Assignment 1

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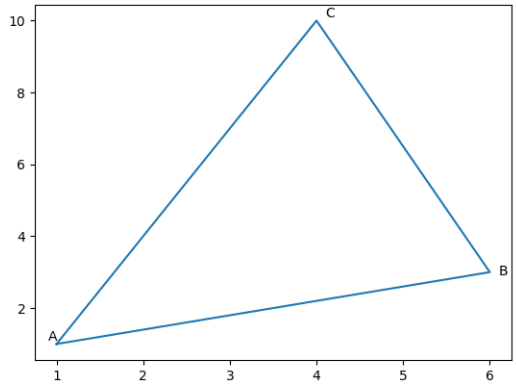
1) In the following figure for the triangle ABC, which of the following is not true:
(A) $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \overrightarrow{0}$
(B) $\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{AC} = \overrightarrow{0}$
(C) $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{AC} = \overrightarrow{0}$
(D) $\overrightarrow{AB} - \overrightarrow{CB} + \overrightarrow{CA} = \overrightarrow{0}$



Solution: We know that,

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

By usinig this we verify each of the given option

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

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \mathbf{B} - \mathbf{A} + \mathbf{C} - \mathbf{B} + \mathbf{A} - \mathbf{C} \tag{0.0.2}$$

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = 0 \tag{0.0.3}$$

Option A is correct.

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

$$\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{AC} = \mathbf{B} - \mathbf{A} + \mathbf{C} - \mathbf{B} - (\mathbf{C} - \mathbf{A}) \tag{0.0.4}$$

$$\overrightarrow{AB} + \overrightarrow{BC} - \overrightarrow{AC} = 0 \tag{0.0.5}$$

Option B is correct.

c) $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{AC} = \overrightarrow{0}$

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{AC} = \mathbf{B} - \mathbf{A} + \mathbf{C} - \mathbf{B} + \mathbf{C} - \mathbf{A} \tag{0.0.6}$$

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{AC} = 2(\mathbf{C} - \mathbf{A}) \tag{0.0.7}$$

Option C is incorrect.

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

$$\overrightarrow{AB} - \overrightarrow{CB} + \overrightarrow{CA} = \mathbf{B} - \mathbf{A} - (\mathbf{B} - \mathbf{C}) + \mathbf{A} - \mathbf{C} \tag{0.0.8}$$

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = 0 \tag{0.0.9}$$

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

$$\mathbf{A} = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \tag{0.0.10}$$

$$\mathbf{B} = \begin{pmatrix} 3 \\ 1 \end{pmatrix} \tag{0.0.11}$$

$$\mathbf{c} = \begin{pmatrix} 6 \\ 6 \end{pmatrix} \tag{0.0.12}$$

$$\overrightarrow{AB} = \mathbf{B} - \mathbf{A} = \begin{pmatrix} 2 \\ 0 \end{pmatrix} \tag{0.0.13}$$

$$\overrightarrow{BC} = \mathbf{C} - \mathbf{B} = \begin{pmatrix} 3 \\ 5 \end{pmatrix} \tag{0.0.14}$$

$$\overrightarrow{CA} = \mathbf{A} - \mathbf{C} = \begin{pmatrix} -5 \\ -5 \end{pmatrix} \tag{0.0.15}$$

$$\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CA} = \begin{pmatrix} 2 + 3 + (-5) \\ 0 + 5 + (-5) \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{0.0.16}$$

Similarly other options can be verified.