EX 6.1 FOL people, songs, albums and disks

Consider a first-order logical knowledge base that describes worlds containing people,  
songs, albums (e.g., “Meet the Beatles”) and disks (i.e., particular physical instances of CDs).  
The vocabulary contains the following symbols:  
  
                     
CopyOf (d, a): Predicate. Disk d is a copy of album a.  
  
Owns(p, d): Predicate. Person p owns disk d.  
  
Sings(p, s, a): Album a includes a recording of song s sung by person p.  
  
Wrote(p, s): Person p wrote song s.  
  
McCartney , Gershwin , BHoliday , Joe , EleanorRigby , TheManILove , Revolver :  
Constants with the obvious meanings.  
  
  
Express the following statements in first-order logic:  
a. Gershwin wrote “The Man I Love.”  
b. Gershwin did not write “Eleanor Rigby.”  
c. Either Gershwin or McCartney wrote “The Man I Love.”  
d. Joe has written at least one song.  
e. Joe owns a copy of Revolver.  
f. Every song that McCartney sings on Revolver was written by McCartney.  
g. Gershwin did not write any of the songs on Revolver.  
h. Every song that Gershwin wrote has been recorded on some album. (Possibly different songs are recorded on different albums.)  
i. There is a single album that contains every song that Joe has written.  
j. Joe owns a copy of an album that has Billie Holiday singing “The Man I Love.”  
k. Joe owns a copy of every album that has a song sung by McCartney. (Of course, each  
different album is instantiated in a different physical CD.)  
l. Joe owns a copy of every album on which all the songs are sung by Billie Holiday.

a/ Wrote(Gershwin, TheManILove)

b/ ¬Wrote(Gershwin, EleanorRigby)

c/ Wrote(Gershwin, TheManILove)∨Wrote(McCartney, TheManILove)

d/ ∃*s*Wrote(Joe, s)

e/ ∃*d*(CopyOf(d, Revolver)∧Owns(Joe, d))

f/ ∀*s*(Sings(McCartney, s, Revolver)→Wrote(McCartney, s))

g/ ∀*s*(∃*p*Sings(p, s, Revolver)→¬Wrote(Gershwin, s))

h/ ∀*s*(Wrote(Gershwin, s)→∃*a*∃*p*Sings(p, s, a))

i/ ∀*s*(Wrote(Gershwin, s)→∃*a*∃*p*Sings(p, s, a))

j/ ∃*a*∃*d*(CopyOf(d, a)∧Owns(Joe, d)∧Sings(BHoliday, TheManILove, a))

k/ ∀*a*(∃*s*Sings(McCartney, s, a)→∃*d*(CopyOf(d, a)∧Owns(Joe, d)))

l/ ∀*a*(∀*s*∀*p*(Sings(p, s, a)→*p*=BHoliday)→∃*d*(CopyOf(d, a)∧Owns(Joe, d)))