1.

a) π country(Users)

Assume that there must be at least one record or tuple

Arity : 1

Cardinality – Min: 1 Max: 100

b) Mail=⋈Mail.mailID=Recipients.mailIDRecipients

Arity: 9

Assume that each mail has at least 1 recipient (to meet join condition perfectly)

Cardinality – Min: 2000 Max: 3500

c) Mail \* Labels (Natural Join)

Arity: 8

Cardinality: 2500

2.

a) π fname, lname, userID, subject, timeSent (σurgent=True (Mail⋈Mail.senderID=Users.userIDUsers))

b)

table1 🡨 σurgent=TrueΛcountry≠’USA’ (Mail⋈Mail.senderID=Users.userIDUsers)

RSLT 🡨 πuserID (table1)

c)

important 🡨 (Mail \* (σlabel=’important’Labels))

table1 🡨 σurgent=False Λ timeSent≥‘2015-01-01 00:00:00’ Λ timeSent<’2016-01-01 00:00:00’(important)

RSLT 🡨 Fcount mailID(table1)

d)

AdaUserID 🡨 πuserID(σfname=’Ada’Λlname=’Lovelace’(Users))

AdaMails 🡨 AdaUserID⋈AdaUserID.userID=Mail.senderIDMail

RecFromAda 🡨 πRecipient.recipientID(Recipients \* AdaMails)

EveryoneExceptAda 🡨 πmailID(Recipients \* RecFromAda) - πmailID(AdaMails)

SendersExceptAda 🡨 πsenderID(Mail \* EveryoneExceptAda)

RSLT 🡨 πRfname, lname(SendersExceptAda⋈SendersExceptAda.senderID=Users.userIDUsers)

e)

senderInUSA 🡨 πmailID(σcountry=’USA’ (Mail⋈Mail.senderID=Users.userIDUsers))

recipientInUSA 🡨 πmailID(σcountry=’USA’ (Recipients⋈Recipients.recipientID=Users.userIDUsers))

senderRecipientInUSA 🡨 senderInUSA ∪ recipientInUSA

RSLT 🡨 πmailID(senderRecipientInUSA \* (σreplyTo=NULLMail))