STUDY FORMULA BOOKLET

Edexcel IAL Chemistry Unit 3 (WCH13): practical skills in chemistry I

No data booklet is issued for Unit 3, so nothing is Given: the molar volume and specific heat capacity are printed in the question. Learn first the titration formulae, mean titre, percentage uncertainty, yield, q = mcΔT and ΔH = -q/n.

GIVEN printed in the question LEARN IT not printed: learn it

Built by CuratedPrep from 23 past question papers for Unit 3 in our question bank, June 2019 to January 2026. Given means it is in the question itself (no data booklet is issued for this unit). Learn it means a past question needed it and the exam did not print it.

Constants printed in the questions

No data booklet is issued for Unit 3, so nothing here is on a sheet: these were printed in the question each time it needed them.

Molar volume of a gas at r.t.p.

Printed in the question. Printed as 24 dm^3 mol^{-1}, 24.0 dm^3 mol^{-1} or 24 000 cm^3 mol^{-1}. When the question asks you to find the molar volume from an experiment, it is the answer and is not printed. Used in: Jan 2026 Q4(b)(i), Mr of a hydrocarbon gas; Jan 2024 Q3, hydrogen peroxide; Jun 2024 Q1(b), identity of a Group 2 metal.

$$V_{\mathrm{m}} = 24\ \mathrm{dm^3\ mol^{-1}}$$

GIVEN

Specific heat capacity of water or a dilute solution

Printed in the question. Papers print 4.18 or 4.2; use the value in your question. Every Unit 3 question that needed c printed it. Used in: Jan 2026 (A) Q1(b)(ii), zinc and copper(II) sulfate; Oct 2024 Q2, neutralisation; Jan 2023 Q2, combustion of ethanol.

$$c = 4.18\ \mathrm{J\ g^{-1}\ {}^{\circ}C^{-1}}$$

GIVEN

Amount of substance, solutions and titration

None of these is printed in the question, so all of them are Learn it.

Amount from mass

Use it both ways, and rearranged (M = m/n) to find a molar mass or an Ar from an experiment. Used in: Oct 2025 (A) Q3(b)(ii), moles of borax; Jan 2026 Q4(b)(i), Mr of a gas; Oct 2019 Q4, molar mass of H2X.

$$n = \frac{m}{M}$$

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Concentration

n = cV, with V in dm^3, so divide a volume in cm^3 by 1000. Used in: Jan 2026 Q2(b)(ii), sodium hydroxide from a titration; Oct 2024 Q2; Jun 2021 Q3, moles of hydrochloric acid in the mean titre.

$$c = \frac{n}{V}$$

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Concentration in g dm^{-3}

c is in mol dm^{-3} and M in g mol^{-1}. Used in: Oct 2025 (A) Q3(c)(ii), hydrochloric acid; Jan 2025 Q3, barium hydroxide; Jun 2023 Q4, calcium hydroxide.

$$\text{concentration in g dm}^{-3} = c \times M$$

LEARN IT

Reacting amounts from an equation

Find the moles of the solution you know, then scale by the coefficients: 1 mol of borax gives 2 mol of NaOH, and Na2CO3 reacts with 2 HCl. Used in: Jan 2026 Q2(a)(ii), thermometric titration; Oct 2025 (A) Q3(c)(ii); Oct 2025 Q3(b)(iii).

$$n(\mathrm{A}) = \frac{\text{coefficient of A}}{\text{coefficient of B}} \times n(\mathrm{B})$$

LEARN IT

Dilution

A 25.0 cm^3 portion made up to 250 cm^3 is a tenfold dilution, so the concentration in the original solution is 10 times larger. Used in: Jan 2026 Q2(b)(ii); Oct 2025 Q3(b)(iii).

$$c_1V_1 = c_2V_2$$

LEARN IT

Mean titre

Titre = final reading minus initial reading. Leave out the rough titre and any result that is not concordant. Used in: Oct 2025 Q3(b)(i); Jun 2024 (R) Q3; Oct 2022 Q2.

$$\text{mean titre} = \frac{\text{sum of the concordant titres}}{\text{number of titres used}}$$

LEARN IT

Percentage by mass of a component

Find the mass of the component from the moles measured, using the equation and its molar mass. Used in: Jan 2026 Q1(c)(iii), Group 2 chloride in a mixture; Oct 2025 Q4(b)(iii), potassium carbonate after heating; Jan 2024 Q2(c), citric acid in lemon juice.

$$\%\ \text{by mass} = \frac{\text{mass of the component}}{\text{mass of the sample}} \times 100$$

