a)

Project all Item_id and Item_desc from ITEM table

$R1 = \pi_{\text{item\_id, item\_desc}} (\text{ITEM})$

Project all Item_id from APPT_SERV table

$R2 = \pi_{\text{item\_id}} (\text{APPT\_SERV})$

Subtracting item_id's which haven't been used

$R3 = \pi_{\text{item\_id}}, (\text{ITEM}) - R2 \bowtie R1$

Or

$\mathbf{R3 = ((\pi_{\text{item\_id}}, (\text{ITEM}) - \pi_{\text{item\_id}} (\text{APPT\_SERV})) \bowtie (\pi_{\text{item\_id, item\_desc}} (\text{ITEM}))}$

b)

Selecting patient who live in Mooroolbark

$R1: \sigma_{\text{patient\_city = Mooroolbark}} (\text{PATIENT})$

Selecting appointment dated on 08th September

$R2: \sigma_{\text{appt\_datetime = 08 September 2023}} (\text{Appointment})$

Joining Patient and Appointment on Patient_no

$R3: R1 \bowtie_{\text{R1.patient\_no = R2. patient\_no}} R2$

Extracting Emergency Contact Details based on the patient

$R4: \text{PATIENT} \bowtie_{\text{patient.ec\_id = emergency\_contact.ec\_id}} \text{EMERGENCY\_CONTACT}$

Joining Filtered result with emergency contact:

R5: R3 ⋈ R4

Projecting the required fields:

RF = π patient_no, patient_fname, patient_lname, ec_fname, ec_lname, ec_phone R5

c)

Selecting Specialization ID:

R1 = π spec_id (σ spec_name= ENDODONTICS (SPECIALISATION))

Projecting provider code with Specialization

R2 = PROVIDER ⋈ provider.spec_id = R1.spec_id R1

Joining Provider with spec_id to appointment

R3 = R2 ⋈ R2. provider_no = appointment.provider_no APPOINTMENT

Extracting Patient Details

R4: R3 ⋈ R3.patient_no = patient.patient_no (PATIENT)

Projecting the required fields:

RF = π patient_no, patient_fname, patient_lname patient_contactemail (R4)