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|---|---|
| 1 "if p , then q " | 8 " p implies q " |
| 2 "if p , q " | 9 " p only if q " |
| 3 " p is sufficient for q " | 10 "a sufficient condition for q is p " |
| 4 " q if p " | 11 " q whenever p " |
| 5 " q when p " | 12 " q is necessary for p " |
| 6 "a necessary condition for p is q " | 13 " q follows from p " |
| 7 " q unless $\neg p$ " | |

If — then — \Rightarrow If p then q $p \rightarrow q$ $p \Rightarrow q$

EXAMPLE 7 Let p be the statement "Maria learns discrete mathematics" and q the statement "Maria will find a good job." Express the statement $p \rightarrow q$ as a statement in English.



Solution: From the definition of conditional statements, we see that when p is the statement "Maria learns discrete mathematics" and q is the statement "Maria will find a good job," $p \rightarrow q$ represents the statement

"If Maria learns discrete mathematics, then she will find a good job."

There are many other ways to express this conditional statement in English. Among the most natural of these are:

"Maria will find a good job when she learns discrete mathematics."
 "For Maria to get a good job (it is sufficient for her to learn discrete mathematics) if she learns discrete mathematics."
 and
 "Maria will find a good job unless she does not learn discrete mathematics."

Connecting word "When"
 q when p
 It is Sufficient
 Sufficient for q is p
 q unless $\neg p \Rightarrow$ If p then q
 q whenever p q if $p \Rightarrow$ If p then q $p \rightarrow q$

CONVERSE, CONTRAPOSITIVE, AND INVERSE of a Conditional Statement

If $p \rightarrow q$ or If p then q be a Conditional Statement then the Conditional statements

- ① $q \rightarrow p$ is If q then p Called Converse of $p \rightarrow q$
- ② $\neg q \rightarrow \neg p$ is "If $\neg q$ then $\neg p$ " Contrapositive " "
- ③ $\neg p \rightarrow \neg q$ is If $\neg p$ then $\neg q$ Inverse " "

Ex: Find Converse, Contrapositive and Inverse of the Conditional Statement. "If it rains then the crops will grow"

If — then — It is of the form If p then q

p : It rains q : The crops will grow.

$\neg p$: It does not rains $\neg q$: The crops will not grow.

① Converse: $(q \rightarrow p)$ If q then p

If — then —

"If the crops will grow then there has been rains."

$(p \rightarrow q)$ $(p \text{ whenever } q)$ $(p \text{ if } q)$

② Contrapositive $(\neg q \rightarrow \neg p)$ "If $\neg q$ then $\neg p$ "

③ Inverse $(\neg p \rightarrow \neg q)$ "If $\neg p$ then $\neg q$ "

③ Inverse $\sim p \rightarrow \sim q$ "If $\sim p$ then $\sim q$ "

Ex) I go to the beach whenever it is a sunny summer day. It is of the form q whenever p

p : It is a Sunny Summer Day

q : I go to the beach

If p then q

"If it is sunny summer day then I will go to the beach"

① Converse $q \rightarrow p$

② Contrapositive $\sim q \rightarrow \sim p$

Inverse: $\sim p \rightarrow \sim q$

11) The contrapositive of the statement "If p (John is a poet) then q (he is poor)" is

a) If John is not poor, then he is not a poet. b) If John is poor then he is a poet. c) If John is not poet then he is not poor. d) None of these

If p then q

$\sim q \rightarrow \sim p$
If $\sim q$ then $\sim p$

13) The converse of the statement "If John is a poet then he is poor" is

a) If John is not poor, then he is not a poet. b) If John is poor then he is a poet. c) If John is not poet then he is not poor. d) None of these

$q \rightarrow p$
If q then p

12) The inverse of the statement "If John is a poet then he is poor" is

a) If John is not poor, then he is not a poet. b) If John is poor then he is a poet. c) If John is not poet then he is not poor. d) None of these

Inverse

$\sim p \rightarrow \sim q$

If $\sim p$ then $\sim q$
If not p then not q