Diploma Programme
Programme du diplôme
Programa del Diploma

Chemistry
Higher level
Paper 1B

15 May 2026

Zone A afternoon | **Zone B** afternoon | **Zone C** afternoon

Session number

2 hours [Paper 1A and Paper 1B]

Instructions to students

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- A clean copy of the **chemistry data booklet** is required for this paper.
- The maximum mark for paper 1B is **[35 marks]**.
- The maximum mark for paper 1A and paper 1B is **[75 marks]**.

292

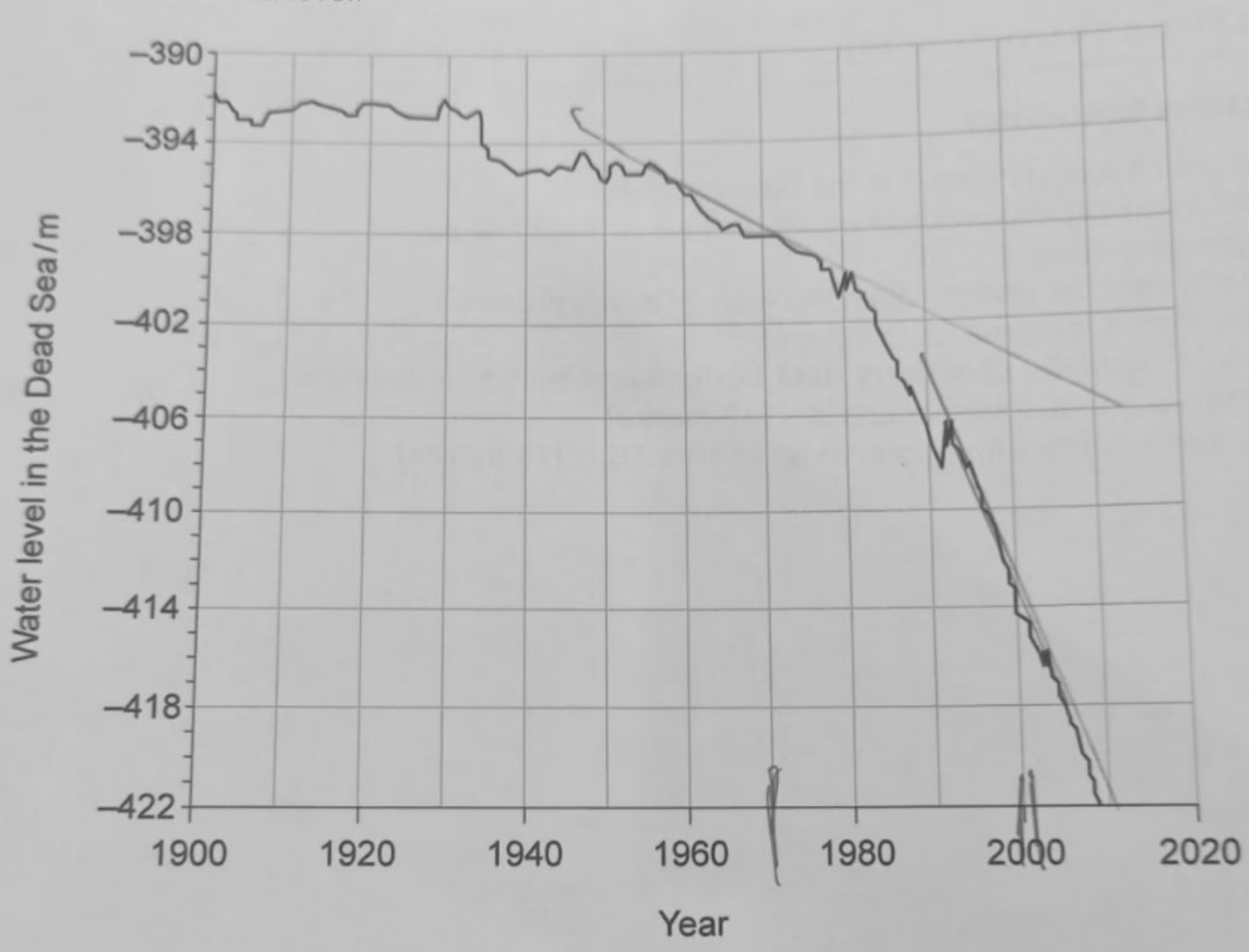
A005

Section B

Answer **all** questions. Answers must be written within the answer boxes provided.

