Discrete Mathematics: HW1

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1.1 Propositional Logic

10 Let p and q be the propositions "The election is decided" and "The votes have been counted," respectively. Express each of these compoun propositions as an English sentence.
d. $q \rightarrow p$
e. $\neg q \rightarrow \neg p$
f. $\neg p \rightarrow \neg q$

12 Let p, q, and r be the propositions
p : You have the flu.
q : You miss the final examination.
r : You pass the course.
Express each of these propositions as an English sentence.
c. $q \rightarrow \neg r$
e. $(p \rightarrow \neg r) \vee (q \rightarrow \neg r)$

22 Write each of these statements in the form "if p, then q" in English. [Hint: Refer to the list of common ways to express conditional statements provided in this section.]
a. It is necessary to wash the boss's car to get promoted.
b. Winds from the south imply a spring thaw.
c. A sufficient condition for the warranty to be good is that you bought the computer less than a year ago.
d. Willy gets caught whatever he cheats.
e. You can access the website only if you pay a subscription fee.
g. Carol gets seasick whenever she is on a boat.

1.2 Applications of Propositional Logic

4 To use the wireless network in the airport you must pay the daily fee unless you are a subscriber to the service. Express your answer in terms of w: "You can use the wireless network in the airport," d: "You pay the daily fee." and s: "You are a subscriber to the service."

16 An explorer is captured by a group of cannibals. There are two types of cannibals – those who always tell the truth and those who always lie. The cannibals will barbecue the explorer unless he can determine whether a particular cannibal always lies or always tells the truth. He is allowed to ask the cannibal exactly one question.
a. Explain why the question "Are you a liar?" does not work.
b. Find a question that the explorer can use to determine whether the cannibal always lies or always tells the truth.

36 Four friends have been identified as suspects for an unaunthorized access into a computer system. They have made statements to the investigating authorities. Alice said "Carlos did it." John said "I did not do it." Carlos said "Diana did it." Diana said "Carlos lied when he said that I did it."
a. If the authorities also know that exactly one of the four suspects is telling the truth, who did

it? Explain your reasoning.
b. If the authorities also know that exactly one is lying, who did it? Explain your reasoning.

1.3 Propositional Equivalences

10 Show that each of these conditional statements is a tautology by using truth tables.
a. $[\neg p \wedge (p \vee q)] \rightarrow q$
b. $[(p \rightarrow q) \wedge (q \rightarrow r)] \rightarrow (p \rightarrow r)$
c. $[p \wedge (p \rightarrow q)] \rightarrow q$

20 Show that $\neg(p \oplus q)$ and $p \Leftrightarrow q$ are logically equivalent.