

## HW 1 ITCS 2175

### Problem 1 [13 points each—39 points total]

a.

<u>p</u>	<u>q</u>	<u>r</u>	<u><math>(p \vee q)</math></u>	<u><math>(p \vee q) \wedge r</math></u>
T	T	T	T	T
T	T	F	T	F
T	F	T	T	T
T	F	F	T	F
F	T	T	T	T
F	T	F	T	F
F	F	T	F	F
F	F	F	F	F

b.

<u>p</u>	<u>q</u>	<u>r</u>	<u><math>(p \wedge q)</math></u>	<u><math>(p \wedge q) \wedge r</math></u>
T	T	T	T	T
T	T	F	T	F
T	F	T	F	F
T	F	F	F	F
F	T	T	F	F
F	T	F	F	F
F	F	T	F	F
F	F	F	F	F

c.

<u>p</u>	<u>q</u>	<u>r</u>	<u><math>(p \wedge q)</math></u>	<u><math>(p \wedge q) \vee \neg r</math></u>
T	T	T	T	T
T	T	F	T	T
T	F	T	F	F
T	F	F	F	T
F	T	T	F	F
F	T	F	F	T
F	F	T	F	F
F	F	F	F	T

**Problem 2 [30 Points]**

Let

K = Kevin is chatting

H = Heather is chatting

R = Randy is chatting

V = Vijay is chatting

A = Abby is chatting

For our compound propositions we know that

$K \vee H$  is true

$R \oplus V$  is true

$A \rightarrow R$  is true

$\neg(V \oplus K)$  is true

$H \rightarrow (A \wedge K)$  is true

Since all compound propositions must be true we can stop any line of the table once a compound proposition is false.

<b>K</b>	<b>H</b>	<b>V</b>	<b>R</b>	<b>A</b>	<b><math>K \vee H</math></b>	<b><math>R \oplus V</math></b>	<b><math>A \rightarrow R</math></b>	<b><math>\neg(V \oplus K)</math></b>	<b><math>H \rightarrow (A \wedge K)</math></b>
T	T	T	T	T	T	F			
T	T	T	T	F	T	F			
T	T	T	F	T	T	T	F		
T	T	T	F	F	T	T	T	T	F
T	T	F	T	T	T	T	T	F	
T	T	F	T	F	T	T	T	F	
T	T	F	F	T	T	F			
T	T	F	F	F	T	F			
T	F	T	T	T	T	F			
T	F	T	T	F	T	F			
T	F	T	F	T	T	T	F		
<b>T</b>	<b>F</b>	<b>T</b>	<b>F</b>	<b>F</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>
T	F	F	T	T	T	T	T	F	
T	F	F	T	F	T	T	T	F	
T	F	F	F	T	T	F			
T	F	F	F	F	T	F			
F	T	T	T	T	T	F			
F	T	T	T	F	T	F			
F	T	T	F	T	T	T	F		
F	T	T	F	F	T	T	T	F	
F	T	F	T	T	T	T	T	T	F
F	T	F	T	F	T	T	T	T	F
F	T	F	F	T	T	F			
F	T	F	F	F	T	F			
F	F	T	T	T	F				
F	F	T	T	F	F				
F	F	T	F	T	F				
F	F	T	F	F	F				
F	F	F	T	T	F				
F	F	F	T	F	F				
F	F	F	F	T	F				
F	F	F	F	F	F				

**So Kevin and Vijay are chatting**

**Problem 3 [40 points]**

Alice, Carlos, John, Diane are the suspects.

Let

p: Alice said Carlos did it.

q: John said I did not do it.

r: Carlos said Diana did it.

s: Diana said Carlos lied when he said I did it.

It is also helpful to come up with some compound propositions to check the consistency of the statements.

For example, statements r and s cannot both be true or both be false, since they contradict each other, so  $r \oplus s$

must be true. Since p and r cannot both be true at the same time, we get  $\neg(p \wedge r)$ . q and s cannot both be

false so we get  $q \vee s$ . Also  $p \rightarrow q$  must be true since if Alice is truthful when she says Carlos did it, then

John's statement must be true. In all there are six compound propositions:  $p \rightarrow q$ ,  $\neg(p \wedge r)$ ,  $p \rightarrow s$ ,  $q \vee \neg r$ ,

$q \vee s$ ,  $r \oplus s$ .

<b>p</b>	<b>q</b>	<b>r</b>	<b>s</b>	<b><math>p \rightarrow q</math></b>	<b><math>\neg(p \wedge r)</math></b>	<b><math>p \rightarrow s</math></b>	<b><math>q \vee \neg r</math></b>	<b><math>q \vee s</math></b>	<b><math>r \oplus s</math></b>	
T	T	T	T	T	F	T	T	T	F	(Inconsistent)
T	T	T	F	T	F	T	T	T	F	
<b>T</b>	<b>T</b>	<b>F</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>(Carlos did it.)</b>
T	T	F	F	T	T	T	T	T	F	
T	F	T	T	F	T	T	T	T	F	
T	F	T	F	F	T	T	T	T	F	
T	F	F	T	F	T	T	T	T	F	
T	F	F	F	F	T	T	T	T	F	
F	T	T	T	T	T	T	T	T	F	
F	T	T	F	T	T	T	T	T	T	(Diana did it.)
F	T	F	T	T	T	T	T	T	T	(Alice did it.)
F	T	F	F	T	T	T	T	T	F	
F	F	T	T	T	T	T	F	F	F	
F	F	T	F	T	T	T	F	F	F	
<b>F</b>	<b>F</b>	<b>F</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>(John did it.)</b>
F	F	F	F	T	T	T	T	F	F	

42a) There are four possible cases if exactly one of the suspects is telling the truth. Of these only one is consistent (FFFT so John did it.)

42b) The only consistent case when exactly one of the suspects is lying is TTFT. (Carlos did it.)

Note that there are two other inputs that result in consistent answers.