P1

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1. A) $\pi_{s.sid, s.sname}(((\rho_s(Student) \bowtie Buys) \bowtie Cites)$

B) (Let S = Student, $M1$ = Major, $M2$ = Major)

$\sigma_{s.sid, s.sname}((S \bowtie_{s.sid = M1.sid} M1)$
$\bowtie_{s.sid = M2.sid \land M1.Major \neq M2.Major} M2)$

C) (Let $b1$ = Buys, $b2$ = Buys)

With $E1$ as $b1.bookno \neq b2.bookno \land b1.sid = b2.sid$

$\pi_{b1.sid}(b1) - \pi_{b1.sid}(b1 \bowtie_{C_1} b2)$

D) (Let b = Book, bu = Buys)

With $E1$ as $\pi_{b.bookno, b.title}(Book)$,
$E2$ as $\pi_{bu.bookno, b.title}(\sigma_{bu.sid <=1001}($
$Bu \bowtie_{bu.bookno = b.bookno} B)$

$\boxed{\pi_{bookno, title}(E1 - E2)}$

E) Let s = Student, $bu1$ = Buys, $bu2$ = Buys, $b1$ = Book, $b2$ = Book

With $E1$ AS $((S \bowtie_{bu1.sid = s.sid} Bu1)$
$\bowtie_{bu2.sid = s.sid} Bu2) \times b1 \times b2$,
$E2$ AS $Bu2.bookno \neq Bu1.bookno \land Bu1.bookno =$
$b1.bookno \land Bu2.bookno = B2.bookno \land b2.price < 50$
$\land b1.price < 50$

$\boxed{\pi_{s.sid, s.sname}(\sigma_{E_2}(E_1))}$

F) (Let $m = $ Major, $b = $ book, $s = $ student, $bu = $ buys

With E1 as $\sigma_{m.major = 'cs'}(M))$
With E2 as $\pi_{b.bookno, s.student}(B \times S)$
With E3 as $\pi_{bu.bookno, E1.sid}(bu \bowtie E1)$

$\pi_{bookno}(E2 - E3)$

G) (Let $b = $ Book, $c = $ cites)

With E1 AS $\pi_{b.bookno, c.citedbookno, b.price}($
$\quad B \bowtie_{c.bookno = b.bookno} C),$
E2 As $\pi_{citedbookno}(\sigma_{price > 50}(E_1))$

$(\pi_{bookno}(B) \cup \pi_{bookno}(E1)) - \pi_{citedbookno}(E_2)$

H) (Let $b1 = $ book, $b2 = $ book, $c = $ cites, $bu = $ buys)

With E1 as $\pi_{b1.bookno, b2.bookno}(B1 \times B2)$
E2 as $\pi_{bookno, citedbookno}(C)$
E3 as $E2 - E1$
E4 as $bu \times E3$

$\pi_{bu.sid, E_3.bookno2}(\sigma_{bu.bookno = E_3.bookno1}(E4))$

J.) (Let $s1 = $ Student, $s2 = $ Student, $b = $ buys

With $E1$ as $s1 \times s2 \times b$

$E2$ as $s1 \times s2$

$E3$ as $s1.sid \neq s2.sid$

$E4$ as $E3 \wedge s1.sid = b.sid$

$E5$ as $E3 \wedge s2.sid = b.sid$

$E6$ as $\pi_{s1.sid, s2.sid}(\sigma_{E3}(E2))$

$E7$ as $\pi_{s1.sid, s2.sid, b.bookno}(\sigma_{E4}(E1))$

$E8$ as $\pi_{s1.sid, s2.sid, b.bookno}(\sigma_{E5}(E1))$

$E9$ as $\pi_{s1.sid, s2.sid}(E7 - E8)$

$$\pi_{s1.sid, s2.sid}(E6 - E9)$$

I) (Let $m = $ major, $bu = $ buys, $b1 = $ book, $b2 = $ book

With cs as $\pi_{sid}(\sigma_{major = \text{'cs'}}(M))$

csbooks as $\pi_{cs.sid, bookno}(cs \bowtie bu)$

$E1$ as $\pi_{b1.bookno, b2.bookno}(B1 \bowtie_{b1.bookno \neq b2.bookno} B2)$

$E2$ as $\pi_{cs.bookno}(csbooks \times B1)$

$E3$ as $\pi_{bn1, bn2}(\pi_{\rho(bn1) b1.bookno, \rho(bn2) csbooks.bookno, csbooks.sid}((B1 \times csbooks) - E2))$

bp as $E1 - E3$

$$\pi_{bp1.bn1, bp1.bn2}(\sigma_{bp1.bn1 = bp2.bn2 \wedge bp1.bn2 = bp2.bn1}(\rho(bp1) bp \times \rho(bp2) bp))$$