hw5

jalbert1

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8.8

$Jim \neq George$
$Spouse(Jim, Laura)$
$\forall X : X \neq Jim \wedge \ Spouse(X, Laura)$
$therefore\ Spouse(George, Laura)$

8.10

$a) Occupation(Emily, Surgeon) \vee Occupation(Emily, Lawyer)$
$b) Occupation(Joe, Actor) \wedge \exists! X : X \neq Actor \wedge Occupation(Joe, X)$
$c) \forall X : Occupation(X, Surgeon) \Rightarrow Occupation(X, Doctor)$
$d) \forall X : Occupation(X, Lawyer) \Rightarrow Customer(Joe, X)$
$e) \exists! X : Boss(X, Emily) \Rightarrow Occupation(X, Lawyer)$
$f) \exists X, \forall Y (Occupation(X, Lawyer) \Rightarrow (Customer(Y, X) \Rightarrow Occupation(Y, Doctor)))$
$g) \forall X, \exists Y : Occupation(X, Surgeon) \Rightarrow Customer(X, Y)$

8.28

$b) \neg Wrote(Gershwin, "EleanorRigby.")$
$d) \exists X : Wrote(Joe, X)$
$g) \forall X, \exists Y : Sings(Y, X, Revolver) \Rightarrow Y \neq Gershwin$
$h) \forall X, \exists Y : Wrote(Gershwin, X) \Rightarrow Sings(Gershwin, X, Y) k) \forall X, \exists Y, \exists Z : Sings(McCartney, X, Y) \Rightarrow (CopyOf(Z, Y) \wedge Owns(Joe, Z))$

9.20

a) $\exists p, \forall q : \neg S(q, q) \iff S(p, q)$

b)
$\exists p, \forall q : \neg S(q,q) \iff S(p,q)$
$\exists p, \forall q : (\neg S(q,q) \Rightarrow S(p,q)) \wedge (S(p,q) \Rightarrow \neg S(q,q))$
$\exists p, \forall q : (S(q,q) \vee S(p,q)) \wedge (\neg S(p,q) \vee \neg S(q,q))$
$\forall q : (S(q,q) \vee S(P,q)) \wedge (\neg S(P,q) \vee \neg S(q,q)) p = P$
$S(q,q) \vee S(P,q)) \wedge (\neg S(P,q) \vee \neg S(q,q))$

c) The CNF form resolves to empty clause so the logic is unsatisfiable

13.13

$P(TestA = pos \mid Virus = Present) = .95$
$P(TestA = pos \mid Virus = Absent) = .1$
$P(TestB = pos \mid Virus = Present) = .9$
$P(TestB = pos \mid Virus = Absent) = .05$
$P(Virus = Present) = .01$
$P(Virus = Present \mid TestA = pos)$
$= \frac{P(TestA=pos|Virus=Present)*P(Virus=Present)}{P(TestA=pos|Virus=Present)\times P(Virus=Present)+P(TestA=pos|Virus=Absent)\times P(Virus=absent)}$
$= \frac{.0095}{.1085} = .088$
$P(Virus = Present \mid TestB = pos)$
$= \frac{P(TestB=pos|Virus=Present)*P(Virus=Present)}{P(TestB=pos|Virus=Present)\times P(Virus=Present)+P(TestB=pos|Virus=Absent)\times P(Virus=absent)}$
$= \frac{.009}{.0585} = .15$