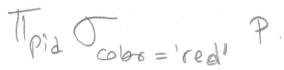
1. Writing queries (SQL and Relation Algebra

For each of the following questions, provide a relational algebra expression that solves it, and its corresponding SQL statement. You can refer to Parts as P, Suppliers are S, and Catalog as C.

(a) [4] Find the **pid** of all the parts that are color *red*.



(b) [4] Find **sid** of suppliers who supply at least one *red* and at least one *blue* part.

(c) [4] Find the **address** of the suppliers who supply the part with **pname** Fire Hydrant Cap.

(d) [4] Find the **pid** of parts in the catalog that that do not have a price (price is not null).



(e) [4] Find out how many tuples in the catalog have a price.

[4] Find out the number of parts that are in the relations Parts (how many tuples are in the relation Parts). (g) [4] For each part in the Parts relation, list its pid, and the number of suppliers that sell (h) [4] For each part in the Catalog relation, list its **pid**, its most expensive price, and the sid of the supplier which sells it at that price. Exactly ore: Two Or More TTRIP - Two Or More. Zor more suppliers.

exactly one supplier. (i) [4] List the **pid of parts that are sold by exactly 2 suppliers. TT (P, M) (P1. Pid = Pid A P. sid \to P. sid (j) [4] List the pname of the parts that are not in the catalog relation. Prame Protopid IN (Tpgc))

2. Normalization

- (a) [5] Consider a relation R(A, B, C, D) with the following functional dependencies (FDs): $A \to B, BC \to D$. Which of the following FDs can be derived from them? Show all your work.
 - $AC \rightarrow D$ Yes.
 - $B \to D$

. comdidate.

(b) [5] Given the relation R(A,B,C) and the set of functional dependencies $F = \{AB \to C, B \to A, C \to B\}$. Find all the keys of this relation. Show all your work.

B,C

(c) [5] Consider the relation B(A,B,C,D), with the following functional dependencies: $AB \to D$, $B \to C$, $C \to B$. Its candidate keys are AB and AC. Is R in BCNF? Is R in 3NF? Show all your work.

(d) [5] Let relation R = (A, B, C), and assume the following set of FDs: $A \to B, B \to C$, $C \to A$. Compute the projection of its set of FDS into the subrelation $R_1 = (A, B)$. Show all your work.

(e) [5] Consider the relation R(A, B, C, D, E) with set of functional dependencies F = $\{AB \to C, AB \to E, E \to A, E \to B, C \to D\}$. F is minimal, and the keys of the relation are AB, and E. This table is not 3NF. Decompose it, using synthesis, into a set of relations that are loss-less join and dependency preserving (you do not have to demonstrate that the resulting relations satisfy these last two properties). Show all your work.

find projection of fils.

ABC Projection of ABO

End of examination

Total pages: 6

Total marks: 65