Scalar and vector quantities

❑ **Scalars are quantities** that have magnitude/size only. Examples of scalars are

- Mass
- Temperature
- Distance
- Speed
- Work
- Time

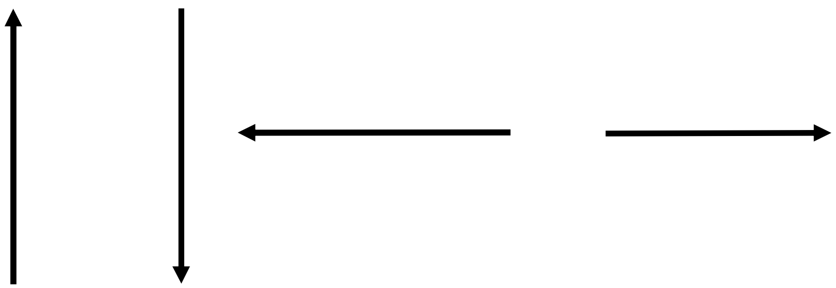
❑ **Vectors are quantities** that have magnitude and direction. Examples of vectors are

- Force
- Velocity
- Acceleration
- Displacement

Vectors can be changed by either changing its magnitude or its direction. There are numerous ways of representing a vector which includes $\overline{F}$, $\underline{F}$ and $\boldsymbol{F}$ (boldface). In these notes we have adopted boldface symbol.

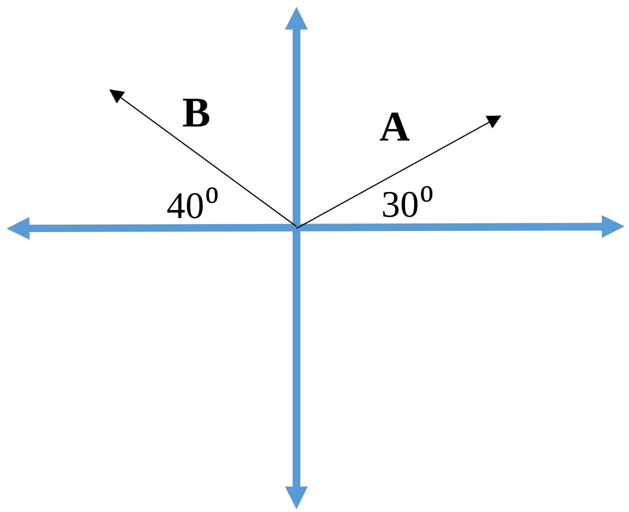
Define the direction of vectors

Up, down, left, right

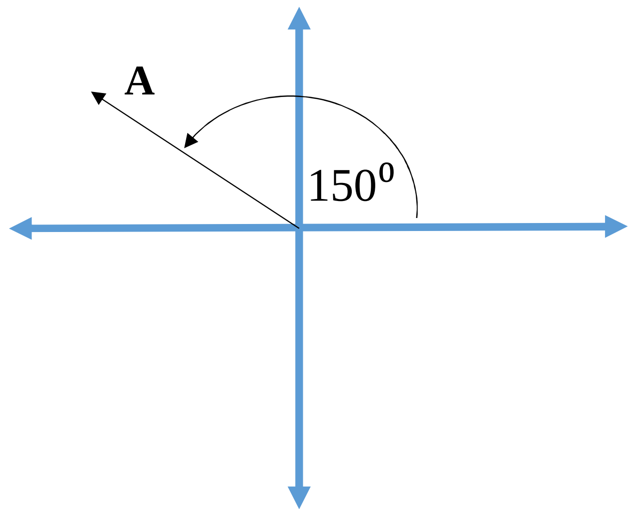


Angles on a Cartesian plane

Vector **A** in at an angle 30^0 with the positive x-axis, vector **B** is at 40^0 with the negative x-axis