1. The level of water in the Dead Sea, a lake that has a high concentration of salt, has been decreasing dramatically.

(a) The following data were collected over several decades. The reference point for the water level is sea level.



(i) Suggest why the values on the y axis are negative. [1]

A005

water level is below sea level

(This question continues on the following page)

(Question 1 continued)

(ii) Describe the general trend in the rate of change of water level from 1970 until 2000, supporting your answer with evidence about the gradient of the graph. [2]

...the..rate..of...change..of..water...level....gradually...decrease..
..from..1970..to..2000.....
.....~~from..1970~~..by..drawing...the..slope..of..curve..at..1970..and..2000
..the..gradient..at..2000..is..much..steeper..than...1970.....
.....

(iii) The surface area of the Dead Sea was approximately 1020 km^2 from 1930 to 1970.

Estimate the volume, in m^3, of water that evaporated during this time. [2]

.....water..level....in..1930..=...-392.2.....
.....in..1970..=..-398.3.....
.....
.....1020..km^2 x [-392.2-(-398.3)]...=..$6.222 \times 10^6 m^3$.....
.....
.....

(iv) Suggest **two** environmental factors that could cause the decreasing level of water in the Dead Sea. [2]

....global..warming...cause...temperature....increase....the..rate..of..evaporation
.....
....reduced....rain..fall...or..drought...causing...less...water..fall...
.....
.....

(This question continues on the following page)

(Question 1 continued)

(b) A variety of ions are found in the Dead Sea. The concentrations of the major ions are shown in the table, based on two different sources (both scientific journals).

Ion	Concentration / g dm^{-3} Based on Source 1	Concentration / g dm^{-3} Based on Source 2
Mg^{2+}	40.65	46
Na^{+}	39.15	37
Ca^{2+}	16.86	17
K^{+}	7.26	8
Cl^{-}	212.40	225
Br^{-}	5.12	6

(i) Suggest **two** reasons for the difference in the concentration of magnesium ions between the two sources, other than experimental errors. [2]

292

...sampling...difference.....two..sample...may...be..taken..in..different..
depth..of..water.....or.....two...sample...may..be..taken...in different. season
.....
.....the apparatus...used..may...be. different...using...different..analysis. method

(ii) Calculate the percentage difference in the concentration of Mg^{2+} ions between Source 2 and Source 1. [1]

A005

$\frac{40.65+46}{2} = 43.33$ ..... $\frac{46-40.65}{43.33} \times 100\% = 6.21\%$

(This question continues on the following page)

(Question 1 continued)

(iii) A student concluded that the most commonly found salts in the Dead Sea are the chlorides of magnesium and sodium. The student created the following table, using the data from Source 1, to confirm the conclusion.

Calculate the missing values in the table. [2]

Ion	Concentration / mol dm^{-3}	$[Cl^-]$ required to form chloride salt / mol dm^{-3}
Na^+ (aq)	1.703	1.703
Mg^{2+} (aq)	1.672	3.344
Cl^- (aq)	5.992	

$\frac{212.40}{35.45} = 5.992$

(iv) Comment on the validity of the student's conclusion in part (b) (iii), giving a reason.

1.703 + 3.344 = 5.04) ∴ the conclusion is basically valid since 5.04) is similar to total concentration of $[Cl^-]$ 5.992

(This question continues on page 7)

(Question 1 continued)

