Questions:

Represent these clauses in predicate calculus, using only those predicates which are necessary. For example, you need not represent `person', and phrases such as `who buys carrots by the bushel' may be represented by a single predicate. Negate the conclusion and convert to clause form, skolemizing as necessary. Prove the unsatisfiability of the resulting set of clauses by resolution.

1. Consider the following axioms:

- 1. Anyone who buys carrots by the bushel owns either a rabbit or a grocery store.
- 2. Every dog chases some rabbit.
- 3. Mary buys carrots by the bushel.
- 4. Anyone who owns a rabbit hates anything that chases any rabbit.
- 5. John owns a dog.
- 6. Someone who hates something owned by another person will not date that person.
- 7. (Conclusion) If Mary does not own a grocery store, she will not date John.

2. Consider the following axioms:

- 1. Every Austinite who is not conservative loves some armadillo.
- 2. Anyone who wears maroon-and-white shirts is an Aggie.
- 3. Every Aggie loves every dog.
- 4. Nobody who loves every dog loves any armadillo.
- 5. Clem is an Austinite, and Clem wears maroon-and-white shirts.
- 6. (Conclusion) Is there a conservative Austinite?
- **3.** Consider the following axioms:
 - 1. Anyone whom Mary loves is a football star.
 - 2. Any student who does not pass does not play.
 - 3. John is a student.
 - 4. Any student who does not study does not pass.
 - 5. Anyone who does not play is not a football star.
 - 6. (Conclusion) If John does not study, then Mary does not love John.
- 4. Consider the following axioms:
 - 1. Every coyote chases some roadrunner.
 - 2. Every roadrunner who says ``beep-beep" is smart.
 - 3. No coyote catches any smart roadrunner.
 - 4. Any coyote who chases some roadrunner but does not catch it is frustrated.
 - 5. (Conclusion) If all roadrunners say ``beep-beep", then all coyotes are frustrated.
- **5.** Consider the following axioms:

- 1. Anyone who rides any Harley is a rough character.
- 2. Every biker rides [something that is] either a Harley or a BMW.
- 3. Anyone who rides any BMW is a yuppie.
- 4. Every yuppie is a lawyer.
- 5. Any nice girl does not date anyone who is a rough character.
- 6. Mary is a nice girl, and John is a biker.
- 7. (Conclusion) If John is not a lawyer, then Mary does not date John.
- 6. Consider the following axioms:
 - 1. Every child loves anyone who gives the child any present.
 - 2. Every child will be given some present by Santa if Santa can travel on Christmas eve.
 - 3. It is foggy on Christmas eve.
 - 4. Anytime it is foggy, anyone can travel if he has some source of light.
 - 5. Any reindeer with a red nose is a source of light.
 - 6. (Conclusion) If Santa has some reindeer with a red nose, then every child loves Santa.
- **7.** Consider the following axioms:
 - 1. Every investor bought [something that is] stocks or bonds.
 - 2. If the Dow-Jones Average crashes, then all stocks that are not gold stocks fall.
 - 3. If the T-Bill interest rate rises, then all bonds fall.
 - 4. Every investor who bought something that falls is not happy.
 - 5. (Conclusion) If the Dow-Jones Average crashes and the T-Bill interest rate rises, then any investor who is happy bought some gold stock.
- **8.** Consider the following axioms:
 - 1. Every child loves every candy.
 - 2. Anyone who loves some candy is not a nutrition fanatic.
 - 3. Anyone who eats any pumpkin is a nutrition fanatic.
 - 4. Anyone who buys any pumpkin either carves it or eats it.
 - 5. John buys a pumpkin.
 - 6. Lifesavers is a candy.
 - 7. (Conclusion) If John is a child, then John carves some pumpkin.
- **9.** Consider the following axioms:
 - 1. Every tree that is an oak contains some grackle.
 - 2. If anyone walks under any tree that contains any grackle, then he hates every grackle.
 - 3. For every building, there is some tree that is beside it.
 - 4. Taylor Hall is a building.
 - 5. Every CS student visits Taylor Hall.

- 6. If anyone visits any building, then he walks under every tree that is beside that building.
- 7. (Conclusion) If some CS student does not hate some grackle, then there is some tree beside Taylor Hall that is not an oak.
- **10.** Consider the following axioms:
 - 1. Every child sees some witch.
 - 2. No witch has both a black cat and a pointed hat.
 - 3. Every witch is good or bad.
 - 4. Every child who sees any good witch gets candy.
 - 5. Every witch that is bad has a black cat.
 - 6. (Conclusion) If every witch that is seen by any child has a pointed hat, then every child gets candy.
- **11.** Consider the following axioms:
 - 1. Every boy or girl is a child.
 - 2. Every child gets a doll or a train or a lump of coal.
 - 3. No boy gets any doll.
 - 4. No child who is good gets any lump of coal.
 - 5. (Conclusion) If no child gets a train, then no boy is good.
- **12.** Consider the following axioms:
 - 1. Every child who finds some [thing that is an] egg or chocolate bunny is happy.
 - 2. Every child who is helped finds some egg.
 - 3. Every child who is not young or who tries hard finds some chocolate bunny.
 - 4. (Conclusion) If every young child tries hard or is helped, then every child is happy.
- **13.** Consider the following axioms:
 - 1. Anything that is played by any student is tennis, soccer, or chess.
 - 2. Anything that is chess is not vigorous.
 - 3. Anyone who is healthy plays something that is vigorous.
 - 4. Anyone who plays any chess does not play any soccer.
 - 5. (Conclusion) If every student is healthy, then every student who plays any chess plays some tennis.
- **14.** Consider the following axioms:
 - 1. Every student who makes good grades is brilliant or studies.
 - 2. Every student who is a CS major has some roommate. [Make ``roommate" a twoplace predicate.]
 - 3. Every student who has any roommate who likes to party goes to Sixth Street.

- 4. Anyone who goes to Sixth Street does not study.
- 5. (Conclusion) If every roommate of every CS major likes to party, then every student who is a CS major and makes good grades is brilliant.
- **15.** Consider the following axioms:
 - 1. Everyone who aces any final exam studies or is brilliant or is lucky.
 - 2. Everyone who makes an A aces some final exam.
 - 3. No CS major is lucky.
 - 4. Anyone who drinks beer does not study.
 - 5. (Conclusion) If every CS major makes an A, then every CS major who drinks beer is brilliant.