Unit 3: Practical Skills in Chemistry I

Pearson WCH13 · core practicals 1–8 (Units 1–2) · written practical skills; bench manipulation stays class work.

What would you do at the bench?

Your turn

A white solid, a colourless liquid and a gas that smells of swimming pools sit on the bench.

A. Which test separates lithium from strontium?

B. Why does the drying agent sit where it does in a gas train?

C. Why is your enthalpy change smaller than the data-book value?

Four abilities the paper tests

Ability	**What it looks like on the paper**
independent thinking	plan or adapt an unfamiliar practical
scientific methods	tests, observations and conclusions
numeracy	graphs, significant figures, accuracy and precision
use of apparatus	selection, range, resolution and safety

The eight core practicals

Core practical	**Key skill**
1 molar volume of a gas	$V_m = V/n$ from a **gas syringe**
2 enthalpy by Hess's law	$q = mc\Delta T$, per mole; error sources
3 and 4 titrations, **standard solution**	**burette** technique, concordant titres, volumetric flask
5 halogenoalkane hydrolysis	timing a clock reaction to compare rates
6 chlorinating 2-methylpropan-2-ol	separating, drying and weighing a product
7 oxidising propan-1-ol	distil for propanal, reflux for propanoic acid
8 inorganic and organic unknowns	observations as colours and precipitates

Flame tests in exact words

Ion	Flame colour
Li^{+}, Na^{+}, K^{+}	crimson, yellow, lilac
Ca^{2+}, Sr^{2+}, Ba^{2+}	brick-red, red, pale green
Cu^{2+}	blue-green

Use the evidence

Li or Sr? Add a soluble sulfate: white $SrSO_4$ precipitates; lithium sulfate stays dissolved.

Halides and the ammonia check

Halide	With acidified $AgNO_3$	Dilute NH_3	Concentrated NH_3
Cl^-	white AgCl	dissolves	dissolves
Br^-	cream AgBr	stays	dissolves
I^-	pale yellow AgI	stays	stays

Use the evidence

Nitric acid first removes carbonate, which would also give a **precipitate**.

Organic tests with a mass spectrum

1. **PCl_5** Misty fumes of hydrogen chloride mean –OH (alcohol or carboxylic acid).
2. **Dichromate** Orange to green means a primary or secondary alcohol, or an aldehyde.
3. **Spectrum** C_3H_8O gives Mr 60; the strongest peak decides the isomer.
4. **Peak** m/z 31 (CH_2OH^+) is propan-1-ol; m/z 45 (CH_3CHOH^+) is propan-2-ol.

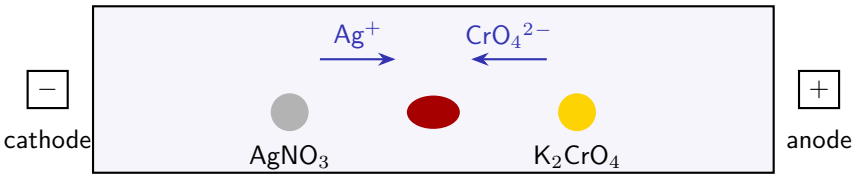
Decision

Write "hydrogen chloride gas", never "hydrochloric acid".

Ions migrate on wet filter paper

Where the ions meet, red Ag_2CrO_4 precipitates, showing both salts are **ionic**.

- Tap water conducts; deionised water barely does.
- Ag^+ moves to the cathode, CrO_4^{2-} to the anode.



red Ag_2CrO_4 forms where the ions meet

Read the migration correctly

Your turn

A green spot of copper(II) chromate is placed in the middle of damp filter paper.

A. Which colour moves towards the cathode, and why?

B. Which colour moves towards the anode?

C. Why must the paper be wet with tap water, not deionised water?

A gas synthesis train

Stage	Reason the scheme credits
conc. HCl on $KMnO_4$	**redox**: $2Cl^- \rightarrow Cl_2 + 2e^-$; manganate(VII) is reduced
anhydrous $CaCl_2$	a **drying agent** removes water from the chlorine
heat iron after 30 s	chlorine flushes the air out first
NaOH at the exit	absorbs excess toxic chlorine
seal the receiver fast	$FeCl_3$ is **deliquescent** and absorbs water

Maximum mass of iron(III) chloride

1. **Moles** $n(\mathrm{Fe}) = 2.00/55.8 = 0.0358$ mol
2. **Mr** $M_r(\mathrm{FeCl_3}) = 55.8 + 3 \times 35.5 = 162.3$
3. **Mass** $0.0358 \times 162.3 = 5.82$ g
4. **Heavier?** The **deliquescent** product absorbs water, forming hydrates.

Decision

Maximum 5.82 g; 5.80 g under-claims what the data support.

Choosing and reading apparatus

Apparatus	Use	Technique
burette	titres, ± 0.05 cm^3 per reading	read the **meniscus** bottom at eye level
volumetric flask	making up a standard solution	transfer quantitatively, make up to the mark
gas syringe	gas volumes	read at room conditions
balance	masses	weigh by difference

Use the evidence

Uncertainty: $\pm$ half a division per reading, doubled for a difference. The rough titre never enters the mean.

exercises.lol exercises.com.cn

Molar volume with a gas syringe

Weigh the magnesium ribbon; acid in excess in the flask.

↓

Drop the ribbon in and seal at once; hydrogen pushes the syringe out.

↓

Read the volume V when the plunger stops, at room conditions.

↓

$n(\mathrm{H_2}) = n(\mathrm{Mg}) = m/24.3$; then $V_m = V/n$.

Mg displacing zinc, worked

1. **Moles** Zn^{2+}: $0.0500 \times 1.00 = 0.0500$ mol; Mg: $2.20/24.3 = 0.0905$ mol, in excess.
2. **ΔT** $55.2 - 19.4 = 35.8$ °C
3. **q** $q = 50.0 \times 4.18 \times 35.8 = 7482$ J
4. **ΔH** $\Delta H = -7.482/0.0500 = -150$ kJ mol^{-1}

Decision

Divide by the zinc ions in solution, not by the magnesium.

Heat loss and the improvements that count

Credited

Polystyrene cup and a lid.

Readings every 30 s or a data logger; a cooling curve extrapolated to mixing.

A lower concentration, so less heat is lost per second.

Ignored

Use a pipette or **burette**.

Use a more accurate balance.

Repeat and average.

Written practice has limits

> Titrating to a sharp end point, transferring a solid and handling concentrated acid are learned at the bench.

- Full marks do not prove bench skill.
- Manipulation is built in class.

Check yourself

Your turn

Answer without notes, then check.

A. Lithium and strontium both flame red. How do you tell their nitrates apart?

B. How does ammonia confirm chloride, bromide and iodide?

C. Why can a weighed $FeCl_3$ product exceed its maximum mass?

D. Give three credited calorimetry improvements and one the scheme ignores.

E. A C_3H_8O isomer peaks strongly at m/z 45. Which isomer is it?