Homework 3 solutions

4.3

1. $\pi_{sname}((\sigma_{color=red}(Parts) \bowtie Catalog) \bowtie Suppliers)$

2. $\pi_{sid}((\sigma_{color=red \vee color=green}(Parts) \bowtie Catalog)$

3. $\pi_{sid}(\sigma_{color=red \vee address='221\ Packer\ Ave'}((Parts \bowtie Catalog) \bowtie Suppliers))$

4. $\pi_{sid}(\sigma_{color=red}(Parts) \bowtie Catalog) \cap \pi_{sid}(\sigma_{color=green}(Parts) \bowtie Catalog)$

5. $\pi_{sid,pid}(Catalog)/\pi_{pid}(Parts)$

6. $\pi_{sid,pid}(Catalog)/\pi_{pid}(\sigma_{color=red}(Parts))$

7. $\pi_{sid,pid}(Catalog)/\pi_{pid}(\sigma_{color=red \vee color=green}(Parts))$

8. $\pi_{sid,pid}(Catalog)/\pi_{pid}(\sigma_{color=red}(Parts)) \cup \pi_{sid,pid}(Catalog)/\pi_{pid}(\sigma_{color=green}(Parts))$

9. $\pi_{sid1,sid2}(\sigma_{cost1 > cost2}(\rho(CatPairs(1 \rightarrow sid1, 4 \rightarrow sid2, 3 \rightarrow cost1, 5 \rightarrow cost2), Catalog \bowtie_{pid=pid} Catalog)))$

   (I am assuming here that the result of joining Catalog to Catalog on pid is a relation with 5 attributes which will be renamed (sid1, pid, cost1, sid2, cost2), in that order.)

10. $\pi_{pid}(Catalog \bowtie_{pid=pid, sid \neq sid} Catalog)$

11. This is easy with aggregation, but harder with just the operators in the book. I did it using the book operators just to show how it can be done. First I cross Catalog with Catalog to get a relation consisting of all pairs of Catalog records. Then I select only the entries where the cost of the first part is greater than or equal to the cost of the second, and join that with Suppliers to get all pairs of parts supplied by Yosemite Sham. This will ensure that there is at least one part that occurs in a pair with every other part because it has higher (or equal) cost than all other parts. The final step does a division to find those first parts in the pair that go with *every* part—these are the ones that have maximum cost.

$\rho(CatPairs(1 \rightarrow sid1, 2 \rightarrow pid1, 3 \rightarrow cost1, 4 \rightarrow sid2, 5 \rightarrow pid2, 6 \rightarrow cost2), Catalog \times Catalog)$

$\rho(CostPairs, \sigma_{sname='Yosemite\ Sham'}(Supplier) \bowtie_{sid1=sid \wedge sid2=sid} \sigma_{cost1 \geq cost2}(CatPairs))$

$\pi_{pid1,pid2}(CostPairs)/\pi_{pid2}(CostPairs))$

12. $\pi_{pid,sid}(Catalog)/\pi_{sid}(Catalog) \cap \pi_{pid,cost}(Catalog)/\pi_{cost}(\sigma_{cost < 200}(Catalog))$

4.4

1. Nothing—the π_{sid} operation returns an empty set. (If it was projecting to pid, then it would be computing the names of suppliers that sell red parts for less than $100. I feel like this is a mistake in the book.)

2. Nothing—it's trying to project to sname from a relation that only has sid.

3. Names of suppliers that provide red parts for less than $100 and green parts for less than $100.

4. sids of suppliers that provide red parts for less than $100 and green parts for less than $100.

5. Names of suppliers that provide red parts for less than $100 and green parts for less than $100.

19.8

1. a. The minimal cover is {AB -> C, AC -> B, BC -> A}. It is in BCNF.

b. The minimal cover is {AB -> C, AC -> B, BC -> A, B -> D}. It is in 1NF. The B -> D FD violates 3NF because B is a proper subset of a key (key ABC). It can be decomposed into ABC, BD which are both in BCNF

c. The minimal cover is {AB -> C, AC -> B, BC -> A, E -> G}. This is not in 3NF because in E -> G, E is a proper subset of a key (key ABCE). It can be decomposed into ABCE, EG which are both in BCNF.

d. The minimal cover is {E -> G}. This is not in 3NF because E -> G causes a violation: E is a proper subset of a key (key DCEH). It can be decomposed into DCEH, EG, which are both in BCNF.

e. The minimal cover is {AC -> E}. This is not in 3NF because AC -> E causes a violation: AC is a proper subset of a key (key ACH). It can be decomposed into ACH, ACE, which are both in BCNF.

2. Set (b) is lossless-join. Set (a) is dependency-preserving.