1.

a)

$\Pi_{\text{Bands.name, Musicians.name}}$
$[\sigma_{\text{Albums.year = 1970}}$
$(\sigma_{\text{Albums.year >= Musicians.from} \wedge \text{ Albums.year <= Musicians.to}}$
(Bands ⋈ Albums ⋈ Musicians)
)
]

b)

$\Pi_{\text{Bands.name, Musicians.name}}$
$[\sigma_{\text{Albums.year >= Musicians.from} \wedge \text{ Albums.year <= Musicians.to}}$
(
$[\sigma_{\text{Albums.year<= Bands.formedIn + 3}}$
(Bands ⋈ Albums)
]⋈ Musicians
)
]

c)

adrian ← $\sigma_{\text{name = “Adrian Belew”}}$(Musicians)

$\Pi_{\text{Albums.title, Albums.year}}$
$[\sigma_{\text{Albums.year < adrian.from}}$
(
$[\sigma_{\text{Bands.name = “King Crimson”}}$

(Bands ⋈ Albums)
] × adrian
)
]

d)

kingAlbums ← $\sigma_{\text{Bands.name = “King Crimson”}}$(Bands ⋈ Albums)

adrianAlbums ← $\sigma_{\text{kingAlbums.year>= Musicians.from ⋀ kingAlbums.year <= to}}$
[KingAlbums ⋈
($\sigma_{\text{name = “Adrian Belew”}}$(Musicians)
)
]

$\Pi_{\text{Albums.title, Albums.year}}$ (kingAlbums) – $\Pi_{\text{Albums.title, Albums.year}}$
(adrianAlbums)

2.
a)

surgery1 ← $\sigma_{\text{date.year < 1404 ⋀ date.year > 1402}}$(surgery)
surgery2 ← $\sigma_{\text{date.year < 1404 ⋀ date.year > 1402}}$(surgery)
Π surgeon.name, surgeon.surname
[(σ patient.city = “yazd”
[(σ surgery1.SID = surgery2.SID
⋀ surgery1.SSN = surgery2.SSN
⋀ surgery1.type != surgery2.type
⋀ surgery1.date != surgery2.date (surgery1 × surgery2)

) ⋈ Patient
]
) ⋈ surgeon]

b)

surgery1 ← surgery
surgery2 ← surgery
Π surgery1.SID, surgery2.SID[
σ surgery1.SID = surgery2.SID
⋀ surgery1.SSN < surgery2.SSN (surgery1 × surgery2)
]

c)

allType ← Π_{type}(surgery)

$\Pi_{SSN,\ type}$(surgery) ÷ allType

3.
a)

Π customer name, account number, balance
[
(
[σ branch.city = “yazd” ⋀ account.balance > 6000(account ⋈ branch)
] ⋈ depositor
) ⋈ customer
]

b)

$$cGetFromOther \leftarrow \Pi_{CID}$$
$$[$$
$$\Pi_{CID,\ branch\ name}(borrower \bowtie customer \bowtie loan \bowtie branch)$$
$$-$$
$$\Pi_{CID,\ branch\ name}(\sigma_{customer.city\ =\ branch.city}(customer \times branch))$$
$$]$$

$$\Pi_{customer\ name}$$
$$[$$
$$(\Pi_{CID}(borrower) - cGetFromOther$$
$$) \bowtie customer$$
$$]$$

c)

$$cNotGetL \leftarrow \Pi_{CID}$$
$$[\Pi_{CID,\ branch\ name}(\sigma_{customer.city\ =\ branch.city}(customer \times branch))$$
$$-$$
$$\Pi_{CID,\ branch\ name}(\sigma_{customer\ city\ =\ branch\ city}(borrower \bowtie customer \bowtie loan \bowtie branch))]$$

$$(\Pi_{CID}(borrower) - cNotGetL)$$