|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| p |  | q |  | ~p |  | ~q |  | pv~q |  | ~p^~q |  |  | ~(pv~q) |  |  | ~(pv~q)v(~P^~q) |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 0 |  | 0 |  | 1 |  | 1 |  | 1 |  | 1 |  |  | 0 |  |  | 1 |
| 0 |  | 1 |  | 1 |  | 0 |  | 0 |  | 0 |  |  | 1 |  |  | 1 |
| 1 |  | 0 |  | 0 |  | 1 |  | 1 |  | 0 |  |  | 0 |  |  | 0 |
| 1 |  | 1 |  | 0 |  | 0 |  | 1 |  | 0 |  |  | 0 |  |  | 0 |

Here, ~(pv~q)v(~P^~q) == ~p. Proved

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| p | q | ~p | ~q | p ^ q | ~p^q | ~p^~q | ((~p^q)v(~p^~q)) | ~((~p^q)v(~p^~q)) | ~((~p^q)v(~p^~q))v(p^q) |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |

Here,  ~((~p^q)v(~p^~q))v(p^q) == p. proved

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| p | q | ~p | ~p^q | ~(~p^q) | (p^(~(~p^q))) | p^q | (p^(~(~p^q)))v(p^q) |
| 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |

Here, (p^(~(~p^q)))v(p^q)==p. Proved

**Ans no. 2**

a. (𝑝 ⊕𝑝) ⊕𝑝

|  |  |  |
| --- | --- | --- |
| **p** | **p ⊕p** | **(p ⊕ p) ⊕p** |
| FALSE | FALSE | FALSE |
| TRUE | TRUE | FALSE |

b. Is (𝑝 ⊕ 𝑞) ⊕ 𝑟≡𝑝 ⊕ (𝑞 ⊕ 𝑟)?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **p** | **q** | **r** | **p ⊕ q** | **q ⊕ r** | **(p⊕ q) ⊕ r** | **p ⊕ (q ⊕ r)** |
| 0 | 0 | 0 | FALSE | FALSE | FALSE | FALSE |
| 1 | 0 | 0 | TRUE | FALSE | TRUE | TRUE |
| 0 | 1 | 0 | TRUE | TRUE | TRUE | TRUE |
| 1 | 1 | 0 | FALSE | TRUE | FALSE | FALSE |
| 0 | 0 | 1 | FALSE | TRUE | TRUE | TRUE |
| 1 | 0 | 1 | TRUE | TRUE | FALSE | FALSE |
| 0 | 1 | 1 | TRUE | FALSE | FALSE | FALSE |
| 1 | 1 | 1 | FALSE | FALSE | TRUE | TRUE |

Therefore, (𝑝 ⊕ 𝑞) ⊕ 𝑟 ≡ 𝑝 ⊕ (𝑞 ⊕ 𝑟).

1. Is (𝑝 ⊕𝑞)⋂𝑟 ≡ (𝑝⋂𝑟) ⊕ (𝑞⋂𝑟) ?

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **p** | **q** | **r** | **p ⊕ q** | **(p ⊕ q) ∧ r** | **p ∧ r** | **q ∧ r** | **(p ∧ r) ⊕ (q ∧ r)** |
| 0 | 0 | 0 | FALSE | FALSE | FALSE | FALSE | FALSE |
| 1 | 0 | 0 | TRUE | FALSE | FALSE | FALSE | FALSE |
| 0 | 1 | 0 | TRUE | FALSE | FALSE | FALSE | FALSE |
| 1 | 1 | 0 | FALSE | FALSE | FALSE | FALSE | FALSE |
| 0 | 0 | 1 | FALSE | FALSE | FALSE | FALSE | FALSE |
| 1 | 0 | 1 | TRUE | TRUE | TRUE | FALSE | TRUE |
| 0 | 1 | 1 | TRUE | TRUE | FALSE | TRUE | TRUE |
| 1 | 1 | 1 | FALSE | FALSE | TRUE | TRUE | FALSE |

Therefore, (𝑝 ⊕𝑞)⋂𝑟 ≡ (𝑝⋂𝑟) ⊕ (𝑞⋂𝑟).

**Ans no. 3**

Answer, here,

p→q is false means that q is False and p is true.

1. ~p→q

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| p | q | ~p | p→q |  | ~p→q |
| TRUE | FALSE | FALSE | FALSE |  | TRUE |

1. p V q

|  |  |  |
| --- | --- | --- |
| p | q | p V q |
| TRUE | FALSE | TRUE |

1. q→p

|  |  |  |
| --- | --- | --- |
| p | q | q→p |
| TRUE | FALSE | TRUE |

**Ans no.4    A)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| p | q | r | ~q | qvr | p^~q | p-->(qvr) | p^~q-->r | (p-->(qvr))<-->((p^~q)-->r) |
| 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | TRUE |
| 1 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | TRUE |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | TRUE |
| 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | TRUE |
| 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | TRUE |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 | TRUE |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | TRUE |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | TRUE |

**B)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| p | q | r | qvr | p^(qvr) | p^q | p^r | (p^q)v(p^r) | p^(qvr)<-->(p^q)v(p^r) |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | TRUE |
| 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | TRUE |
| 1 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | TRUE |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | TRUE |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | TRUE |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | TRUE |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | TRUE |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | TRUE |

**C)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| p | q | r | q-->r | p-->(q-->r) | p^q | (p^q)-->r | p-->(q-->r)<-->(p^q)-->r |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | TRUE |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | TRUE |
| 1 | 0 | 1 | 1 | 1 | 0 | 1 | TRUE |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 | TRUE |
| 0 | 1 | 1 | 1 | 1 | 0 | 1 | TRUE |
| 0 | 1 | 0 | 0 | 1 | 0 | 1 | TRUE |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 | TRUE |
| 0 | 0 | 0 | 1 | 1 | 0 | 1 | TRUE |