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Q1. a) Convert to simple English sentences

i)
$$\pi_{sname}(\\
\quad \pi_{sid}(\\
\qquad (\sigma_{tagname='PPE'}ProductTag) \bowtie (\sigma_{cost<6}Catalog)\\
\quad) \bowtie Suppliers\\
)$$

Get the names of the suppliers that have PPE that costs less than 6.
[Outputs the suppliers that have products tagged with 'PPE' and a cost of less than 6]

ii)
$$\pi_{sname}(\\
\quad \pi_{sid}(\\
\qquad (\sigma_{tagname='PPE'}ProductTag) \bowtie (\sigma_{cost<6}Catalog) \bowtie Suppliers\\
\quad)\\
)$$

Nothing is returned from this operation.
[$(\sigma_{tagname='PPE'}ProductTag) \bowtie (\sigma_{cost<6}Catalog)$ returns the products with tag PPE and cost ¡ 6, columns are: tid, pid, tagname, sid, pid, cost. Natural join with supplier looks at common sid, so that returns the suppliers with products of tag PPE and cost ¡ 6. Projecting sid will result in each tuple only having an sid. Projecting the sname of a table where the tuples have only sid results in nothing being returned.]

iii)
$$\pi_{sname}(\\
\quad (\sigma_{tagname='PPE'}ProductTag) \bowtie (\sigma_{cost<6}Catalog) \bowtie Suppliers\\
) \cap \pi_{sname}(\\
\quad (\sigma_{tagname='SuperTech'}ProductTag) \bowtie (\sigma_{cost<6}Catalog) \bowtie Suppliers\\
)$$

Gets the names of the suppliers that offer PPE made by SuperTech that costs less than 6.

iv)
$$\pi_{sid}(\\
\quad (\sigma_{tagname='PPE'}ProductTag) \bowtie (\sigma_{cost<6}Catalog) \bowtie Suppliers\\
) \cup \pi_{sid}(\\
\quad (\sigma_{tagname='SuperTech'}ProductTag) \bowtie (\sigma_{cost<6}Catalog) \bowtie Suppliers\\
)$$

Gets the supplier IDs of suppliers that offer PPE or (inclusive) SuperTech products, both having a cost less than 6.

v)
$$\pi_{sname}(\\
\quad (\pi_{sid,sname}(\\
\qquad (\sigma_{tagname='PPE'}ProductTag) \bowtie (\sigma_{cost<6}Catalog) \bowtie Suppliers)\\
\quad) \cap (\pi_{sid,sname}(\\
\qquad (\sigma_{tagname='SuperTech'}ProductTag) \bowtie (\sigma_{cost<6}Catalog) \bowtie Suppliers)\\
\quad)\\
)$$

Get the names of the suppliers that offer PPE made up SuperTech with a cost less than 6.

Q1. b) Write relational algebra

i) $\pi_{snames}(\sigma_{(tagname='PPE') \vee (tagname='Testing')}ProductTag \bowtie Suppliers)$

ii) $(\pi_{sid}((\sigma_{tagname='PPE'}ProductTag) \bowtie (\sigma_{cost<10 \wedge cost>420}Catalog) \bowtie Suppliers))$

iii) $(\pi_{sid}((\sigma_{tagname='PPE'}ProductTag) \bowtie (\sigma_{cost\geq10 \wedge cost\leq1337}Catalog) \bowtie Suppliers))$

iv)
$R1 := \sigma_{tagname='Cleaning'}ProductTag$
$R2 := \pi_{sid,pid}(R1 \bowtie Catalog)$
$R3 := \pi_{pid}(R1 \bowtie Catalog)$
$R4 := R2 \div R3$

v)

vi)

vii)

viii)

ix)

x)