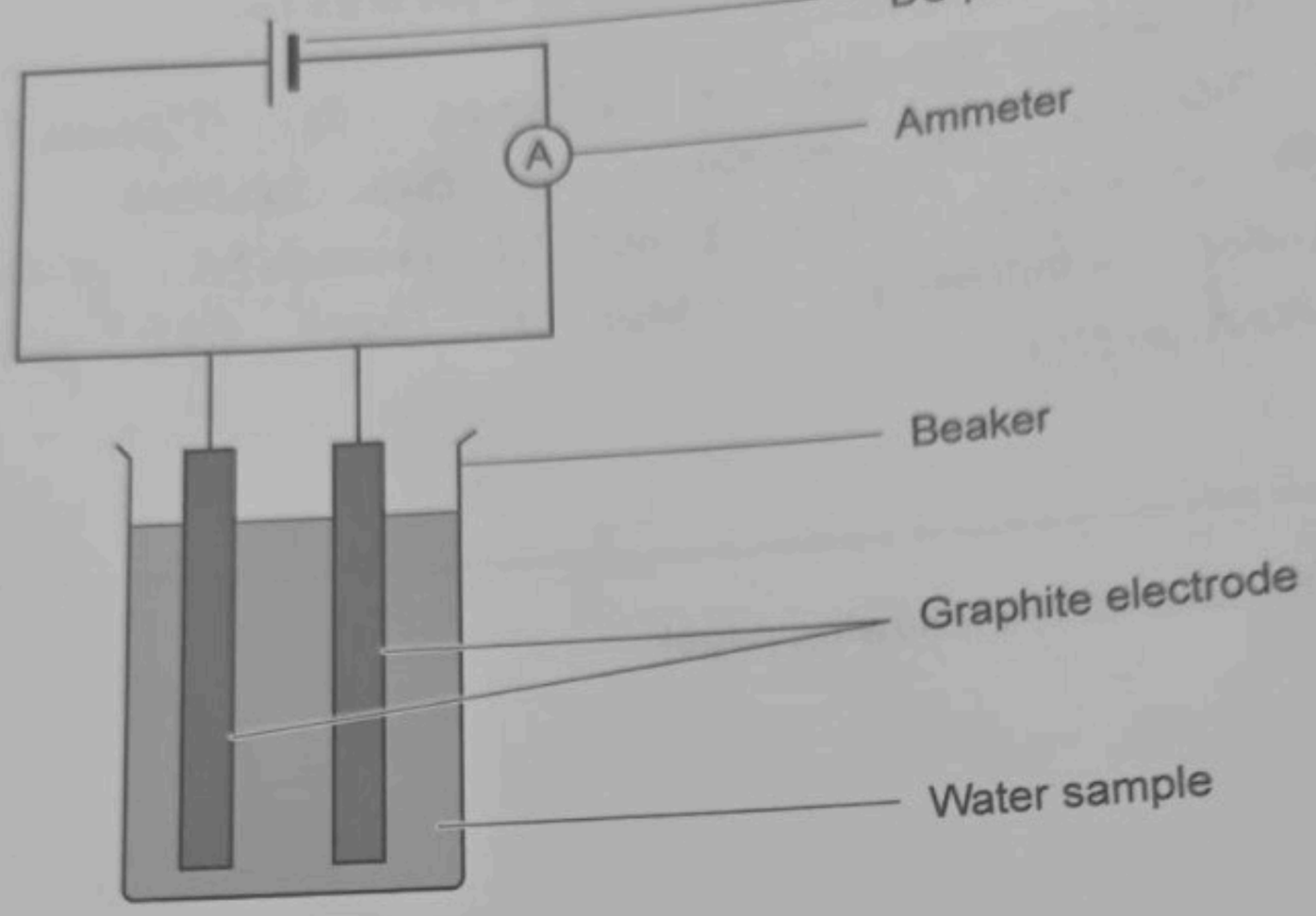
(v) The concentration of some of the ions was determined using a spectrophotometer and a calibration curve. Describe how a calibration curve is constructed using a standard solution of a salt of the ion. [3]

...make...a...series...of...standard...solutions...in...different...concentrations
...~~make~~...measure...the...absorbance...of...these...solutions.....
.....make...a...graph...with...x-axis...is...concentration...y-axis...is.....
...corresponding...absorbance.....draw...a...linear...line...passing...all...
...dots...and...origin.....
.....

(This question continues on the following page)

(Question 1 continued)

(c) A simple set up was used to compare the conductivity of samples of water obtained from the Dead Sea at different depths.



