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]**.

2226–4217

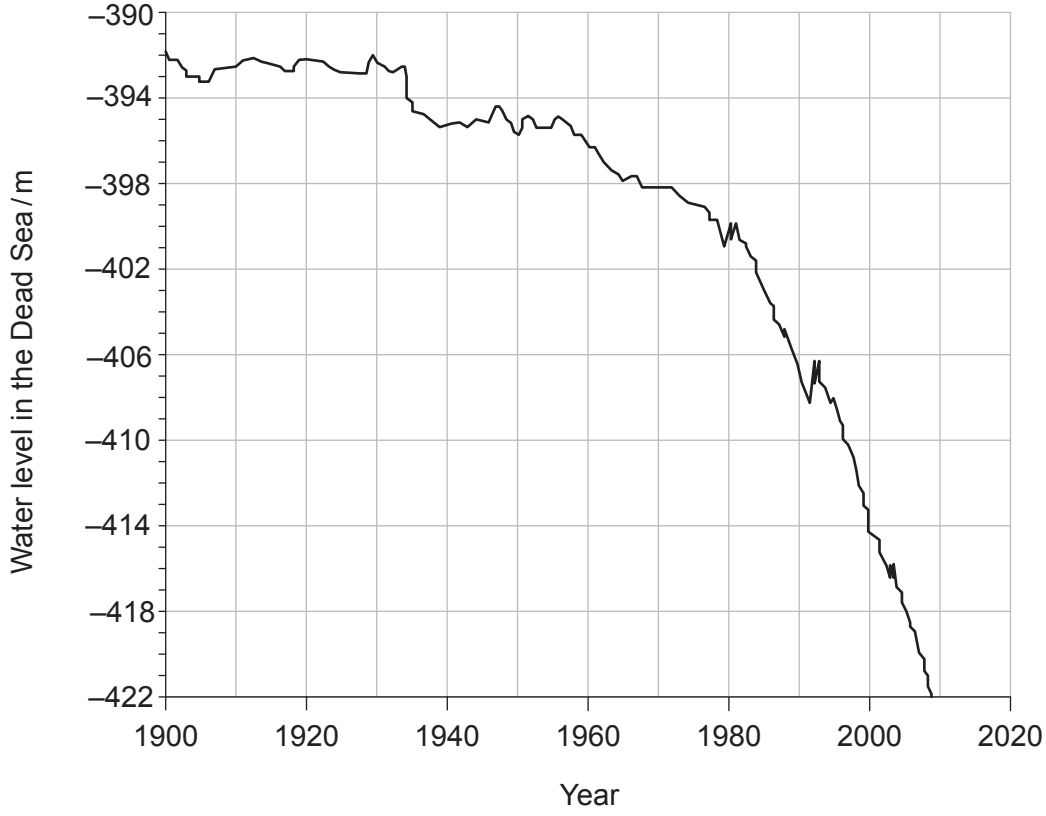
13 pages

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]

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(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]

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(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]

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

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(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]

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

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(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	. . . . .
Cl^- (aq)	. . . . .	

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(iv) Comment on the validity of the student's conclusion in part (b)(iii), giving a reason. [1]

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will not be marked.

(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]

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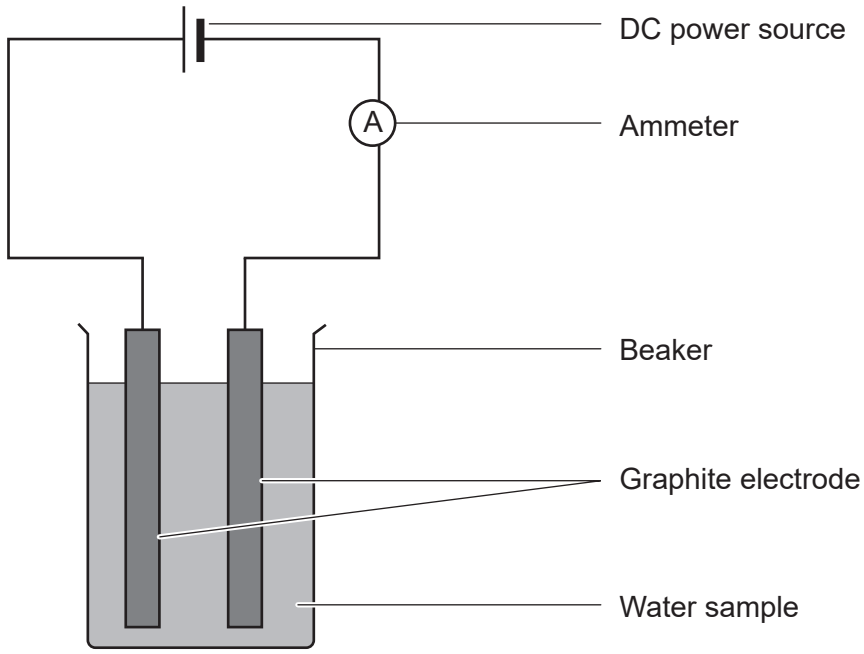
(Question 1 continued)

(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: . . . . . .