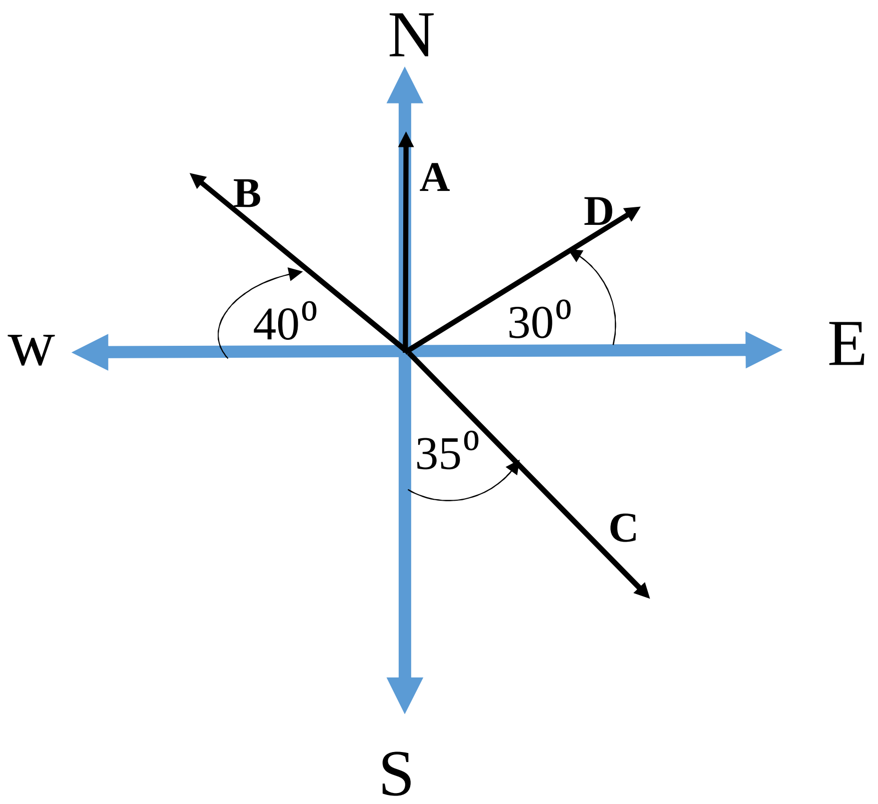


Vector **A** in at an angle 150^0



Define direction cont.

Using geographic coordinates



- Vector **A** points North
- Vector **B** points 40^0 North of West
- Vector **C** points 35^0 East of South
- Victor **D** points 30^0 North of East

Addition of Scalars

Scalars are added by considering their algebraic/arithmetic sum.

Example

5 kg + 10 kg + 2 kg = 17 kg

3 s + 4 s + 7 s = 14 s

Addition of Vectors

Due to the fact that vectors have magnitude and direction, **sum** of vectors or the **resultant** vector is not just an algebraic sum. There are three methods of adding vectors:

1. Addition of vectors by construction
2. Addition of vectors by components
3. Addition of vectors using parallelogram

Addition of vectors by construction

In this method, a length of a vector is proportional to a size of a vector while the direction is indicated by an arrow. The ratio can be used to represent the magnitude of the vector. For example, in representing a force using length in cm, a ratio 10:1 may indicate that 10 N is represented by 1 cm. The direction of the vector may be measured using a protractor. This method is however not accurate.

Method (Tail-to-head)

1. Draw the **first** vector,
2. The **next** vector should be drawn such that its tail is on the **head** of the **previous** vector,
3. Then the **resultant** vector is drawn such that its **tail** is on the **tail** of the **first** vector and its **head** is on the **head** of the **last** vector.

Illustration to be done in class

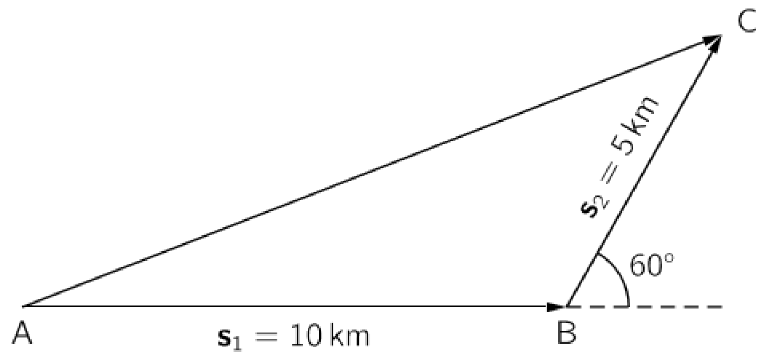
Example 1.6

Suppose a car travels from point A in an easterly direction for 10 km to point B, and then travels another 5 km in a direction 60^0 north of east to point C. Determine the total (i) **distance** travelled and the (ii) **displacement** of the car.

Solution:

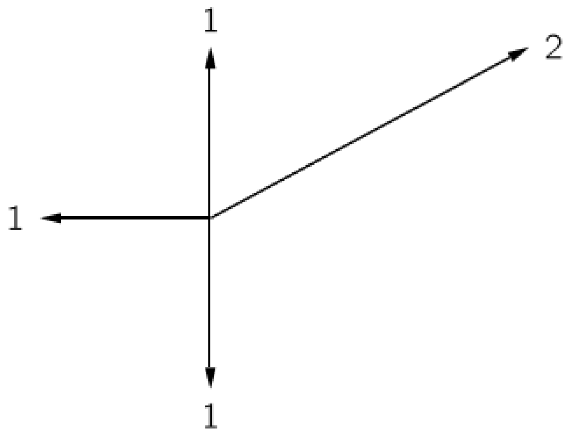
(i) The distance is a scalar, thus the total distance is an algebraic sum of the distances from A to B and from B to C, i.e. 10 km + 5 km = 15 km.

