4 (a) Required RA is P ∩ Q where:

P: $\pi_{w1.cname,\ w1.pid,\ w1.salary}(W_1 - \sigma_{w3.pid = w4.pid \wedge w3.salary \leq w4.salary}\ (W_3 \bowtie W_4))$

Q: $\pi_{w2.cname,\ w2.pid,\ w2.salary}(W_2 \bowtie_{w2.pid = k.pid1} K \bowtie_{k.pid2 = ps.pid} \pi_{ps.pid}\ (\sigma_{skill = \text{'OperatingSystems'}}(pS))$

5 (a) Required RA is P ∩ Q where:

P: $\pi_{w1.cname,\ w1.pid,\ w1.salary}(\sigma_{w1.pid = p1.pid}(W_1 \bowtie P_1) - \sigma_{w3.pid = w4.pid \wedge w3.salary < w4.salary}\ (W_3 \bowtie W_4) \bowtie \sigma_{w3.pid = p2.pid}\ (P_2))$

Q: $\pi_{p1.pname,\ w1.salary,\ p1.city}(\sigma_{w1.pid = p1.pid}(W_1 \bowtie P_1) - \sigma_{w3.pid = p2.pid}(W_3 \bowtie P_2 \bowtie_{p2.pid = ps.pid} \pi_{ps.pid}\ (\sigma_{ps.skill = \text{'Networks'}}(pS))))$

6 (a) Required RA is P:

P: $\pi_{c1.cname,\ c2.cname}((\sigma_{p1.city \neq \text{'Chicago'} \wedge p2.city \neq \text{'Chicago'}}(C_1 \bowtie_{c1.cname \neq c2.cname} C_2 \bowtie_{c1.cname = w1.cname} W_1 \bowtie_{c1.cname = w2.cname} W_2 \bowtie_{w1.pid = p1.pid} P_1 \bowtie_{w2.pid = p1.pid} P_2))$

7 $\pi_{pid}(P) \subseteq \pi_{p1.pid}(P_1 \bowtie_{p1.pid=h.eid} H \bowtie_{h.mid=p2.pid} (P_2)) \cap \pi_{p1.pid}(P_1) \bowtie_{p1.pid=k.pid1} K \bowtie_{k.pid2=p2.pid} (P_2))$

8 *(Everyone at amazon knows at least 3 people)*

$\pi_{p.pid}(\sigma_{w.cname = \text{'Amazon'}}(W)) - (\pi_{p.pid}(P \bowtie_{p.pid = k1.pid1} K_1 \bowtie_{p.pid = k2.pid1 \wedge k1.pid2 \neq k2.pid2} K_2 \bowtie_{p.pid = k2.pid1 \wedge k1.pid2 \neq k3.pid2} K_3)) = \emptyset$

9 $\pi_{pid}(P) \notin \pi_{w1.pid}(W_1 \bowtie_{w1.cname = cl.cname}\ (\sigma_{cl.city = \text{'Cupertino'}}(cL))) \cap \pi_{w2.pid}(W_2 \bowtie_{w2.salary < wl.salary} W_3 \bowtie_{w3.pid <> ps.pid} (pS))$