

Medium

Deputy Executive Engineer (Electrician)

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Sports Authority of Gujarat / Assistant Engineer (Electrical)

**With respect to the mathematical properties of convolution in linear time-invariant (LTI) systems, consider the following statements: 1. The convolution operation**

A

1 and 2 only

B

1, 2 and 3 only

Correct

C

2 and 4 only

D

All of the above

### Correct Answer: B

#### Full Detailed Explanation

Correct Answer: B - 1, 2 and 3 only  
Quick Concept Explanation For an LTI system, output is the convolution of input and impulse response. Convolution is commutative, associative and distributive. Key relation:  $y = x * h$ ; DT:  $y[n] = \sum x[k]h[n-k]$ . Exam focus: Flip, shift, multiply, sum. Common trap: Convolution usually increases finite-sequence length; it does not always reduce it. Statement-wise Verification Statement 1 - Correct. The convolution operation between two signals satisfies the commutative property irrespective of signal type. Convolution is commutative, associative and distributive. Statement 2 - Correct. The associative property of convolution allows grouping of signals without affecting the final output. Convolution is commutative, associative and distributive. Statement 3 - Correct. Convolution distributes over addition, enabling decomposition of complex inputs into simpler components. Convolution is commutative, associative and distributive. Statement 4 - Incorrect. Convolution is applicable only to time-invariant systems and not to time-varying systems. The correct principle is: Convolution is commutative, associative and distributive. Core Concept For an LTI system, output is the convolution of input and impulse response. Convolution is commutative, associative and distributive. Graphically, one signal is reversed, shifted, multiplied and summed/integrated.