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Dependent variable: . . . . . .

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(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: . . . . . .

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Controlled variable 2: . . . . . .

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(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]

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

Conclusion: . . . . . .

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Explanation: . . . . . .

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(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. [2]

Cathode: . . . . . .

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Anode: . . . . . .

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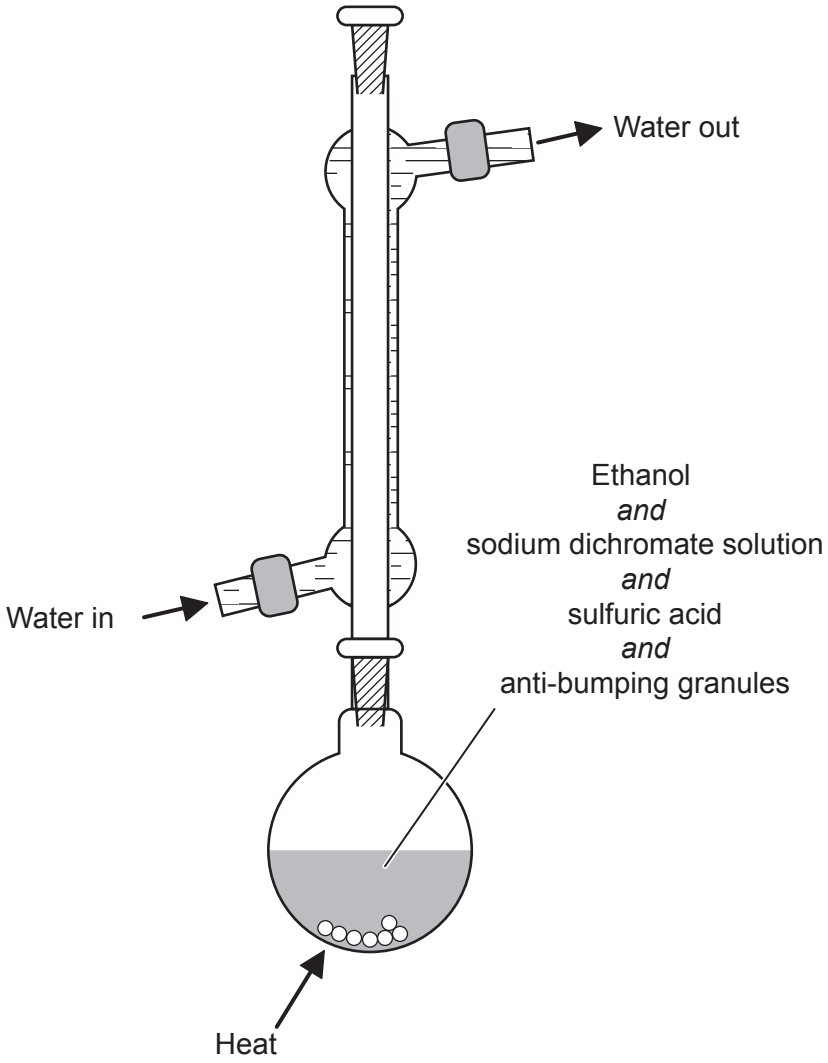
2. In a student experiment, the apparatus shown was used to prepare ethanoic acid, CH_3COOH, from ethanol, C_2H_5OH.

