Joshua Baker

(let b = book, bu = buys, m = major)

A) $\pi_{m.sid, m.major}$ ($\sigma_{m.sid = bu.sid \,\wedge}$

$bu.bookno = b.bookno \wedge b.price < 20$ ($M \times Bu \times b$))

B) (let $bu1$ = buys, $bu2$ = buys, $b1$ = book, $b2$ = book)

With E1 as $bu1 \bowtie_{bu1.bookno = b1.bookno} b1$

E2 as $bu2 \bowtie_{bu2.bookno = b2.bookno} b2$

E3 as $\pi_{bu1.sid, b1.bookno}$ ($\sigma_{bu1.sid \,\wedge}$

$b1.price > b2.price$ ($E1 \times E2$))

$\pi_{sid, bookno}$ ($\pi_{bu1.sid, b1.bookno}$ ($E3$))

C) let bu = buys, c = cites, $b1$ = book, $b2$ = book

With E1 as $bu \bowtie_{bu.bookno = c.citedbookno} C$

E2 as $E1 \bowtie_{c.citedbookno = b1.bookno} B1$

E3 as $E2 \bowtie_{c.bookno = b2.bookno} B2$

$\pi_{s.sid, s.sname}$ ($\sigma_{r.sid = m.sid \wedge s.sid = bu.sid}$

$\wedge b1.price > b2.price \wedge m.major = 'cs'$ ($E3$))

D) Let $b = book$, $m = major$, $bu = buys$

With $E1$ as $\pi_{b.bookno, b.title, bu.sid}($
$\quad B \times M \times bu)$

$E2$ as $\pi_{b.bookno, b.title, bu.sid}($
$\quad \sigma_{m.major = 'cs' \wedge bu.bookno = b.bookno}$
$\quad \wedge m.sid = bu.sid}(B \times M \times bu)$

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

E) Let $b = book$, $s = student$, $m1 = major$,
$m2 = major$, $bu = buys$

With $E1$ as $(b \times (s \bowtie_{s.sid = m1.sid} M1)$
$\bowtie_{s.sid = m2.sid} M2) \times Bu$

$E2$ as $(b \times (s \bowtie_{s.sid = m1.sid} M1)$
$\bowtie_{s.sid = m2.sid} M2)$

$E3$ as $\pi_{b.bookno, b.title, s.sid}(\sigma_{m1.major = 'cs'}$
$\wedge M2.major = 'Math' \wedge s.sid = bu.sid \wedge$
$bu.bookno = b.bookno}(E1))$

$E4$ as $\pi_{b.bookno, b.title, s.sid}(\sigma_{m1.major = 'cs' \wedge}$
$M2.major = 'Math'}(E2))$

$E5$ as $\pi_{bookno, title, sid}(E4) -$
$\quad \pi_{bookno, title, sid}(E3)$

$E6$ as $\pi_{bookno, title}(b) - \pi_{bookno, title}(E5)$

$\boxed{\pi_{bookno, title}(E6)}$