Q1. The SafeBox customer tells you "The LED needs to light up at the time that the patient closes the pillbox compartment."

Q1.1 [5 pt] Which EARS template should be used to state this requirement?

Event-driven

Q1.2 [5 pt] What is that template's keyword?

WHEN

Q2 [10 pt] How does the SafeBox software know the state of the compartment's lid?

Sensors

Q3 [5 pt] Identify and briefly describe (one sentence) an exception (off-nominal) scenario for the SafeBox Scenario "Reschedule Missed Pill", where the normal scenario's precondition, "Compartment contains Pill," is also met in the exception scenario. (You are not constructing the scenario or its steps, you are merely identifying/describing it.)

[Answers will vary; needs to be an exception scenario that the software behavior of the "Reschedule Missed Pill" scenario responds to. Ex: pill can't be rescheduled due to medication conflict with other pills.]
[Note that answer can't be "pill missing", as that is given; can't be "no pill in compartment" as that's given.]

Q4 The Mine Safety Control System (MSCS) is a software controller for a new mine safety system. The following description of it is copied, with a few changes, from A. van Lamsweerde, Requirements Engineering, Wiley, 2009. Sump definition (google dictionary): "a pit or hollow in which liquid collects, especially one in the floor of a mine or basement."

[System-as-is.] Miners are exposed to multiple hazards while working inside a mine. These include life-threatening levels of percolating water, carbon monoxide, and methane. Currently, human supervisors have to alert miners inside the mine for prompt evacuation when any of those levels is estimated to be dangerous.

Sumps are placed at selected places in the mine for water collection. Each sump is equipped with a pump. The water level in each sump is regularly checked by operators to see if the water level is too high. When this level is too high, the corresponding pump must be turned on by an operator to pump the water out of the mine. To avoid the risk of explosion, pumps may not be operated when the methane level exceeds a critical threshold.

The current situation results in unacceptable exposure to risks, due to: possible human lack of awareness or misjudgment of potentially dangerous situations; sudden flows of gas or water without operators at the right place to act on them; or pump-functioning problems. On the other hand, lack of accurate assessment sometimes results in unnecessary evacuations. The labor cost of safety control is another concern.

[System-to-be.] To address these problems, a distributed safety control system will be installed. Each sump will be equipped with water-level sensors to detect when the water is above a *high* or below a *low* level, respectively. A software-based controller, the MSCS, will need to turn a pump

on whenever the water in the corresponding sump has reached the *high* water level, and *off* whenever the water has reached the *low* water level.

The mine will also be equipped with sensors at selected places to monitor the carbon monoxide and methane levels. The MSCS will need to sound an alarm in the mine and inform the operator within one second whenever any of these levels has reached a critical threshold, so that the mine can be evacuated promptly.

Human operators can also use the MSCS to remotely control the operation of a pump, but within limits. An operator can command a pump *on* or *off* if the water is between the *low* and *high* water levels. A special operator, the supervisor, can use the MSCS to command the pump *on* or *off* without this restriction.

The Mine Safety Control System also will maintain sensor readings and pump operation records for history tracking and analysis of anomalies.

Q4.1 [10 pt] List the Adjacent Systems that are not sensors in the Context Diagram for the Mine Safety Control System. (No drawings, and don't list sensors.)

Pump, Alarm, Operator
[Note: software doesn't communicate with sump itself.]

Q4.2 [10 pt] List the data/signals that the Mine Safety Control System sends to Adjacent Systems in its Context Diagram. Hint: Consider the labels on arrows from the "work" in the Context Diagram. (No drawings.)

Turn Pump On/Off
Turn Alarm On/Off
Alert Operator

Q4.3 [10 pt]. Which of these use cases does not/do not belong in the *Product Use Case Diagram* for the Mine Safety Control System? Give the numbers only.

1. Methane sensors placed appropriately
2. Record sensor readings
3. Switch pump on,
4. Pump malfunctions
5. Carbon monoxide reaches dangerous levels
6. Miners evacuate mine area

1, 4, 5, 6

Q4.4[10 pt] What is the rationale for the requirement to keep the pump off if the methane level is high?

Avoid explosion

Q5 [10 pt] [Credit: adapted from IREB e.V., source & owner of the copyright]
Which two of the following approaches are particularly well suited to elicit and document the requirements in this case?

a) Establishing a glossary
b) Facilitating a creativity workshop
c) Creating a use case diagram and documenting the use cases
d) Eliciting and documenting the quality requirements
e) Creating a class model

a & c

Q6 [5 pt] What category of nonfunctional requirement is this, according to the Robertsons (textbook authors)? "FINDER shall save parameter settings in a persistent way so that they can be restored after battery failure."

Performance [Reliability is OK, as it's part of performance]
[Note: Read the definitions in Chap. 11 before requesting a re-grade on this question to see why usability, operational & environmental, and maintainability & support are wrong answers.]

409 Only: Q7 Answer with "True" or "False" for each.

Q7.1 [5 pt] "The X software application shall comply with the accessibility standards of company Y, available at Y.com/Z" is a non-functional requirement.
True
Q7.2 [5 pt] "The system shall have high availability from 8 a.m. to 6 p.m on weekdays" is a non-functional requirement.
True
Q7.3 [5 pt] Some requirements describe qualities the software product being developed must have instead of what it must do.
True

Q7.4 [5 pt] Sending an "TURN OFF" command to the SafeBox LED is an event, not an state.
True

509 Only:
Q7 [10 pts] According to Van Lamsweerde's definition in the paper you read for HW2, is this a soft goal? Explain why or why not.
"SafeBox should notify the caregiver as soon as possible about a missed pill."

Yes.

Expresses a preference among alternatives.

[from paper, p. 3: "Unlike behavioral goals, a *soft goal* cannot be established in a clear-cut sense. It prescribes preferences among alternative system behaviors, being more satisfied along some alternatives and less satisfied along others. Behavioral goals are therefore used for deriving system operations to satisfy them whereas soft goals are used for comparing alternative options to select most preferred ones .]

509 Only:
Q8 [10 pts] [Adapted from Van Lamsweerde 2009]
Consistent with the Jackson and Zave paper, label each of these as a "Shared phenomenon", an "Environmental phenomenon", a "Software phenomenon", OR an "Environmental assumption".

(a) Train is physically moving.

Environmental Phenomenon. [the software can't directly observe whether it's moving or not]

(b) Train's measured speed is X.

Shared phenomenon [the speedometer in the environment controls the speed; the software can observe the measured speed]

(c) Train's position is updated in the controller's internal database.

Software phenomenon [the software controls the value of the train-position variable; the environment can't observe the variable's value