

Study Guide — BI Problem 1: Emergency Room (End-of-Unit Cumulative Test)

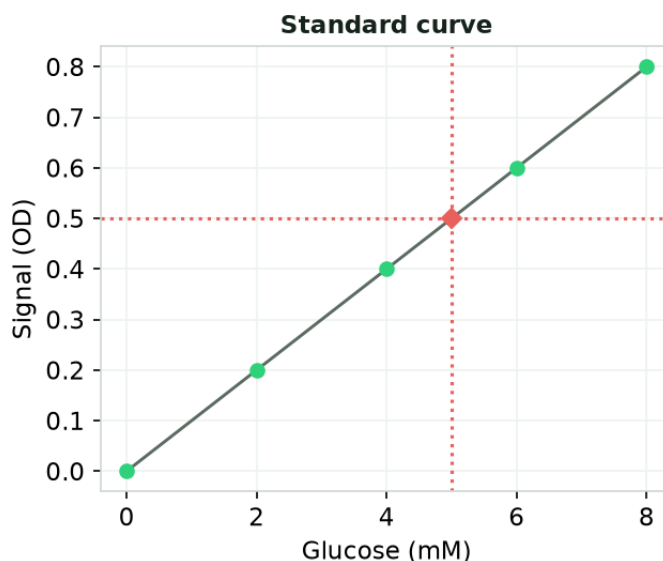
Biomedical Innovations · Problem 1 — Emergency Room · Modeled on the PLTW Guided Review format

Vocabulary to know cold

Term	Definition
Cold chain	Keeping a temperature-sensitive specimen continuously cold from collection through analysis using insulation.
Sharps container	Rigid, puncture-resistant container for needles, lancets, scalpel blades, and glass capillaries.
Biohazard bag	Red bag for soft waste contaminated with blood or body fluids.
Pre-analytical error	Error before testing — wrong tube, mislabeling, delayed or improper-temperature transport.
Accuracy	How close a measurement is to the true value.
Precision	How close repeated measurements are to each other (reproducibility).
Sensitivity	Ability of a test to correctly identify true positives (few false negatives).
Specificity	Ability of a test to correctly identify true negatives (few false positives).
Standard curve	A graph of known concentrations vs. signal used to estimate an unknown sample's concentration.
Correlation	A statistical association between two variables; positive (rise together), negative (one rises as other falls).
Replication	Repeating trials/measurements to improve reliability and reduce random error.
Control	A known reference (e.g., known sample or standard protocol) used to judge whether a test or experiment is working.

Worked examples (follow the reasoning)

Example 1. Use the standard curve to estimate the glucose concentration of an unknown sample that gives a signal of OD 0.50.



- Identify the linear relationship: each 2 mM raises OD by 0.2, so $OD = 0.1 \times \text{concentration}$.
- Set the unknown signal equal to the relationship: $0.50 = 0.1 \times \text{concentration}$.
- Solve for concentration: $\text{concentration} = 0.50 / 0.1 = 5$.
- Read off the curve to confirm OD 0.50 falls at ~5 mM.

Answer: About 5 mM.

Example 2. A technician's five repeated readings of a control are tightly grouped but consistently 15% above the true value. Classify the precision and accuracy and suggest a fix.

- Tight grouping of repeats indicates HIGH precision.
- A consistent offset from the true value indicates LOW accuracy (systematic error/bias).
- Systematic offsets usually come from a mis-calibrated instrument.
- Recalibrate the instrument against a known standard, then re-measure the control.

Answer: Precise but not accurate (systematic bias); recalibrate the instrument against a known standard.

Example 3. At the end of a POC testing shift you have used lancets, a blood-soaked gauze, an empty in-date reagent bottle, and leftover liquid chemical reagent. Where does each go?

- Lancets are sharp and can puncture skin -> rigid sharps container.
- Blood-soaked gauze is contaminated soft waste -> red biohazard bag.
- Empty, non-contaminated reagent bottle -> per facility policy (often regular or recycling if rinsed/non-hazardous).
- Leftover liquid chemical reagent -> labeled chemical waste container, never down the sink.

