

8. Algebra of Proposition

قانون الايدئو	Idempotent laws:	(1a) $p \vee p \equiv p$	(1b) $p \wedge p \equiv p$
التجميع	Associative laws:	(2a) $(p \vee q) \vee r \equiv p \vee (q \vee r)$	(2b) $(p \wedge q) \wedge r \equiv p \wedge (q \wedge r)$
الايوالم	Commutative laws:	(3a) $p \vee q \equiv q \vee p$	(3b) $p \wedge q \equiv q \wedge p$
التوزيع	Distributive laws:	(4a) $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$	(4b) $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$
قوانين المحايد	Identity laws:	(5a) $p \vee F \equiv p$ (6a) $p \vee T \equiv T$	(5b) $p \wedge T \equiv p$ (6b) $p \wedge F \equiv F$
قانون عكس المعك	Involution law:	(7) $\neg\neg p \equiv p$	
قانون المتمم	Complement laws:	(8a) $p \vee \neg p \equiv T$ (9a) $\neg T \equiv F$	(8b) $p \wedge \neg p \equiv F$ (9b) $\neg F \equiv T$
قانون دي مورغان	DeMorgan's laws:	(10a) $\neg(p \vee q) \equiv \neg p \wedge \neg q$	(10b) $\neg(p \wedge q) \equiv \neg p \vee \neg q$

Example :- By using algebra proposition laws simplify the following:

- $\neg p \wedge \neg q$
- $\neg(\neg p \wedge \neg q)$
- $(p \vee q) \wedge \neg p$
- $\neg(p \vee q) \vee (\neg p \wedge q)$

Solution:

- $$\neg p \wedge \neg q \equiv \neg(p \vee q)$$

(DeMorgan's laws).
- $$\neg(\neg p \wedge \neg q) \equiv \neg\neg p \vee \neg\neg q$$

(DeMorgan's laws).

$$\equiv (p \vee q)$$

(Complement laws).