The following data was obtained:

Depth water sample was obtained from /m ±0.05 m	**Electric current recorded by the ammeter /A ±0.01 A**
5.00	2.52
10.00	2.50
15.00	2.47
20.00	2.21
25.00	2.16

(i) State the independent and dependent variables in this experiment. [2]

Independent variable: ....depth...water....sample....obtained...from.....

.....

Dependent variable: .electric...current...recorded....by...ammeter...which..

..indicate...the..conductivity...of...sample.....

(This question continues on the following page)

(Question 1 continued)

(ii) Suggest **two** variables, besides temperature, that must be controlled to get a fair comparison of the conductivity of the samples. [2]

Controlled variable 1: ....The..voltage...of...D.C....power...source.....

.....

Controlled variable 2: ..the..distance.....between...two...graphite...electrode

.....

(iii) Calculate the fractional uncertainty in the electric current at a depth of 5.00 m. State the answer using the appropriate number of significant figures. [1]

.....$\frac{0.01}{2.52}$.....$\times 100\% = 0.4\%$

.....

.....

(iv) Suggest a conclusion for the experiment with an explanation. [2]

Conclusion: ..with...the...increase...of....depth..to..obtain..water..sample

....the..conductivity....of..water...sample...decreased.....

.....

Explanation: ....less...gas....dissolved.....with....increase..of..water..depth

....less...sedimentation....from..air.....

.....

(v) Deduce the half-equations for the electrolysis reactions taking place at the cathode and anode while the current is flowing. Use section 19 of the data booklet.

Cathode: .....$2H_2O + 2e^- \rightarrow H_2 + 2OH^-$.....

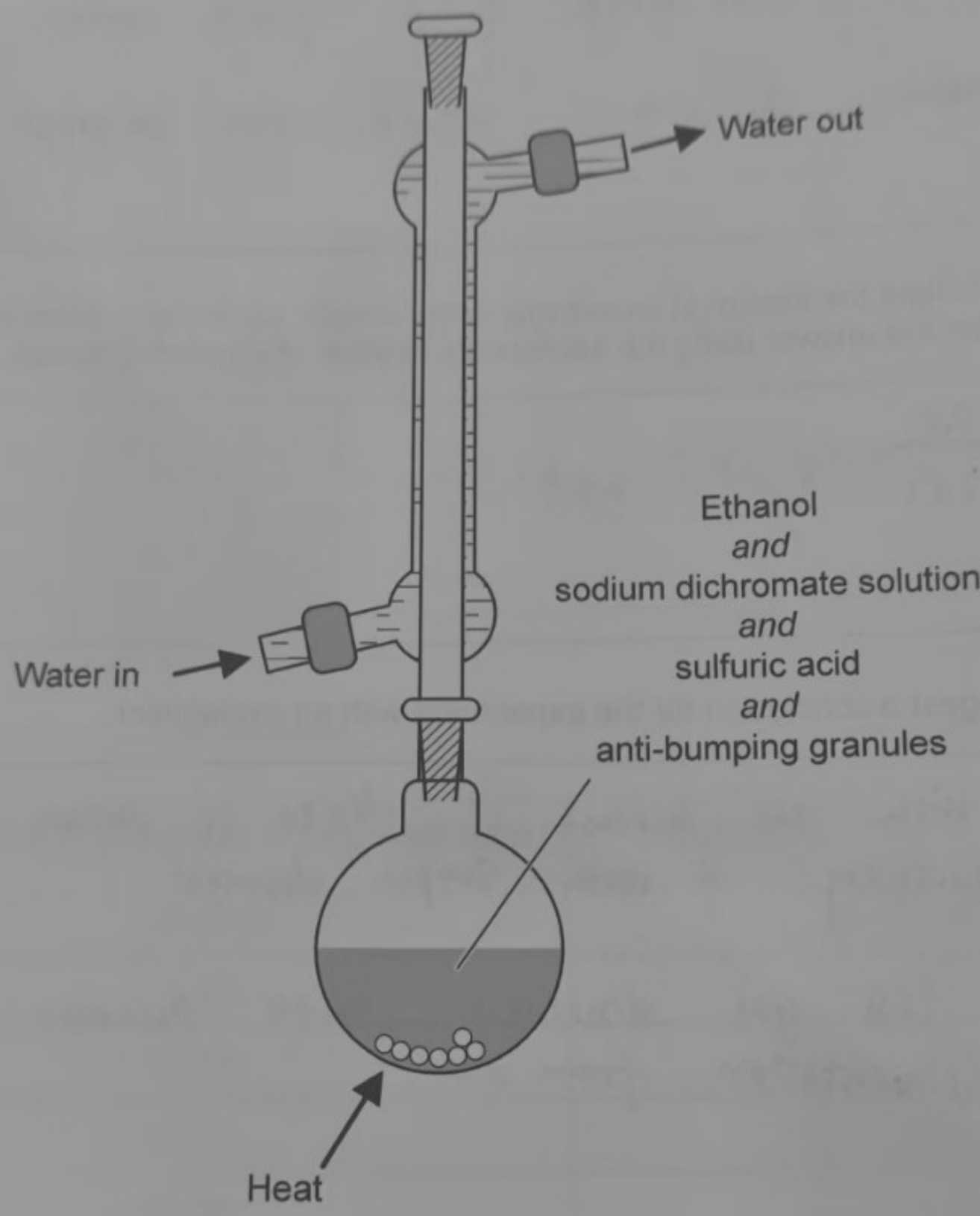
.....