(ii) The displacement may be obtained using construction

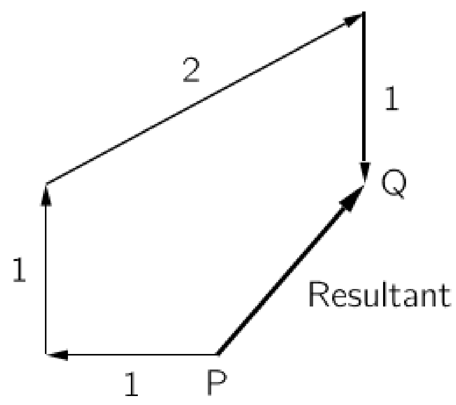


The resultant AC=13.3 km and the direction is 19.1^0 N of E

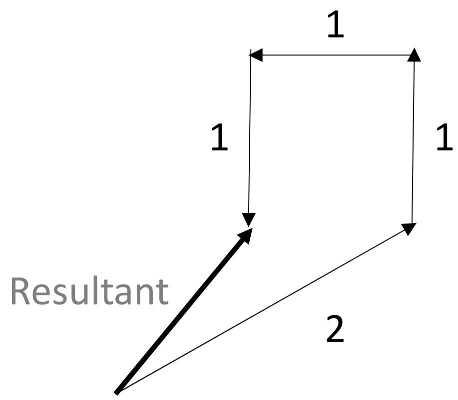
Addition of vectors by construction cont.



(a)



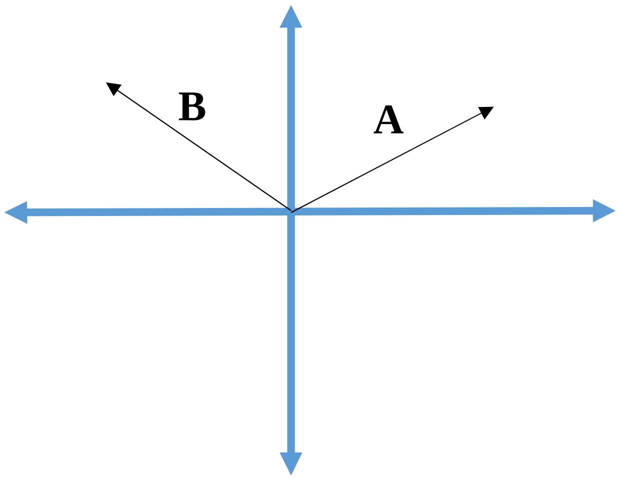
(b)

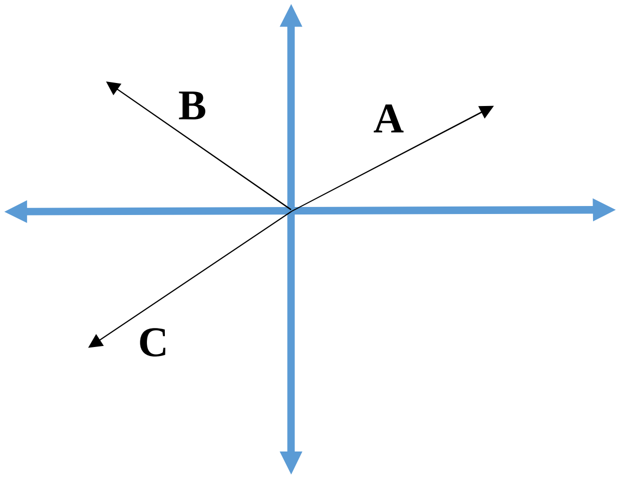


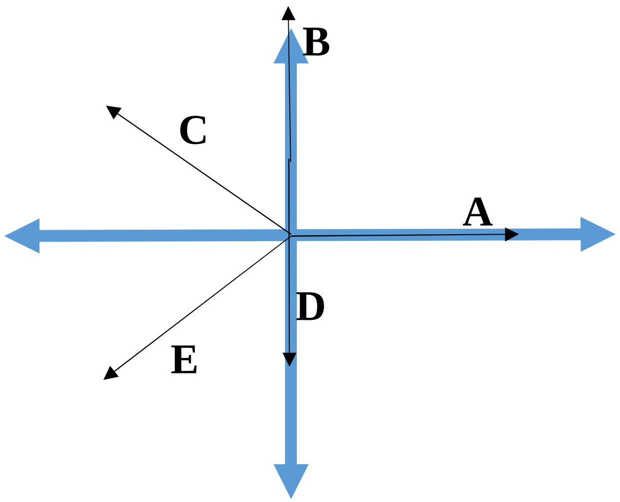
(c)

Homework - Addition of vectors by construction cont.

Draw sketches using the tail-to-head method to find the resultant of these vectors.







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