ComS 472
Homework 4

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- 7.22 -

1) If the pair of clauses has no complimentary literals, there are no resolvents. ✓

   If the pair has one or more sets of complimentary literals, the resulting resolvents acquired from applying the same set of literals in any order will eventually reduce down to a single resolvent. ✓

2) See s02

3) For a clause to resolve with a copy of itself, it must contain only complimentary literals. This would make the initial clause equivalent to True

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1)

F	P	D	F ⇒ P	D ⇒ P	(F ⇒ P)∨ (D ⇒ P)	F ∧ D	(F ∧ D) ⇒ P	(F ⇒ P)∨(D ⇒ P) ⇒ (F ∧ D)⇒ P
T	T	T	T	T	T	T	T	T
T	T	F	T	T	T	F	T	T
T	F	T	F	F	F	T	F	T
T	F	F	F	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	F	T	T
F	F	F	T	T	T	F	T	T

The sentence is valid as it is true for all combinations of variables.

2) Original $(F \Rightarrow P) \vee (D \Rightarrow P) \Rightarrow (F \wedge D) \Rightarrow P$

Implication Elim: $(\neg F \vee P) \vee (D \Rightarrow P) \Rightarrow (F \wedge D) \Rightarrow P$
Implication Elim: $(\neg F \vee P) \vee (\neg D \vee P) \Rightarrow (F \wedge D) \Rightarrow P$
Implication Elim: $(\neg F \vee P) \vee (\neg D \vee P) \Rightarrow \neg(F \wedge D) \vee P$
De Morgan: $(\neg F \vee P) \vee (\neg D \vee P) \Rightarrow (\neg F \vee \neg D) \vee P$
Implication Elim: $\neg((\neg F \vee P) \vee (\neg D \vee P)) \vee (\neg F \vee \neg D) \vee P$
De Morgan: $\neg(\neg F \vee P) \wedge \neg(\neg D \vee P) \vee (\neg F \vee \neg D) \vee P$
De Morgan: $(F \wedge \neg P) \wedge (D \wedge \neg P) \vee (\neg F \vee \neg D) \vee P$
Associativity: $(F \wedge \neg P \wedge D \wedge \neg P) \vee (\neg F \vee \neg D \vee P)$
Duplicates: $(F \wedge \neg P \wedge D) \vee (\neg F \vee \neg D \vee P)$

Final Form (CNF): $\mathbf{(F \wedge \neg P \wedge D) \vee (\neg F \vee \neg D \vee P)}$

3)

F	P	D	¬F	¬P	¬D	F ∧ ¬P ∧ D	¬F ∨ P ∨ ¬D	F ∧ ¬P ∧ D ∨ ¬F ∨ P ∨ ¬D
T	T	T	F	F	F	F	T	T
T	T	F	F	F	T	F	T	T
T	F	T	F	T	F	T	F	T
T	F	F	F	T	T	F	T	T
F	T	T	T	F	F	F	T	T
F	T	F	T	F	T	F	T	T
F	F	T	T	T	F	F	T	T
F	F	F	T	T	T	F	T	T

The resolved sentence is logically equivalent to the original.

- 7.26 -

S1) $A \Leftrightarrow (C \vee E)$ to...
$(A \Rightarrow (C \vee E)) \wedge ((C \vee E) \Rightarrow A)$
$(\neg A \vee (C \vee E)) \wedge (\neg(C \vee E) \vee A)$
$(\neg A \vee C \vee E) \wedge ((\neg C \wedge \neg E) \vee A)$
$(\neg A \vee C \vee E) \wedge (\neg C \vee A) \wedge (\neg E \vee A)$

S2) $E \Rightarrow D$ to...
$\neg E \vee D$

S3) $B \wedge F \Rightarrow \neg C$ to...
$\neg(B \wedge F) \vee \neg C$
$\neg B \vee \neg F \vee \neg C$

S4) $E \Rightarrow C$ to...
$\neg E \vee C$

S5) $C \Rightarrow F$ to...
$\neg C \vee F$

S6) $C \Rightarrow B$ to...
$\neg C \vee B$

- 8.11 -

1) Occupation(Emily, Surgeon) $\vee$ Occupation(Emily, Lawyer)

2) Occupation(Joe, Actor) $\wedge \exists$ j (Occupation(Joe, j) $\wedge \neg$(j=Actor))

3) $\forall$ s (Occupation(s, Surgeon) $\Rightarrow$ Occupation(s, Doctor))

4) $\forall$ l (Occupation(l, Lawyer) $\Rightarrow \neg$Customer(Joe, l))

5) $\exists$ b (Boss(b, Emily) $\wedge$ Occupation(b, Lawyer))

6) $\exists$ l $\forall$ c (Occupation(l, Lawyer) $\wedge$ (Customer(c, l) $\Rightarrow$ Occupation(c, Doctor)))

7) $\forall$ s $\exists$ l (Occupation(s, Surgeon) $\Rightarrow$ (Customer(s, l) $\wedge$ Occupation(l, Lawyer)))

- 8.23 -

1) $\exists$ d Parent(Joan, d) $\wedge$ Female(d)

2) $\exists!$ d Parent(Joan, d) $\wedge$ Female(d)

3) ($\exists!$ d Parent(Joan, d)) $\wedge$ ($\forall$ d Parent(Joan, d) $\Rightarrow$ Female(d))

4) $\exists!$ c Parent(Joan, c) $\wedge$ Parent(Kevin, c)

5) ($\exists$ c Parent(Joan, c) $\wedge$ Parent(Kevin, c)) $\wedge$ $\neg$($\exists$ c Parent(Joan, c) $\wedge$ $\neg$Parent(Kevin, c))

- 8.29 -

1)

2)

3)

- 9.4 -

1)

2)

3)

4)

- 9.7 -

1)

2)

3)

4)

5)

6)

- 9.9 -

1)
2)
3)
4)
5)

- 9.16 -

1)
2)
3)

- 9.18 -

1)
2)

$\neg\vee\wedge$
