

$$1. \pi_{\text{citedBookNo}} (\text{Cites} \bowtie (\sigma_{\text{price} < 50} (\text{Book})))$$

$$2. \pi_{\text{bookNo}, \text{Title}} (\text{Book} \bowtie \text{Buys} \bowtie (\sigma_{\text{major} = 'cs'} (\text{Major}) \bowtie \sigma_{\text{major} = 'math'} (\text{Major})))$$

$$3. \text{With CB as } \text{Cites} \bowtie \sigma_{\text{price} < 50} (\text{Book})$$

$$\pi_{\text{sid}, \text{bookNo}} \left(\text{Buys} \bowtie_{\text{bookNo} = \text{citedBookNo}} \left(\text{CB}_1 \bowtie_{\text{CB}_1, \text{citedBookNo} = \text{CB}_2, \text{citedBookNo} \wedge \text{CB}_1, \text{bookNo} < > \text{CB}_2, \text{bookNo}} (\text{CB}_2) \right) \right)$$

$$4. \text{With B as Book}$$

$$\pi_{\text{bookNo}} (\sigma_{B_1, \text{price} < B_2, \text{price}} (B_1 \bowtie B_2))$$

$$- \pi_{\text{bookNo}} (\sigma_{B_1, \text{price} < B_2, \text{price} \wedge B_2, \text{price} < B_2, \text{price}} (B_1 \bowtie B_2 \bowtie B_3))$$

$$5. \pi_{\text{sid}} (\text{Buys}) - \pi_{\text{sid}} \left(\pi_{\text{sid}, \text{bookNo}} (\text{buys} \times \sigma_{\text{price} > 50} (\text{Book})) - \pi_{\text{sid}, \text{bookNo}} (\text{Buys}) \right)$$

$$6. \pi_{\text{bookNo}} (\text{Book}) - \pi_{\text{bookNo}} \left((\text{buys}) \bowtie \sigma_{\text{major} = 'CS'} (\text{Major}) \right)$$

$$7. \pi_{\text{bookNo}} \left(\pi_{\text{sid, bookNo}} \left(\text{Book} \times \sigma_{\text{major} = 'CS'} (\text{Major}) \right) - \pi_{\text{sid, bookNo}} (\text{Buys}) \right)$$

$$8. E_1 = \text{Buys} \times \text{Book}. \quad E_2 = \text{Student} \times \text{Cites}.$$

$$\pi_{\text{sid, citedBookNo}} (E_1 - E_2).$$

$$9. \pi_{\text{sid, bookNo}} \left((\text{Student} \times \text{Book}) - (E_1 - E_2) \right)$$

$$10. E = (\text{Book}_1 \times \text{Book}_2) - \text{Cites}$$

$$E_4 = \sigma_{E_1.\text{citedBookNo} < E_2.\text{citedBookNo}} (E_1 \bowtie E_2)$$

$$E_5 = \sigma_{E_1.\text{citedBookNo} < E_2.\text{citedBookNo} \wedge E_2.\text{citedBookNo} < E_3.\text{citedBookNo}} (E_1 \bowtie E_2 \bowtie E_3)$$

$$\pi_{\text{bookNo}} (E_4 - E_5)$$