Exercise 3: formalize the following sentences in predicate calculus:

1. "A is above C, D is on E and above F."

Above (A,C) ∧ On(D,E) ∧ Above(D,F)

2. "A is green while C is not."

Green(A) ∧ ¬Green(C)

3. "Everything is on something."

∀x ∃y On(x ,y)

4. "Everything that is free has nothing on it."

∀x (Free(x) → ¬∃y On(y ,x))

5. "Everything that is green is free."

∀x (Green(x) → Free(x))

6. "There is something that is red and is not free."

∃x (Red(x) ∧ ¬Free(x))

7. "Everything that is not green and is above B is red."

∀x ((¬Green(x) ∧ Above(x ,B)) → Red(x))

Exercise 4: By using truth table

1- The logical operator "↔" is read "if and only if." P ↔ Q is defined as being equivalent to (P→Q) ∧ (Q→P). Based on this definition, show that P ↔ Q is logically equivalent to (P∨Q) → (P∧Q)

P	Q	P ↔ Q	P ∨ Q	P ∧ Q	(P ∨ Q) → (P ∧ Q)
T	T	T	T	T	T
T	F	F	T	F	F
F	T	F	T	F	F
F	F	T	F	F	T