Exam 2 CS348 Database Systems Name:_____

1. Briefly and in your own words (not the textbook's) explain what a functional dependency **α→β** on a relation **R** means.

   Whenever two tuples agree on **α** they agree on **β**.

2. If the functional dependency **αβ →γ** is valid for a relation schema **R** can we conclude that the dependency **β →γ** is also valid? Show why or why not.

   No. A simple counterexample is easy to construct. Look at the table in question 4 and let **α=A, β=B,** and **γ=C**

3. Is the following relation in *First Normal Form*? Briefly explain why or why not.

PNO	Pname	Available colors	City	Weight
1	Nut	Red, blue, green	Paris	5
2	Bolt	Orange	NYC	6

   No, Available colors is non-atomic.

4. Consider the relation schema ***R = (A,B,C)*** and an instance **r** below:

A	B	C
a1	b1	c1
a2	b3	c3
a3	b2	c2
a3	b1	c4

   a. What non-trivial functional dependencies could currently hold for **r**?

      There are six, **C→A, C→B, C→AB, AB→C, AC→B, BC→A**

   b. What are the possible candidate keys for **r**?

      C

   c. What are the possible super-keys for **r**?

      C, AB, BC, AC, ABC

5. Consider the following set ***F*** of functional dependencies on a relation schemea ***R=(A,B,C)***.
   F = { A → BC, B →C }

   a. Compute the closure F^+ of ***F***. (Do not include trivial dependencies)

      F^+ = { ***A → BC, B → C, A→B, A→C, AC→BC, AB→BC, AB→C, AC→B, AB→AC***}

b. Is ***F*** a canonical cover for ***R***? If it is explain why, if it is not, give the canonical cover.

No, { *A → B, B → C* } is the canonical cover.

6. Consider the following set of dependencies ***F*** on a relation scheme ***R = (V,W,X,Y,Z).***
F= { V →WX, XY→Z, W→Y, Z→V }

a. Compute the *attribute closure* Z^+ of ***F***.

$Z^+ = \{V,W,X,Y,Z\}$

b. Is ***Z*** a candidate key? Show why or why not?

Yes, it determines every other attribute.

c. Is there another candidate key? Explain why or why not?

Yes, V is as well. Compute V^+ to see.

7. Given the dependencies from question 6 is the decomposition ***(W,X,Z)*** and ***(V,Y,Z)*** lossless? Show why or why not.

Let R_1={W,X,Z} and **R_2={V,Y,Z}** since $R_1 \cap R_2 = \{Z\}$ and Z is a candidate key by 6a then $R_1 \cap R_2 \rightarrow R_1$ so the decomposition is lossless. By the way, $R_1 \cap R_2 \rightarrow R_2$ also, but only one is requred to hold. Note: I did not ask that the decomposition be dependency preserving.

8. Is the functional dependency ***WX→V*** valid for the set of dependencies in 6? Show why or why not.

Yes, V is in $\{WX\}^+$

9. Give a lossless decomposition of ***R*** from question 6 into BCNF.

There are lots of correct aswers, but many that are wrong as. In particular make sure you don't put W and Y in the same relation since ***W→Y*** and W is not a super-key. So **R_1 = (V,X,Y,Z)** and **R_2 = (W,Z)** will do.

10. Consider a university database that keeps track of current students, courses, and academic departments. A student has a name and an ID. A course has a name, a number, and a department. A department has a name. Students take one or more courses, departments offer one or more courses, and departments have zero or more students as majors. A course can be either a lecture course or a lab course. Functional requirements include needing to know what courses a department offers, what students are enrolled in what courses, current majors in a department, and looking up information about specific students, courses, and departments.

a. Draw an E-R diagram that best represents the university database.

b. What are the relation schemas for your database?

Everyone got this correct.