LEARN IT

Yield, density and gases

Percentage yield

Compare moles with moles or masses with masses. To find the mass made at a stated yield, multiply the theoretical mass by yield / 100. Used in: Oct 2025 Q5(d), 2-chloro-2-methylpropane; Jan 2026 (A) Q4(c)(i), 1-bromobutane; Jan 2025 Q4(f), mass at 70 % yield.

$$\%\ \text{yield} = \frac{\text{actual amount of product}}{\text{theoretical amount of product}} \times 100$$

LEARN IT

Density

The density of a reactant is printed in the question; the formula is not. Turn a volume of liquid into a mass, then moles. Used in: Oct 2025 Q5(d), 10.0 cm^3 of 2-methylpropan-2-ol; Jan 2025 Q4(f); Jan 2024 Q4, mass of water heated.

$$\rho = \frac{m}{V}$$

LEARN IT

Amount of a gas from its volume

V in dm^3 with V_m = 24 $dm^3\ mol^{-1}$, or in cm^3 with 24 000 $cm^3\ mol^{-1}$. Used in: Jan 2026 Q4(b)(i); Jun 2024 Q1(b); Jan 2024 Q3(b).

$$n = \frac{V}{V_\text{m}}$$

LEARN IT

Molar volume found by experiment

Find n from the mass or volume of reactant and the equation, then divide the gas volume you collected by n. Used in: Jan 2025 Q2(d), hydrogen from magnesium; Jun 2024 (R) Q1(c), sulfur dioxide; Jun 2023 Q4(a)(ii), hydrogen from calcium.

$$V_\text{m} = \frac{V}{n}$$

LEARN IT

Enthalpy changes in experiments

Energy transferred

m is the mass of solution or of water heated, not of the solid added: most questions print the density of the solution (1.0 g cm^{-3}, but Jun 2022 Q1 and Jan 2026 (A) Q1 did not. Printed as a word expression in Jun 2024 Q4 and in symbols in Jan 2022 Q1; the Jun 2025 Q5 scheme gives a mark for recalling it. Used in: Jan 2026 (A) Q1(b)(ii); Jun 2025 Q5(b), 50.0 g of solution; Jan 2024 Q4, water heated by ethanol.

$$q = mc\Delta T$$

LEARN IT

Enthalpy change of an experiment

Divide q by 1000 for kJ, and use the moles of the limiting reagent, or of the fuel burnt in a combustion experiment. Printed in Jan 2022 Q1 and Jun 2024 Q4 only. Used in: Jan 2026 (A) Q1(b)(iii); Oct 2024 Q2, neutralisation; Jan 2023 Q2, combustion of ethanol.

$$\Delta H = -\frac{q}{n}$$

LEARN IT

Enthalpy of hydration from two enthalpies of solution

From the Hess cycle: anhydrous salt plus water forms the hydrate, and both salts dissolve to the same solution. Used in: Oct 2025 (A) Q2(d)(i), magnesium sulfate; Oct 2021 Q3(d)(i), copper(II) sulfate.

$$\Delta_{\text{hyd}}H = \Delta_{\text{sol}}H(\text{anhydrous salt}) - \Delta_{\text{sol}}H(\text{hydrated salt})$$

LEARN IT

Rates of reaction

Rate from the time taken

A shorter time means a faster rate. Oct 2021 Q4 printed it as 1 / t, but Oct 2025 (A) Q5 did not. Used in: Oct 2025 (A) Q5(b), rates of hydrolysis from precipitate times; Oct 2021 Q4(a), rate at 15 C from a graph.

$$\text{rate} = \frac{1}{\text{time}}$$

LEARN IT

Measurement uncertainty and error

Percentage uncertainty

A quantity found from two readings (a temperature change, a titre, a mass by difference) has both uncertainties added, so +/-0.1 C on each reading gives 0.2 C. Used in: Jan 2026 Q2(c), flask against pipette; Jan 2025 Q2(f), mass of magnesium; Jan 2023 Q2(b)(iv), temperature change.

$$\%\ \text{uncertainty} = \frac{\text{uncertainty}}{\text{measured value}} \times 100$$

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Range from a percentage uncertainty

Use it to see whether a result agrees with a data book value, or to give the range for a measurement such as 9.53 g +/- 0.01 g. Used in: Oct 2025 (A) Q3(b)(i), range for a mass of 9.53 g; Jun 2022 Q2(b)(ii), Ar of 37.52 with 4.5 % uncertainty; Jan 2022 Q1(b)(ii), enthalpy change against a data book value.

$$\text{value} \pm \left(\frac{\%\ \text{uncertainty}}{100} \times \text{value}\right)$$

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Percentage error

Divide the difference by the data book value. Used in: Jun 2023 Q4(b)(i), molar volume of hydrogen 21.8 against 23.9 $\text{dm}^3\ \text{mol}^{-1}$; Jun 2022 Q2(b)(i), Ar of potassium.

$$\%\ \text{error} = \frac{|\text{experimental value} - \text{data book value}|}{\text{data book value}} \times 100$$

LEARN IT

The periodic table of elements

Units 1, 3 and 6 have no data booklet. Relative atomic masses here are as printed in the data booklet's periodic table, for revision; use the values your paper gives.

