**AND operation**

∀x (P(x) ∧ Q(x)) ≡ ∀x P(x) ∧∀x Q(x)

∃x (P(x) ∧ Q(x)) ≡ ∃x P(x) ∧ ∃x Q(x)

**OR operation**

∀x (P(x) ∨ Q(x)) ≡ ∀x P(x) ∨ ∀x Q(x)

∃x (P(x) ∨ Q(x)) ≡ ∃x P(x) ∨ ∃x Q(x)

**NOT operation**

¬(∀x P(x)) ≡ ∃x (¬P(x))

¬(∃x P(x)) ≡ ∀x (¬P(x))

**Examples**

D = {x|x ∈ Z(all integers)}

P(x): x is a prime number

Q(x): sum of x’s divisors(excluding x itself) is equal to x

1. ∀x P(x)

False: not all integers are prime numbers

1. ∃x Q(x)

True: eg 28. 1 + 2 + 4 + 7 + 14 = 28

1. ∃x (P(x) ∧ Q(x))

False: no such prime number exists

1. ∀x (P(x) ∨ Q(x))

False: not all integers are either P(x) or Q(x)

1. ¬∃x P(x)

False: negation of true is false

1. ∃x ¬Q(x)

True: there exists an integer that is not Q(x)

1. ∀x ¬(P(x) ∧ Q(x))

True: negation of false is true

1. ¬∀x (P(x) ∨ Q(x))

True: there exists an integer that is either P(x) or Q(x)