Anode: .....$2Br^- \rightarrow Br_2 + 2e^-$.....

.....

2. In a student experiment, the apparatus shown was used to prepare ethanoic acid, CH_3COOH, from ethanol, C_2H_5OH.

1.60 g of ethanol, excess oxidizing agent (acidified $Na_2Cr_2O_7(aq)$) and a few anti-bumping granules were added to the round bottom flask.



(a) *Outline* ***two*** *features of this experiment that ensure that the ethanal intermediate is not a major product.* [2]

.....Use....reflux...to....heat....consistently.....

.....

.....excess...oxidising..agent....(..acidified..$Na_2Cr_2O_7$)?.....

.....

(This question continues on the following page)

(Question 2 continued)

(b) Outline **two** safety precautions that must be taken during the preparation of ethanoic acid, besides wearing a lab coat and safety goggles. [2]

H_2SO_4 : $Na_2Cr_2O_7$ is corrosive, gloves must be worn.
C_2H_5OH is flammable, stay far away from flame.
Heating ~~must~~ avoid scalding, use thermal gloves or wait till system cools down.

(c) After 30 minutes, the student stopped heating the mixture and titrated a sample of the solution remaining in the flask with NaOH to determine the experimental yield of ethanoic acid.

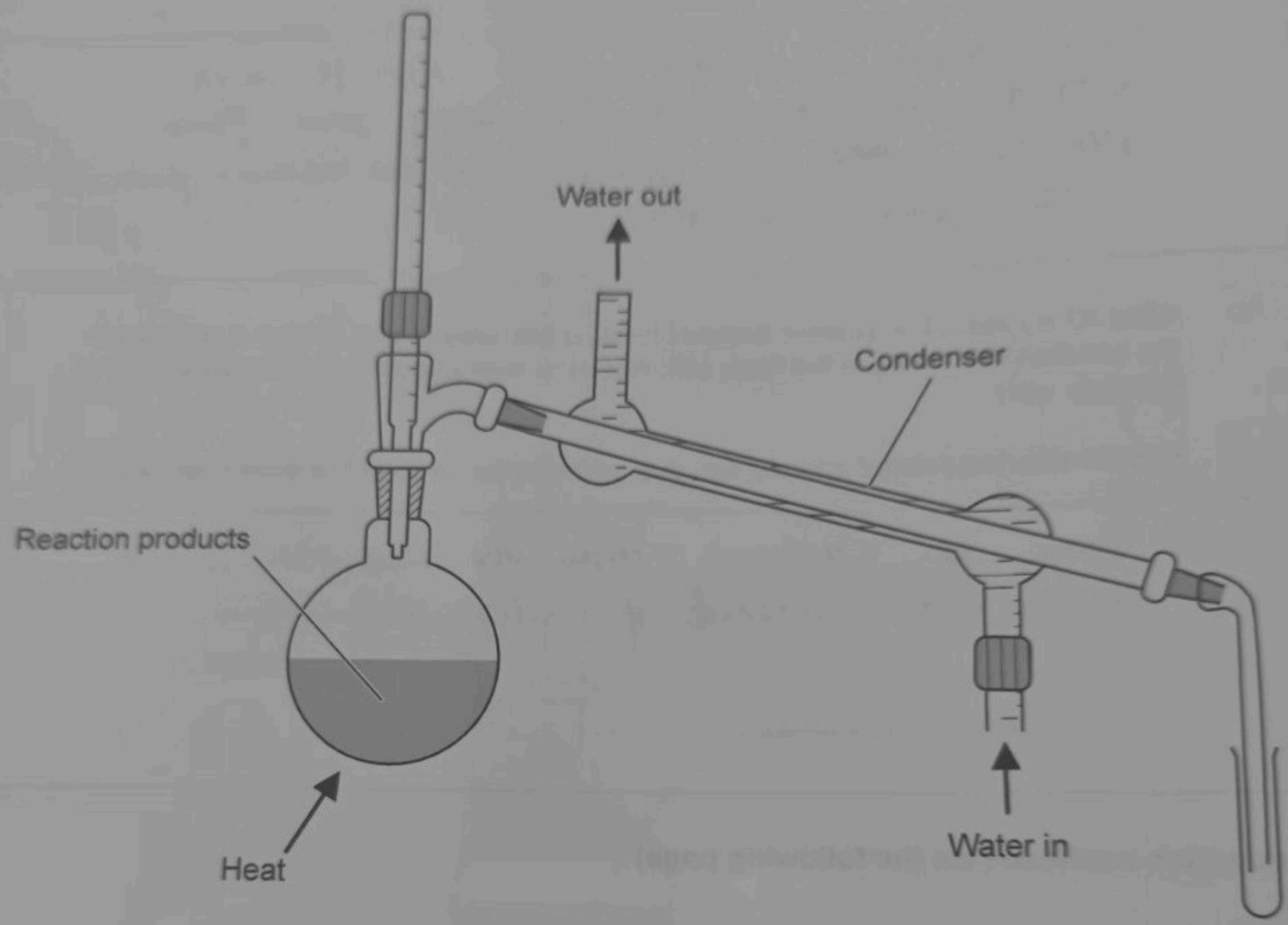
Explain why the titrated sample will give an incorrect value of the experimental yield. [2]

Sample has H_2SO_4 : H_2SO_4 also react with NaOH
the calculated amount of CH_3COOH is higher

(This question continues on the following page)

