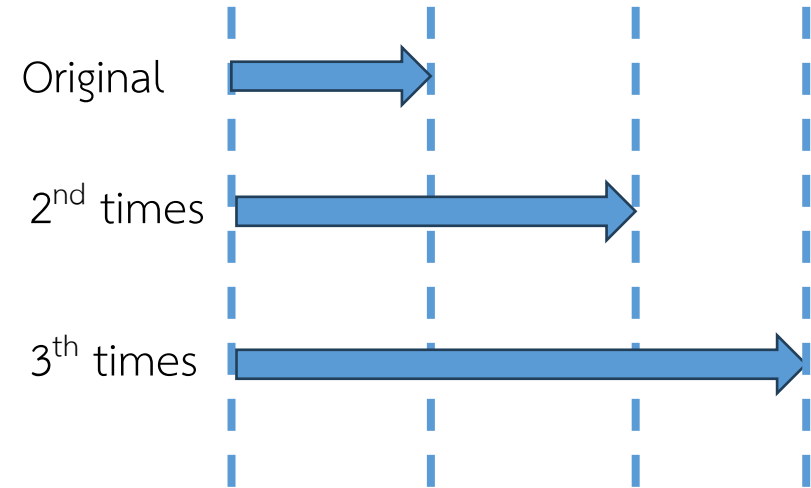
Scalar and Vector Quantities

Multiplication Vector with Scalar

The basic of multiplication vector with scalar is duplicate it into number of time that the scalar multiplication.

   A. First, draw the vector(blue) with magnitude and direction.

   B. Second, duplicate the magnitude of original vector with number of time that the scalar multiplication and same the original direction.

Original

2nd times

3th times

Scalar and Vector Quantities

Conclusions

✓ Physical quantities are the characteristics or properties of an object that can be measured or calculated from other measurements such as mass, length, area and volume.

✓ There are 2 types of physical quantities:
- Scalar quantity has magnitude only such as distance and speed.
- Vector quantity has both magnitude and direction such as displacement and velocity.

✓ A vector quantity can be represented with an arrow. The length of the arrow indicates the magnitude and the direction of the arrow indicates the direction of the vector.