

Logical Equivalence :-

P and Q are said to be logically equivalent to each other if
 $P \leftrightarrow Q$ is a tautology

$$P \equiv Q$$

P :- Good items are not cheap.

p :- Items are good

q :- Items are cheap.

P :- If items are good then items are not cheap

$$P := P \rightarrow \neg q$$

P	q	$\neg p$	$\neg q$	$P \rightarrow \neg q$	$q \rightarrow \neg p$	$(P \rightarrow \neg q) \leftrightarrow (q \rightarrow \neg p)$
T	F	F	T	F	T	T
T	F	F	T	T	T	T
F	T	T	F	T	T	T
F	F	T	T	T	T	T

Q :- Cheap items are not good.

$$Q := q \rightarrow \neg p$$

a tautology

$$P \rightarrow \neg q \equiv q \rightarrow \neg p$$

$p \rightarrow q$ is logically equivalent to:

- a) $\neg p \vee \neg q$
- b) $p \vee \neg q$
- c) $\neg p \vee q$
- d) $\neg p \wedge q$

p	q	$\neg p$	$\neg q$	$p \rightarrow q$	$\neg p \vee \neg q$	$p \vee \neg q$	$\neg p \vee q$
T	T	F	F	T	F	T	T
T	F	F	T	F	T	T	F
F	T	T	F	T	T	F	T
F	F	T	T	T	T	T	T

$\neg(p \leftrightarrow q)$ is logically equivalent to:

- a) $q \leftrightarrow p$
- b) $p \leftrightarrow \neg q$
- c) $\neg p \leftrightarrow \neg q$
- d) $\neg q \leftrightarrow \neg p$

$\neg q$	$\neg p$	p	q	$\neg(p \leftrightarrow q)$	$q \leftrightarrow p$	$p \leftrightarrow \neg q$	$\neg p \leftrightarrow \neg q$
F	F	T	T	F	T	F	T
T	R	T	F	T	F	T	F
F	T	F	T	T	F	T	F
T	T	F	F	F	T	F	T

$$p \leftrightarrow q = q \leftrightarrow p$$

Converse, Inverse and Contrapositive of a Conditional proposition

$$P \rightarrow q$$

If P then q .

Converse :- The statement

$$q \rightarrow P$$

is called the Converse of the conditional proposition $(P \rightarrow q)$.

Inverse :- The statement

$$\neg p \rightarrow \neg q$$

is called inverse of $P \rightarrow q$.

Contrapositive :- The statement

$$\neg q \rightarrow \neg p$$

is called the Contrapositive of the $P \rightarrow q$.

(Converse & Inverse)

(Converse of the inverse)

"The home team sings whenever it is raining"
 $p \rightarrow q$

"If it is raining then the home team sings" $(p \rightarrow q)$

Converse: $q \rightarrow p$: "If the home team sings then it is raining"

Inverse: $\neg p \rightarrow \neg q$: "If it is not raining then the home team does not sing"

Contrapositive: $\neg q \rightarrow \neg p$: "If the home team does not sing then it is not raining."

?	$q \rightarrow p$	$\neg p \rightarrow \neg q$	$\neg q \rightarrow \neg p$
T	T	T	T
F	F	T	F
T	T	F	T
F	T	T	T

$(p \rightarrow q) \equiv [\neg q \rightarrow \neg p]$

- If the proposition is always False for any truth value of its variable then that proposition is a
 (a) Tautology (b) Contingency (c) Contradiction (d) None of the above