## Assignment 1

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1) In the following figure for the triangle ABC, which of the following is not true:

(A) 
$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \overrightarrow{0}$$

(B) 
$$\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{AC} = \overrightarrow{0}$$

(A) 
$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \overrightarrow{0}$$
  
(B)  $\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{AC} = \overrightarrow{0}$   
(C)  $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{AC} = \overrightarrow{0}$   
(D)  $\overrightarrow{AB} - \overrightarrow{CB} + \overrightarrow{CA} = \overrightarrow{0}$ 

(D) 
$$\overrightarrow{AB} - \overrightarrow{CB} + \overrightarrow{CA} = \overrightarrow{0}$$

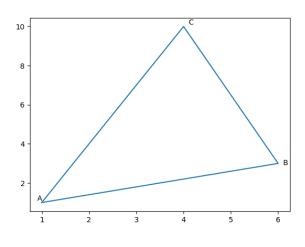


Fig. 1

**Solution:** We know that,

$$\overrightarrow{AB} = \mathbf{B} - \mathbf{A} \tag{0.0.1}$$

$$\overrightarrow{BC} = \mathbf{C} - \mathbf{B} \tag{0.0.2}$$

$$\overrightarrow{CA} = \mathbf{A} - \mathbf{C} \tag{0.0.3}$$

By usinig this we verify each of the given option

a)

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \mathbf{B} - \mathbf{A} + \mathbf{C} - \mathbf{B} + \mathbf{A} - \mathbf{C}$$

$$(0.0.4)$$

$$= 0$$

$$(0.0.5)$$

Option A is correct.

b)
$$\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{AC} = \mathbf{B} - \mathbf{A} + \mathbf{C} - \mathbf{B} - (\mathbf{C} - \mathbf{A})$$

$$(0.0.6)$$

$$= 0 \qquad (0.0.7)$$

Option B is correct.

c)
$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{AC} = \mathbf{B} - \mathbf{A} + \mathbf{C} - \mathbf{B} + \mathbf{C} - \mathbf{A}$$

$$(0.0.8)$$

$$= 2(\mathbf{C} - \mathbf{A})$$

$$(0.0.9)$$

Option C is incorrect.

d) 
$$\overrightarrow{AB} - \overrightarrow{CB} + \overrightarrow{CA} = \mathbf{B} - \mathbf{A} - (\mathbf{B} - \mathbf{C}) + \mathbf{A} - \mathbf{C}$$
 (0.0.10) 
$$= 0$$
 (0.0.11)

Option D is correct.

The options A, B, D are correct and the option C is incorrect.

Verification: Let us take an example to verify

$$\mathbf{A} = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \tag{0.0.12}$$

$$\mathbf{B} = \begin{pmatrix} 3 \\ 1 \end{pmatrix} \tag{0.0.13}$$

$$\mathbf{c} = \begin{pmatrix} 6 \\ 6 \end{pmatrix} \tag{0.0.14}$$

$$\overrightarrow{AB} = \mathbf{B} - \mathbf{A} = \begin{pmatrix} 2 \\ 0 \end{pmatrix} \tag{0.0.15}$$

$$\overrightarrow{BC} = \mathbf{C} - \mathbf{B} = \begin{pmatrix} 3 \\ 5 \end{pmatrix} \tag{0.0.16}$$

$$\overrightarrow{CA} = \mathbf{A} - \mathbf{C} = \begin{pmatrix} -5 \\ -5 \end{pmatrix} \tag{0.0.17}$$

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \begin{pmatrix} 2+3+(-5) \\ 0+5+(-5) \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$$
 (0.0.18)

Similarly other options can be verified.