1	2											3	4	5	6	7	0
1 H hydrogen 1.0																	2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3											13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium [98]	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57 La lanthanum 138.9	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium [209]	85 At astatine [210]	86 Rn radon [222]
87 Fr francium [223]	88 Ra radium [226]	89 Ac actinium [227]	104 Rf rutherfordium [261]	105 Db dubnium [262]	106 Sg seaborgium [266]	107 Bh bohrium [264]	108 Hs hassium [277]	109 Mt meitnerium [268]	110 Ds darmstadtium [271]	111 Rg roentgenium [272]							

58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium [147]	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
90 Th thorium 232	91 Pa protactinium [231]	92 U uranium 238	93 Np neptunium [237]	94 Pu plutonium [242]	95 Am americium [243]	96 Cm curium [247]	97 Bk berkelium [245]	98 Cf californium [251]	99 Es einsteinium [254]	100 Fm fermium [253]	101 Md mendelevium [256]	102 No nobelium [254]	103 Lr lawrencium [257]

Z Sym name A_r — atomic number · symbol · name · relative atomic mass

Also learn these

Back titration

Moles of acid added minus moles of excess acid (the titre moles times the dilution factor) gives the moles that reacted with the sample. Used in: Oct 2022 Q2, magnesium carbonate in an antacid tablet.

Maximum temperature change from a graph

Draw a straight line through the cooling points, extrapolate it back to the time of mixing, and subtract the starting temperature there; in a thermometric titration the two lines meet at the end-point volume. Used in: Jan 2026 (A) Q1(a)(ii); Oct 2025 (A) Q2(b); Jan 2026 Q2(a)(i).

Showing a reagent is in excess

Work out the moles of each reactant, divide each by its coefficient, and compare; the larger value is the one in excess. Used in: Jan 2026 (A) Q1(b)(i), zinc powder in excess; Jun 2022 Q1(b)(i).

Water of crystallisation

Find the moles of the anhydrous salt from the titration, take its mass from the sample mass, and divide the mass of water by 18 to give the moles of water, then n = moles of water / moles of salt. Used in: Oct 2025 Q3(b)(iii), washing soda; Jan 2022 Q3, BaCl2.xH2O.

Formula from masses

Divide each mass by its Ar, divide by the smallest, then scale to whole numbers. Used in: Oct 2019 Q3, formula of a copper oxide; Jan 2022 Q2, empirical formula of X.

Reducing a percentage uncertainty

A percentage uncertainty is the uncertainty divided by the measurement, so measure a larger mass, volume or temperature change. Used in: Jan 2020 Q2(b)(ii), temperature change; Jun 2022 Q2(b)(iii), burette volume; Jan 2025 Q2(f)(ii), mass of magnesium.

Infrared absorptions

Alcohols show a broad O-H absorption at 3750 to 3200 cm^{-1}, carboxylic acids O-H at 3300 to 2500 cm^{-1}, and aldehydes, ketones and acids C=O at about 1740 to 1680 cm^{-1}; to follow a reaction, name the peak that disappears and the peak that appears. Three questions printed these ranges (Jun 2023 Q2, Jan 2022 Q2, Jun 2021 Q2) but Oct 2025 Q5(c) did not.

Using the booklet in the exam

- There is no data booklet in Unit 3. Use the molar volume, specific heat capacity and Ar values your question prints; the periodic table at the end of this booklet is for revision only.
- Write q = mcΔT from memory with the mass of solution (volume x density), then divide by 1000 and by the moles for ΔH in kJ mol^{-1}, with a sign: negative if the temperature rose.
- In a titration calculation, take the mean of concordant titres only, work out the moles from c x V / 1000, use the equation ratio, then scale for any dilution (25.0 cm^3 from 250 cm^3 is a factor of 10).

- For a percentage uncertainty add the uncertainty of both readings of a difference first, then divide by the measured value; use the uncertainty printed for a flask or pipette once.
- Read the question for 'to an appropriate number of significant figures' and 'include units': round only at the end, and match the data.

Built by CuratedPrep from the Edexcel International A Level Chemistry Unit 3 (WCH13) papers June 2019 to January 2026 in our question bank (23 question papers). No data booklet is issued for this unit. Updated 17 November 2026. Always practise with the version of the official booklet your exam uses. More free sheets and topic worksheets at curatedprep.com.