

Instructions: Show all work. Justify answers as completely as possible. If you are asked to prove something, mere computation is not enough. You must explain your reasoning. Be sure to state your conclusion clearly. Incomplete work or justification will not receive full credit. Use exact answers unless specifically asked to round.

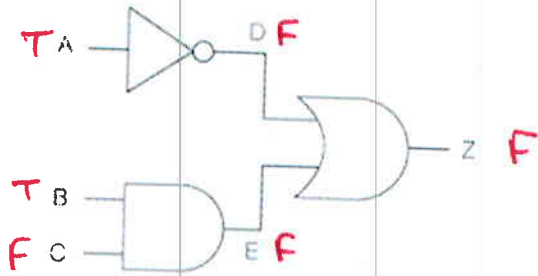
1. Complete the truth table below for the statement $\neg p \wedge (p \vee \neg q)$.

p	q	$\neg p$	$\neg q$	$p \vee \neg q$	$\neg p \wedge (p \vee \neg q)$
T	T	F	F	T	F
T	F	F	T	T	F
F	T	T	F	F	F
F	F	T	T	T	T

2. In order to determine the truth values of a compound statement constructed from 7 simple statements (p, q, r, s, t, u, v), how many lines would the truth table need to have?

$$2^7 = 128$$

3. If the inputs to A and B are true, and C is false, what is the truth values of the Z output?



4. If $P(x)$ is the statement 'x can speak Japanese', and $Q(x)$ is the statement 'x can program in LaTeX', then express the sentence 'There is a student (in your school) who can speak Japanese, but who cannot program in LaTeX' using appropriate predicate syntax, logical connectors and quantifiers. Use DeMorgan's Law to write the negation of that same statement.

$$\exists x (P(x) \wedge \neg Q(x))$$

$$\forall x (\neg P(x) \vee Q(x))$$

5. If $S(x)$ is the predicate 'x is a student' and $F(x)$ is the predicate 'x is a faculty member', and $A(x, y)$ is the predicate 'x asks y a question', then translate the following statements into predicate logic form with appropriate quantifiers and connectives.
- a. Every faculty member has either asked Professor Michaels a question or has been asked a question by Professor Miller.

$$\forall x (A(x, \text{Prof Michael}) \vee A(\text{Prof Miller}, x)) \wedge F(x)$$

- b. There is a faculty member who has asked every other faculty member a question.

$$\exists x \forall y (x \neq y) A(x, y) \wedge (F(x) \wedge F(y))$$

- c. There is exactly one faculty member who has asked the student Mary Jane a question.

$$S(\text{Mary Jane}) \wedge \exists ! x (F(x) \wedge A(x, \text{Mary Jane}))$$