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]

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(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]

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(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]

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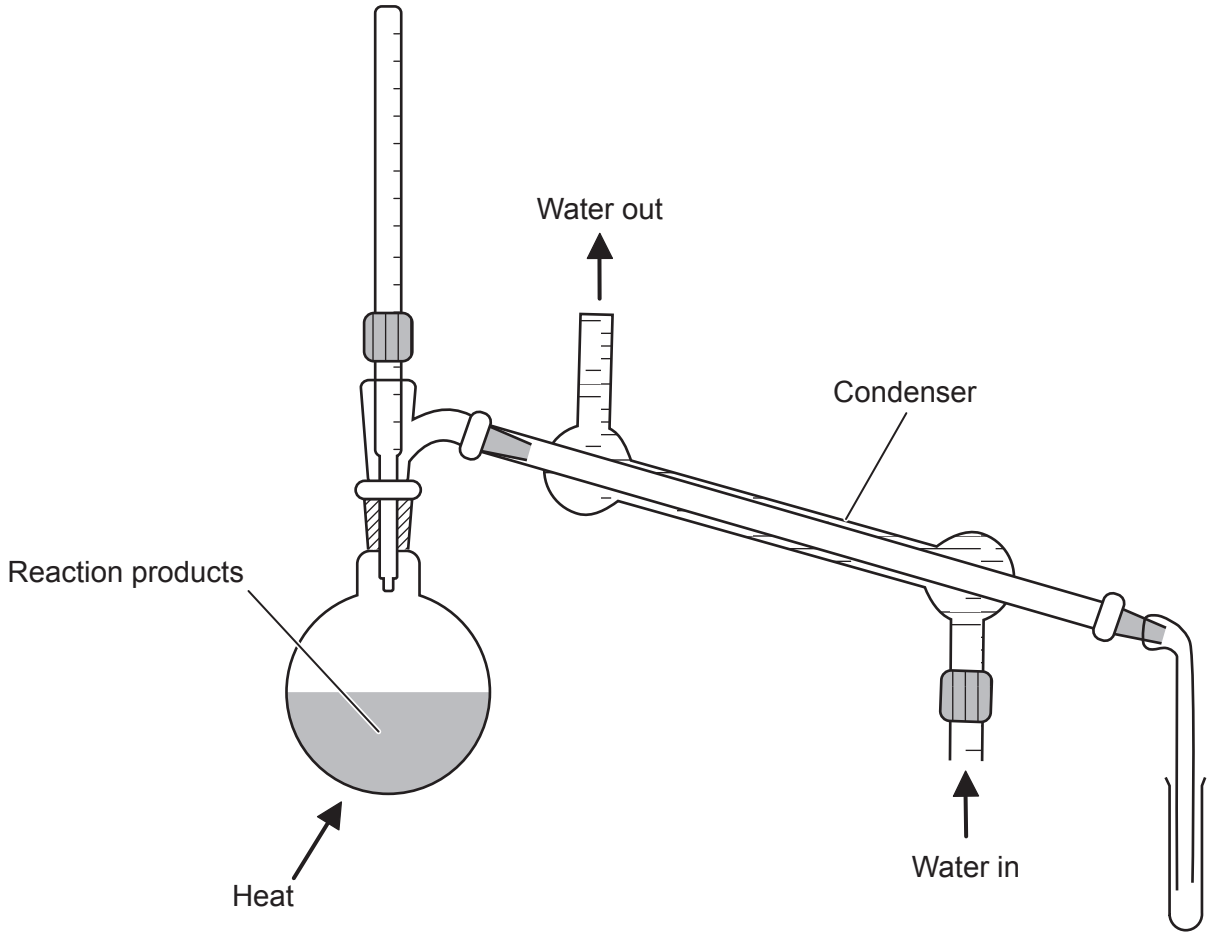
(Question 2 continued)

(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]

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(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]

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(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	. . . . .		

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

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References:

1.a Bookman, R., Bartov, Y., Enzel, Y., and Stein, M., 2006, Quaternary lake levels in the Dead Sea basin: Two centuries of research, in Enzel, Y., Agnon, A., and Stein, M., eds., *New frontiers in Dead Sea paleoenvironmental research: Geological Society of America Special Paper 401*, pp. 155–170, https://doi.org/10.1130/2006.2401(10).

1.b Article 1: Abeer Al Bawab et al. 2018 *IOP Conf. Ser.: Mater. Sci. Eng.* **305** 012003. **DOI** 10.1088/1757-899X/305/1/012003. Open access article licensed under CC BY 3.0 https://creativecommons.org/licenses/by/3.0/.

Article 2: Khlaifat, A., Batarseh, M., Nawayseh, K., Amira, J. and Talafeha, E., 2020. Mixing of Dead Sea and Red Sea waters and changes in their physical properties. *Heliyon* 6(11): e05444. https://doi.org/10.1016/j.heliyon.2020.e05444. Open access article licensed under CC BY 4.0 https://creativecommons.org/licenses/by/4.0/.

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