

# 1

Q1. b) RA

i)

$ppe\_or\_testing := \sigma_{tagname='PPE' \vee tagname='Testing'}(ProductTag)$   
 $names := \pi_{sname}(ppe\_or\_testing \bowtie Catalog \bowtie Suppliers)$

ii)

$ppe\_filter := \sigma_{tagname='PPE'}(ProductTag) \bowtie \sigma_{cost < 10 \wedge cost > 420}(Catalog)$   
 $sids := \pi_{sid}(ppe\_filter)$

iii)

$to\_remove := \sigma_{tagname='PPE'}(ProductTag) \bowtie \sigma_{10 \leq cost \leq 1337}(Catalog)$   
 $sids := \pi_{sid}(Catalog) - \pi_{sid}(to\_remove)$

iv)

$cleaning := \rho_{cleaning}(\pi_{pid}(\sigma_{tagname='Cleaning'}(ProductTag)))$   
 $suppliers := \sigma_{sid}(Catalog \div cleaning)$

v)

$cat1 := \rho_{cat1}(Catalog)$   
 $cat2 := \rho_{cat2}(Catalog)$   
 $pairs := \sigma_{cat1.sid < cat2.sid}(cat1 \times cat2)$   
 $filter := \sigma_{cat1.cost \geq cat2.cost \times 1.2}(pairs)$   
 $format := \rho_{format(sid1, sid2)}(\pi_{cat1.sid, cat2.sid}(filter))$

vi)

$cat1 := \rho_{cat1}(Catalog)$   
 $cat2 := \rho_{cat2}(Catalog)$   
 $unique := \sigma_{cat1.sid < cat2.sid \wedge cat1.pid = cat2.pid}(cat1 \times cat2)$   
 $format := \rho_{format(pid)}(\sigma_{cat1.pid}(unique))$

vii)

$suptech1 := \rho_{suptech1(sid, pid, cost)}(\pi_{Catalog.sid, Catalog.pid, Catalog.cost}((\sigma_{tagname='SuperTech'}(ProductTag) \bowtie Catalog \bowtie \sigma_{scountry='USA'}(Suppliers))))$   
 $suptech2 := \rho_{suptech2}(suptech2)$   
 $pairs := suptech1 \bowtie_{subtech1.cost < subtech2.cost} suptech2$   
 $less\_than\_something := \rho_{less\_than\_something(pid)}(\pi_{subtech1.pid}(pairs))$   
 $most\_expensive := \pi_{pid}(Products) - less\_than\_something$   
 $answer := \pi_{sid}(most\_expensive \bowtie Catalog)$

viii)

$suptech1 := \rho_{suptech1(sid, pid, cost)}(\pi_{Catalog.sid, Catalog.pid, Catalog.cost}((\sigma_{tagname='SuperTech'}(ProductTag) \bowtie Catalog \bowtie \sigma_{scountry='USA'}(Suppliers))))$   
 $suptech2 := \rho_{suptech2}(suptech2)$   
 $pairs := suptech1 \bowtie_{subtech1.cost < subtech2.cost} suptech2$   
 $less\_than\_something := \rho_{less\_than\_something(pid)}(\pi_{subtech1.pid}(pairs))$   
 $most\_expensive := \pi_{pid}(Products) - less\_than\_something$   
 $most\_expensive\_items := \rho_{most\_expensive\_items(sid, pid, cost)}(\pi_{subtech1.sid, subtech1.pid, subtech1.cost}(subtech1 \bowtie_{suptech1.pid = most\_expensive.pid} (most\_expensive))))$   
 $rem\_most\_exp1 := subtech1 - most\_expensive\_items$   

- Most expensive item removed, find the most expensive item in tables without the previous most expensive item, so find second most expensive item

 $rem\_most\_exp2 := \rho_{rem\_most\_exp2}(rem\_most\_exp1)$   
 $rem\_pairs := rem\_most\_exp1 \bowtie_{rem\_most\_exp1.cost < rem\_most\_exp2.cost} rem\_most\_exp2$   
 $rem\_less\_than := \rho_{rem\_less\_than(pid)}(\pi_{rem\_most\_exp1.pid}(rem\_pairs))$   
 $second := \pi_{sid}(Products) - most\_expensive - rem\_less\_than$   
 $answer := \pi_{sid}(second \bowtie Catalog)$

ix)

$products := \rho_{products}(pid, sid, cost)(\pi_{Product.pid, Suppliers.sid}(Product \bowtie Catalog))$   
 $unique := \pi_{pid}(R1)$   
 $all := products \div unique$   
 $filter := \sigma_{cost < 69}(all)$   
 $answer := \pi_{sid}(filter)$

x)

$\pi_{pid}(\sigma_{quantity=0}(Inventory))$

Q1. c) RA

i)

$Cat1 := \rho_{Cat1}(Catalog)$   
 $Cat2 := \rho_{Cat2}(Catalog)$   
 $JoinedSuppliers := Suppliers \bowtie_{Suppliers.sid=Cat1.sid} (Cat1) \bowtie_{Suppliers.subid=Cat2.sid} (Cat2)$   
 $Both := \sigma_{Cat1.pid=Cat2.pid}(JoinedSuppliers)$   
 $Stock := Both \bowtie_{Inventory.pid=Cat1.pid} (Inventory)$   
 $None := \sigma_{quantity=0}(Stock)$   
 $Format := \rho_{Format}(pid, sid1, sid2, cost1, cost2)(\pi_{Cat1.pid, Suppliers.sid, Suppliers.subid, Cat1.cost, Cat2.cost}(None))$

ii)

$Cat1 := \rho_{Cat1}(Catalog)$   
 $Cat2 := \rho_{Cat2}(Catalog)$   
 $Filtered := \sigma_{Cat1.sid <> Cat2.sid \wedge Cat1.pid=Cat2.pid \wedge Cat1.cost=Cat2.cost}(Cat1 \times Cat2)$   
 $Format := \rho_{Format}(pid, sid, cost)(\pi_{Cat1.pid, Cat1.sid, Cat1.cost}(Filtered))$

iii)

$Tag1 := \rho_{Tag1}(ProductTag)$   
 $Tag2 := \rho_{Tag2}(ProductTag)$   
 $Tag3 := \rho_{Tag3}(ProductTag)$   
 $Cross := Tag1 \times Tag2 \times Tag3$   
 $SameProduct := \sigma_{Tag1.pid=Tag2.pid=Tag3.pid \wedge Tag1.tagname <> Tag2.tagname <> Tag3.tagname}(Cross)$   
 $Filter := \sigma_{Tag1.tagname='PPE' \wedge Tag2.tagname='SuperTech'}(SameProduct)$   
 $Products := \rho_{pid}(\pi_{Tag1.pid}(Filter))$   
 $All := (Products \bowtie_{Products.pid=Catalog.pid} Catalog) \bowtie_{Products.pid=Product.pid} Product$   
 $Format := \rho_{Format}(pid, pname, cost)(\pi_{Products.pid, pname, cost}(All))$