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

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

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

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