Answer: Lancets -> sharps container; gauze -> biohazard bag; empty bottle -> regular/recycling per policy; liquid reagent -> labeled chemical waste container.

Practice questions (with reasoning)

1. A specimen drawn into the wrong tube type is an example of:

- A. An analytical error
- B. A pre-analytical error
- C. A post-analytical error
- D. No error

Answer: B. Wrong tube selection happens before testing, so it is pre-analytical.

2. On a scatter plot, points trend downward from upper-left to lower-right. This shows a:

- A. Positive correlation
- B. Negative correlation
- C. No correlation
- D. Causation

Answer: B. A downward trend is a negative correlation; it does not by itself prove causation.

3. Which is the strongest experimental design for testing a new triage protocol?

- A. Test 2 patients once with no comparison
- B. Test many patients with both the new and existing protocol and replicate measurements
- C. Ask one nurse her opinion
- D. Use the protocol only on the healthiest patients

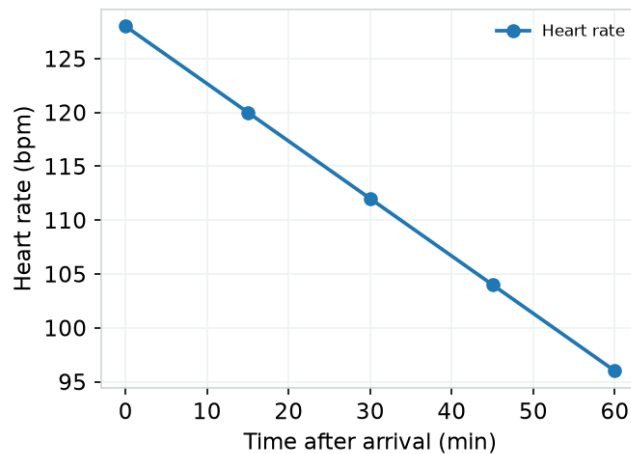
Answer: B. A large sample, a control (existing protocol), and replication give reliable, comparable data.

4. A used scalpel blade must be discarded in the:

- A. Biohazard bag
- B. Sharps container
- C. Regular trash
- D. Sink

Answer: B. Sharp, puncture-capable items always go in the sharps container.

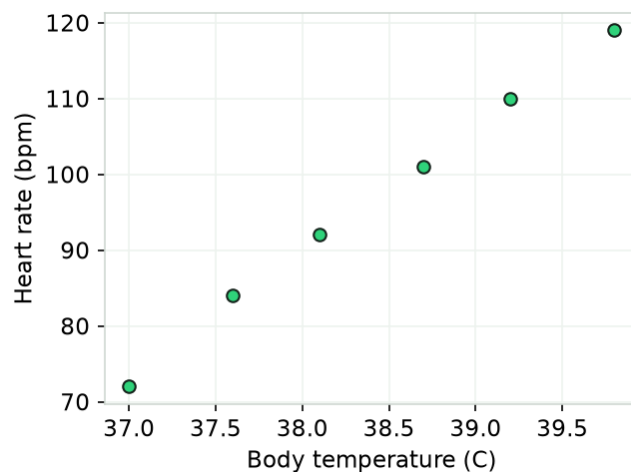
5. The graph shows a triage patient's heart rate recorded every 15 minutes after arrival. What does the trend indicate about the patient's status during the first hour?



- A. The heart rate is rising, suggesting the patient is deteriorating
- B. The heart rate is steadily falling toward normal, suggesting the patient is stabilizing
- C. The heart rate is unchanged
- D. The data show no measurable pattern

Answer: B. The line falls from 128 to 96 bpm over the hour, a steady decline toward a normal resting range that indicates the patient is stabilizing.

6. The scatter plot compares each patient's measured body temperature with measured heart rate. What relationship between the two variables does the study data show?



- A. No correlation
- B. A negative correlation
- C. A positive correlation, though this alone does not prove fever causes the higher rate
- D. The data prove that fever causes a higher heart rate

Answer: C. As temperature rises, heart rate rises together with it (positive correlation); correlation by itself does not establish causation.