2.

If all prime numbers are odd, then 2 is odd.

2 is not odd.

Therefore, it is not the case that all prime numbers are odd.

3.

(a) m ∧ ¬ c

(b)

* ¬ w ∧ s ∧ h
* ¬ (w ∨ s ∨ h)
* w ∧ ¬ (s ∧ h)

(c) (n ∧ ¬ k) ∨ (¬ n ∧ k)

4. “jaguar” AND “cheetah” AND (“speed” OR “fastest”) AND (NOT(“car” OR “automobile” OR “auto”)

5.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| p | q | ¬ p | ¬ q | ¬ (p ∧ q) | ¬ p ∧ ¬ q |
| T | T | F | F | T | F |
| T | F | F | T | T | F |
| F | T | T | F | T | F |
| F | F | T | T | F | T |

According to deMorgans Law ¬ (p ∧ q) = ¬ p ∨ ¬ q, and since ∨ and ∧ do not mean the same thing ¬ (p ∧ q) != ¬ p ∧ ¬ q

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| P | q | r | p ∨ q | p ∧ r | (p ∨ q) ∨ (p ∧ r) | (p ∨ q) ∧ r |
| T | T | T | T | T | T | T |
| T | T | F | T | F | T | F |
| T | F | T | T | T | T | T |
| F | T | T | T | F | T | T |
| T | F | F | T | F | T | F |
| F | T | F | T | F | T | F |
| F | F | T | F | F | F | F |
| F | F | F | F | F | F | F |
|  |  |  |  |  |  |  |

According to the distributive law (p ∨ q) ∧ r = (p ∧ r) ∨ (q ∧ r) which means r has to be true for that statement to be true. This is not the same as (p ∨ q) ∨ (p ∧ r) which is true whenever p or q is true or if p and r is true.

6.

* Sam is not an orange belt or Kate is not a red belt.
* The train is not late and my watch is not fast.

7.

|  |  |  |
| --- | --- | --- |
| p | q | (¬p ∨ q) ∨ (p ∧ ¬q) |
| T | T | T |
| T | F | T |
| F | T | T |
| F | F | T |

The statement is a tautology as it is always true

8. Yes, exclusive or is associative.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| p | q | r | (p ⊕ q) ⊕ r | p ⊕ (q ⊕ r) |
| T | T | T | T | T |
| T | T | F | F | F |
| T | F | T | F | F |
| T | F | F | T | T |
| F | T | T | F | F |
| F | T | F | T | T |
| F | F | T | T | T |
| F | F | F | F | F |

9.