

## Exercise 5: (Laws of Logic)

1.

$$F \wedge (F \vee G) \equiv F$$

$$\Leftrightarrow (F \wedge F) \vee (F \wedge G) \equiv F \quad \text{see part 2}$$

$$\Leftrightarrow F \vee (F \wedge G) \equiv F$$

So the truth table for both formulae looks like this:

F G	$F \vee G$	$F \wedge (F \vee G)$
0 0	0	0
0 1	1	0
1 0	1	1
1 1	1	1

2.

$$F \wedge (G \vee H) \equiv (F \wedge G) \vee (F \wedge H)$$

F G H	$G \vee H$	$F \wedge (G \vee H)$	$F \wedge G$	$F \wedge H$	$(F \wedge G) \vee (F \wedge H)$
0 0 0	0	0	0	0	0
0 0 1	1	0	0	0	0
0 1 0	1	0	0	0	0
0 1 1	1	0	0	0	0
1 0 0	0	0	0	0	0
1 0 1	1	1	0	1	1
1 1 0	1	1	1	0	1
1 1 1	1	1	1	1	1

$$F \vee (G \wedge H) \equiv (F \vee G) \wedge (F \vee H)$$

F G H	$G \wedge H$	$F \vee (G \wedge H)$	$F \vee G$	$F \vee H$	$(F \vee G) \wedge (F \vee H)$
0 0 0	0	0	0	0	0
0 0 1	0	0	0	1	0
0 1 0	0	0	1	0	0
0 1 1	1	1	1	1	1
1 0 0	0	1	1	1	1
1 0 1	0	1	1	1	1
1 1 0	0	1	1	1	1
1 1 1	1	1	1	1	1

**3.**

$$\neg(F \wedge G) \equiv \neg F \vee \neg G$$

F	G	$F \wedge G$	$\neg F \vee \neg G$
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

$$\neg(F \vee G) \equiv \neg F \wedge \neg G$$

F	G	$F \vee G$	$\neg F \wedge \neg G$
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

**Exercise 6: (Two proofs)****Exercise 7: (CNF and DNF)****Exercise 8: (Switch and and or)**