



Premium IB tuition — Physics, Chemistry, Maths

IB Chemistry: Uncertainties and Errors

Practice Questions

For both SL and HL students – 30 questions, graded Easy to Medium to Hard

Easy Practice Questions (Q1–Q10)

- Q1. A ruler with smallest division 0.1 cm measures a length of 7.3 cm. What is the absolute uncertainty?
- Q2. A digital balance reads 4.56 g. What is the absolute uncertainty?
- Q3. Calculate the percentage uncertainty for a volume of $250.0 \pm 0.5 \text{ cm}^3$.
- Q4. A student records initial temperature 21.0°C and final temperature 65.0°C , both with uncertainty $\pm 0.5^\circ\text{C}$. Calculate ΔT with uncertainty.
- Q5. Three measurements of a mass are: 5.23 g, 5.25 g, 5.22 g. Calculate the mean.
- Q6. Calculate the percentage uncertainty for $0.0500 \pm 0.0005 \text{ mol}$.
- Q7. A burette reading has uncertainty $\pm 0.05 \text{ cm}^3$. A titre is calculated from two readings. What is the uncertainty in the titre?
- Q8. Express $15.0 \pm 0.3 \text{ g}$ as a percentage uncertainty.
- Q9. A measurement of 2.50 cm has a percentage uncertainty of 4%. What is the absolute uncertainty?
- Q10. Calculate the area of a rectangle $4.0 \pm 0.1 \text{ cm}$ by $3.0 \pm 0.1 \text{ cm}$ with uncertainty.

Medium Practice Questions (Q11–Q20)

- Q11. Calculate the concentration: $n = 0.0250 \pm 0.0005 \text{ mol}$, $V = 0.500 \pm 0.005 \text{ dm}^3$. Give answer with absolute uncertainty.
- Q12. A student dilutes $25.00 \pm 0.05 \text{ cm}^3$ of $2.00 \pm 0.02 \text{ mol dm}^3$ solution to $500.0 \pm 0.5 \text{ cm}^3$. Calculate the diluted concentration with uncertainty.
- Q13. Mass of hydrated salt = $3.45 \pm 0.01 \text{ g}$. Mass after heating = $2.12 \pm 0.01 \text{ g}$. Calculate mass of water lost with uncertainty.

- Q14. Calculate the percentage uncertainty in molar mass of HO (Ar: $H = 1.01 \pm 0.01$, $O = 16.00 \pm 0.01$).
- Q15. In a titration, titre = 25.00 cm^3 , burette uncertainty $\pm 0.05 \text{ cm}^3$ per reading. What is the percentage uncertainty in the titre?
- Q16. Four temperature readings: $24.2, 24.4, 24.3, 24.5^\circ\text{C}$. Calculate mean and uncertainty using the range method.
- Q17. A mass of 0.500 g has percentage uncertainty 0.2% . Calculate the absolute uncertainty.
- Q18. Calculate the density: mass = $25.00 \pm 0.01 \text{ g}$, volume = $10.0 \pm 0.1 \text{ cm}^3$. Give answer with uncertainty.
- Q19. Percentage uncertainty in volume is 1% and in concentration is 2% . What is the percentage uncertainty in moles ($n = C \times V$)?
- Q20. Calculate the percentage uncertainty in rate = $k[A]$ where $k = 0.050 \pm 0.001 \text{ s}^{-1}$ and $[A] = 0.200 \pm 0.005 \text{ mol dm}^3$.

Hard Practice Questions (Q21–Q30) – [HL] marks where indicated

- Q21. A sphere has radius $2.00 \pm 0.02 \text{ cm}$. Calculate the volume $V = \frac{4}{3}\pi r^3$ with uncertainty. **[HL]**
- Q22. A cube has side $1.50 \pm 0.01 \text{ cm}$. Calculate surface area $A = 6s^2$ with uncertainty. **[HL]**
- Q23. In a calorimetry experiment: $m = 50.0 \pm 0.5 \text{ g}$, $c = 4.18 \pm 0.01 \text{ J g}^{-1}^\circ\text{C}^{-1}$, $\Delta T = 10.0 \pm 0.5^\circ\text{C}$. Calculate $q = mc\Delta T$ with uncertainty.
- Q24. Calculate kinetic energy $E = \frac{1}{2}mv^2$ where $m = 0.500 \pm 0.001 \text{ kg}$, $v = 2.00 \pm 0.05 \text{ m s}^{-1}$. **[HL]**
- Q25. A student dissolves $0.1240 \pm 0.0001 \text{ g}$ of NaSO to make $1000.0 \pm 0.4 \text{ cm}^3$ of solution. Calculate the percentage uncertainty in molar concentration. ($M_r(\text{Na}_2\text{S}_2\text{O}_3) = 158.11 \pm 0.01 \text{ g mol}^{-1}$)
- Q26. In a back titration, moles of excess HCl = $0.0200 \pm 0.0004 \text{ mol}$, moles of NaOH used in titration = $0.0080 \pm 0.0002 \text{ mol}$. Calculate moles of CaCO ($2\text{HCl} + \text{CaCO}_3 \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$) with uncertainty. **[HL]**
- Q27. Calculate the pH uncertainty: $[H^+] = 2.5 \times 10^{-5} \pm 0.1 \times 10^{-5} \text{ mol dm}^3$. **[HL]** (logarithmic)
- Q28. For a second-order reaction, rate = $k[A]^2$. If $[A] = 0.300 \pm 0.005 \text{ mol dm}^3$ and $k = 0.025 \pm 0.001 \text{ dm}^3 \text{ mol}^{-1} \text{ s}^{-1}$, calculate rate with uncertainty. **[HL]**
- Q29. Using Beer–Lambert law $A = \varepsilon cl$: $A = 0.750 \pm 0.005$, $\varepsilon = 1500 \pm 20 \text{ dm}^3 \text{ mol}^{-1} \text{ cm}^{-1}$, $l = 1.00 \pm 0.01 \text{ cm}$. Calculate c with uncertainty. **[HL]**

- Q30. A student determines molar mass of an unknown monoprotic acid: mass = 0.150 ± 0.001 g, titre = 18.50 ± 0.05 cm³, NaOH concentration = 0.100 ± 0.001 mol dm³. Calculate M with uncertainty.

Answers available in the companion Mark Scheme PDF.

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