Concrete Math

First Day Problems January 30, 2018

In the counting problems below you have a collection of balls and a number of buckets. You place all the balls in buckets so that each ball has been placed. There will be either no restriction on the number of balls that can be in any bucket or you will be restricted to at most one, or at least one. Also in each case the balls are either numbered or not and the buckets are numbered or not. Your task is to determine how many ways the balls can be placed into the buckets subject to the constraints given

1. Place B *labeled* balls into U *labeled* urns with
    a. No restriction
    b. At most one ball per urn
    c. At least one ball per urn
2. Place B **unlabeled** balls into U *labeled* urns with
    a. No restriction
    b. At most one ball per urn
    c. At least one ball per urn
3. Place B *labeled* balls into U **unlabeled** urns with
    a. No restriction
    b. At most one ball per urn
    c. At least one ball per urn
4. Place B **unlabeled** balls into U **unlabeled** urns with
    a. No restriction
    b. At most one ball per urn
    c. At least one ball per urn

Solve the 12 problems above in any way, with 7 balls and 3 urns.

Solve the 12 problems above in any way, with 4 balls and 8 urns.

Find isomorphisms for at least 4 of the above 12 problems into different counting problems.