Homework 1

(a) If P, Q, R are propositions, show that \((P \lor \sim Q) \rightarrow R\) is logically equivalent to 
\((\sim P \land Q) \lor R\)

(b) Let P: He needs a doctor, Q: He needs a lawyer, R: He has an accident, S: He is sick, U: He is injured
State the following formulas in English:
(a) \(((S \rightarrow P) \land (R \rightarrow Q))\)
(b) \(P \rightarrow (S \lor U)\)
(c) \((P \land Q) \rightarrow R\)

c) Symbolize the following statements by formulas:
(a) If the humidity is so high, it will rain either this afternoon or this evening
(b) It requires courage and skills to climb that mountain
(c) If he is a man who campaigns so hard, he probably will be elected

d) Establish which of the following statements are tautologies and which are contradictions:
\((P \land Q) \lor (\sim P \lor (P \land \sim Q))\)
\((\sim P \lor Q) \lor (P \land \sim Q)\)
\((P \land \sim Q) \land (\sim P \lor Q)\)

(e) Abdul's shop was robbed, but the loot was recovered. There were three suspects: their names were Abu, Ibn, and Hasib. At the trial, they made the following statements:
- Abu: I did not commit the robbery!
- Ibn: Hasib certainly didn't!
- Hasib: Yes, I did!

Later on, two of them confessed to having lied. Who committed the robbery?

(f) (a) Is \((P \oplus Q) \oplus R\) logically equivalent to \(P \oplus (Q \oplus R)\)? Justify your answer.
(b) Is \((P \oplus Q) \land R\) logically equivalent to \((P \land R) \oplus (Q \land R)\)? Justify your answer.

(g) Challenge problem: Given that if the congress refuses to enact new laws, then the strike will not be over unless it last more than one year and the president of the firm resigns, will the strike not be over if the congress refuses to act and the strike just starts?