(Question 2 continued)

(d) The student used distillation to obtain pure ethanoic acid from the reaction mixture.



(i) State **two** impurities, apart from unreacted ethanol, that were present in the ethanoic acid before distillation. [1]

$Na_2Cr_2O_7$ / H_2SO_4 Cr^{3+} CH_3CHO

A005

(This question continues on the following page)

(Question 2 continued)

(ii) The approximate experimental yield of ethanoic acid was calculated using the mass of ethanoic acid collected in the distillation. The student's hypothesis was that impurities collected with the ethanoic acid during the distillation lowered this calculated yield.

Evaluate this statement. [1]

The statement is false. Impurities contain H_2SO_4 which also reacts with NaOH would higher the calculated

(e) The ethanoic acid obtained by the distillation was an aqueous solution with a volume of 18.7 cm^3.

Three 5.00 cm^3 samples of that solution were titrated with 0.250 mol dm^{-3} NaOH to determine the accurate experimental yield of ethanoic acid.

	Sample 1	Sample 2	Sample 3
Initial volume of NaOH / cm^3 ($\pm$ 0.05 cm^3)	0.00	22.85	0.00
Final volume of NaOH / cm^3 ($\pm$ 0.05 cm^3)	22.85	45.60	22.80
Volume of NaOH added / cm^3 ($\pm$ 0.10 cm^3)	22.85	22.75	22.80
Mean volume of NaOH / cm^3	22.80		

Determine the amount, in mol, of the ethanoic acid obtained from the distillation. [2]
Show your working.

$22.80 \times 10^{-3} \times 0.250 \text{ mol dm}^{-3} \times \frac{18.7}{5.00} = 0.0213 \text{ mol}$