

## CISC 3410 Fall 2010, Homework 5

1. Which, if any, of the following sentences is a proposition? In each case, justify your answer.

- (a) Twice two is four.
- (b) The square root of ten is three.
- (c)  $5 > 6$
- (d) Please write a specimen of your signature in the space provided.
- (e) Would you believe Lady Gaga once stood in exactly that spot?

(15 points)

2. Using the following propositions:

$p$  Its is raining  
 $q$  I have an umbrella  
 $r$  I get wet

Formulate the following expressions in words:

- (a)  $(p \wedge q)$
- (b)  $(p \wedge \neg q) \wedge r$
- (c)  $\neg p \wedge \neg r$
- (d)  $p \wedge (q \vee r)$
- (e)  $\neg p \vee r$

(10 points)

3. For each of the propositions in the previous question. write out the truth table.

(10 points)

4. For each of the propositions in question 2, say whether it is: consistent, inconsistent and/or a tautology.

(10 points)

5. Use the truth table method to decide whether the following statements are true:

- (a)  $(p \wedge q) \models \neg(p \vee q)$
- (b)  $p, (p \Leftrightarrow q) \models p \wedge q$
- (c)  $(p \Rightarrow q) \models ((p \Rightarrow r) \Rightarrow (p \Rightarrow r))$

(15 points)

6. There is a list of natural deduction proof rules for propositional logic on the class web page. Using these, try to prove the following:

- (a)  $(p, p \Rightarrow (q \wedge r)) \vdash (p \wedge r)$
- (b)  $(p, p \Rightarrow (q \wedge r)) \vdash (s \vee r)$
- (c)  $(p \wedge (p \Rightarrow (q \wedge r))) \vdash (p \Rightarrow r)$
- (d)  $(p \Rightarrow (q \wedge r)) \vdash (p \Rightarrow r)$
- (e)  $(\neg q, p \Leftrightarrow (q \wedge r)) \vdash \neg p$

(25 points)

7. Prove  $(p, p \Rightarrow q, p \Rightarrow r) \vdash r$  using resolution.

(10 points)