

M5–M8 Mixed Quiz 1 (15 MC)

2025-08-26

Instructions: Choose the best answer. SI units and precise terminology are expected.

1 Questions

- 1) Module 5 — In planning a fair test, which statement best distinguishes validity from reliability?
 - A. Validity refers to how close measurements are to the true value; reliability refers to random error only.
 - B. Validity concerns whether the investigation answers the research question; reliability concerns consistency of repeated measurements.
 - C. Validity is improved by increasing sample size; reliability is improved by eliminating systematic error only.
 - D. Validity is about calibration; reliability is about accuracy.
- 2) Module 5 — A data logger sampling temperature every 0.20 s records 5 significant figures. The sampling rate is best reported as:
 - A. 0.20 Hz
 - B. 2.0 Hz
 - C. 5.0 Hz
 - D. 20 Hz
- 3) Module 6 — A strain gauge is calibrated using standard masses. The best practice to reduce systematic error in calibration is to:
 - A. Randomise the order of applied masses and repeat each three times.
 - B. Zero the gauge before each mass and verify linearity across the full range.
 - C. Increase the sampling frequency during calibration runs only.
 - D. Use more decimal places when reading the masses.
- 4) Module 7 — A media article claims a new supplement “doubles energy levels” based on an online poll ($n = 84$). The most critical flaw is:
 - A. Absence of double-blind procedure

- B. Small sample size alone
 - C. Non-representative, self-selected sample lacking experimental control
 - D. Failure to report p-values below 0.05
- 5) Module 8 — Which statement best captures a precautionary approach in science and society decisions?
- A. Adopt new technologies immediately; risks can be mitigated later.
 - B. Delay adoption until proof of zero risk is obtained.
 - C. Where plausible serious harm is indicated, shift burden of proof to proponents to demonstrate safety.
 - D. Use cost–benefit analysis and ignore uncertainty.
- 6) Module 5 — In an investigation of enzyme activity vs temperature, the independent variable is:
- A. Enzyme concentration
 - B. Reaction temperature
 - C. Rate of product formation
 - D. pH buffer identity
- 7) Module 6 — The resolution of a 12-bit ADC over 0–5.0 V is approximately:
- A. 1.2 mV per count
 - B. 0.61 mV per count
 - C. 5.0 mV per count
 - D. 0.12 mV per count
- 8) Module 7 — Which best distinguishes correlation from causation when evaluating claims?
- A. Correlation implies causation when $r > 0.7$.
 - B. Causation requires controlled manipulation of variables with confounders accounted for; correlation alone does not.
 - C. Correlation requires temporal precedence; causation does not.
 - D. Causation exists if two variables change together in observational data.
- 9) Module 8 — Which is the most ethical approach when human participants are involved?
- A. Proceed with implied consent if the risk is minimal.
 - B. Obtain informed consent, ensure confidentiality, and allow withdrawal without penalty.
 - C. Provide incentives sufficient to ensure participation.
 - D. Blind participants to risks to avoid nocebo effects.
- 10) Module 5 — A control improves an investigation by:
- A. Eliminating both systematic and random errors.
 - B. Providing a baseline for comparison to isolate the effect of the independent variable.
 - C. Increasing accuracy by adding more instruments.

- D. Ensuring validity through replication alone.
- 11) Module 6 — A sensor has drift over time. The most appropriate mitigation is to:
- A. Increase the sampling frequency.
 - B. Apply frequent zeroing and schedule periodic recalibration against standards.
 - C. Use moving average smoothing on outputs only.
 - D. Replace the sensor with a higher-resolution model.
- 12) Module 7 — An advertisement quotes a single expert’s opinion without data. This is an example of:
- A. Appeal to authority
 - B. Ad hominem
 - C. Slippery slope
 - D. Straw man
- 13) Module 8 — In risk–benefit assessment for a new diagnostic test, which is most appropriate?
- A. Prioritise benefits; risks are acceptable if optional.
 - B. Weigh sensitivity/specificity, cost, equity of access, and potential harms from false outcomes.
 - C. Adopt if the mean benefit exceeds the mean risk.
 - D. Seek only expert views; public values are not relevant.
- 14) Module 5 — Which source of error is most reduced by increasing sample size and averaging?
- A. Calibration bias
 - B. Zero offset
 - C. Random error
 - D. Scale factor error
- 15) Module 6 — A thermal camera reports ± 2 °C accuracy and 0.05 °C resolution. Which statement is best?
- A. Readings within 0.05 °C are accurate.
 - B. High resolution guarantees low uncertainty.
 - C. The device can show small changes, but absolute values may still be off by up to ~ 2 °C.
 - D. Accuracy equals precision here.

2 Answer key

Q	Ans	Rationale
1	B	Validity: answers the question; Reliability: consistency of repeated measurements.
2	D	0.20 s period \neq 5 Hz; sampling rate reported as 5 Hz (not 0.20 Hz).
3	B	Zeroing and verifying linearity reduce systematic bias across range.
4	C	Self-selected poll lacks control; cannot infer causal effect.
5	C	Precautionary principle shifts burden to show safety when serious harm is plausible.
6	B	Independent variable manipulated: temperature.
7	A	$5.0\text{ V}/4096 = 0.00122\text{ V per count} = 1.22\text{ mV per count}$.
8	B	Causation requires control and addressing confounders; correlation alone insufficient.
9	B	Informed consent, confidentiality, and right to withdraw are essential.
10	B	Controls isolate the independent variable's effect.
11	B	Drift is mitigated via zeroing and scheduled recalibration.
12	A	Appeal to authority without data.
13	B	Consider diagnostic metrics, costs, equity, and harms from false results.
14	C	Averaging reduces random error; systematic errors persist.
15	C	Resolution shows small changes; accuracy bounds absolute error.

Note on Q7: 12-bit ADC over 0–5.0 V: $5.0/4096 = 1.22\text{ mV per count}$; the correct option is A (1.2 mV per count).