Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

person–passport: 1 : 1

author–book: M : N

customer–order: 1 : N

2.2

candidate keys: `id` and `email`

primary key `id`: it never changes, while an email can

2.3

in `orders`: `customer_id`

each order has exactly one customer, so one column is enough

2.4

`appointment(doctor_id, patient_id, start_time, notes)`

both ids are foreign keys

key `(doctor_id, patient_id, start_time)`: the same pair can meet many times

3.1

(a) `member(member_id, name, email)`; `book(isbn, title, author)`; `copy(copy_id, isbn)` with `isbn` a foreign key; `loan(loan_id, copy_id, member_id, out_date, back_date)`

(b) member–loan 1 : N; book–copy 1 : N

(c) title and author are stored once per book, while each copy has its own loans and condition

3.2

(a) `RESTRICT`: the delete is refused while loans exist; `CASCADE`: the loans are deleted too; `SET NULL`: the loans stay, with no member

(b) `RESTRICT` for open loans, so books are returned first; after that `SET NULL` keeps loan history for stock statistics without personal data

3.3

(a) columns `phone1`, `phone2`, `phone3` in `student`; a table `phone(student_id, number)` with one row per number

(b) $3 \times 10^4 = 30\,000$ cells, 14 000 used: **16 000** NULLs

(c) `... WHERE phone1 = '0574-1234' OR phone2 = ... OR phone3 = ...; SELECT student_id FROM phone WHERE number = '0574-1234'`

(d) the separate table: no NULLs, no limit of three, one simple query and one index

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