

AQA AS Measurement Errors, Accuracy and Precision worksheet

35-40 minutes independent practice + 15-20 minutes review | 38 marks

Specification points covered

- 3.1.2(a) Identify random errors and systematic errors, including how they affect measurements.
- 3.1.2(b) Explain precision, repeatability, reproducibility, resolution and accuracy in measurement.

Medical-device measurement audit

A laboratory is checking infusion pumps and environmental sensors before they are used by several hospitals and field teams.

Use the measurement-quality terms precisely and link each proposed improvement to the error it addresses.

1. Measurement language

1. Define accuracy and precision in the context of a physical measurement. [2 marks]

2. Distinguish repeatability from reproducibility. [2 marks]

3. Two infusion pumps are tested against a reference delivery of 5.00 mL. Pump A gives 5.33, 5.34, 5.33, 5.34 and 5.33 mL. Pump B gives 4.86, 5.07, 5.04, 5.10 and 4.93 mL. Compare the accuracy and precision of the two pumps. [4 marks]

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2. Error patterns and instrument limits

4. For each pump in Question 3, identify the dominant type of measurement error and state one suitable action to improve the result. [3 marks]

5. A digital flow sensor changes its display in steps of 0.01 mL s^{-1} . An analogue meter has scale divisions of 0.1 mL s^{-1} . State the resolution of each instrument and explain which can detect the smaller change. [2 marks]

6. A balance reads $+0.07 \text{ g}$ when empty. It displays 12.64 g for a component. Determine the corrected mass and explain why repeating the uncorrected reading would not remove this error. [2 marks]

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3. Correcting and comparing measurements

7. A micrometer has a zero reading of -0.006 mm. Four displayed diameter readings are 0.842, 0.839, 0.841 and 0.840 mm. Calculate the corrected mean diameter and explain why readings are taken at several positions. [4 marks]

8. A glacier-temperature sensor gives closely grouped readings during one visit. A second team using different equipment obtains a mean 0.36 °C higher under the same conditions. Explain what this shows about repeatability and reproducibility. [3 marks]

9. A pupil times one rotation of a wind-tunnel fan with a stopwatch. Explain two changes that would improve the quality of the period measurement and identify the error each change addresses. [4 marks]

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4. Selecting and judging instruments

10. Choose a suitable instrument for each task and justify the choice using resolution: (a) diameter of a 0.62 mm wire; (b) length of a 1.20 m air track; (c) delivery of 25.0 cm³ of liquid. [3 marks]

11. A digital balance gives 8.420, 8.420 and 8.421 kg for a certified 8.000 kg mass. Describe the data using the terms precise, repeatable and accurate. [3 marks]

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