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Ex:1

1)  $7P \vee 9$ : Swimming at New Jersey seeshore is not allowed or sharks have been spotted near seeshore.

2)  $7P \vee (PA \wedge 79)$ : Swimming at New Jersey seeshore is not allowed or swimming at New Jersey seeshore is allowed and sharks have not been spotted near see shore.

Ex:2

1)  $P \wedge 79$

2)  $7P \wedge 79$

3)  $P \leftrightarrow 9$  or  $9 \leftrightarrow P$

Ex: 3

1)

| P | q | r | $\neg q$ | $\neg q \vee r$ | $P \rightarrow (\neg q \vee r)$ |
|---|---|---|----------|-----------------|---------------------------------|
| T | T | T | F        | T               | T                               |
| T | T | F | F        | F               | F                               |
| T | F | T | T        | T               | T                               |
| T | F | F | T        | F               | F                               |
| F | T | T | F        | T               | T                               |
| F | T | F | F        | F               | F                               |
| F | F | T | T        | T               | T                               |
| F | F | F | T        | F               | F                               |

2)  $(P \rightarrow q) \vee (\neg P \rightarrow r)$

| P | q | r | $\neg P$ | $P \rightarrow q$ | $\neg P \rightarrow r$ | $(P \rightarrow q) \vee (\neg P \rightarrow r)$ |
|---|---|---|----------|-------------------|------------------------|---|
| T | T | T | F        | T                 | T                      | T   |
| T | T | F | F        | T                 | F                      | T   |
| T | F | T | F        | F                 | T                      | T   |
| T | F | F | F        | F                 | F                      | F   |
| F | T | T | T        | T                 | T                      | T   |
| F | T | F | T        | T                 | F                      | T   |
| F | F | T | T        | T                 | T                      | T   |
| F | F | F | T        | T                 | F                      | T   |

Ex: 4

$$[P \wedge (P \rightarrow Q)] \rightarrow Q$$

| P | Q | $P \rightarrow Q$ | $P \wedge (P \rightarrow Q)$ | $[P \wedge (P \rightarrow Q)] \rightarrow Q$ |
|---|---|-------------------|------------------------------|--|
| T | T | T                 | T                            | T  |
| T | F | F                 | F                            | T  |
| F | T | T                 | F                            | T  |
| F | F | T                 | F                            | T  |

Ex: 5

$$\neg(P \rightarrow Q) \rightarrow \neg Q$$

$$\neg(\neg P \vee Q) \rightarrow \neg Q$$

$$\neg P \wedge \neg Q \vee \neg Q$$

$$\neg P \vee \underbrace{\neg Q \vee \neg Q}_T$$

$$\neg P \vee T \Rightarrow T \Rightarrow \text{tautology.}$$