2021 **BORED OF STUDIES TRIAL EXAMINATION**

3rd November

Chemistry

General instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using a black or blue pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- A formulae sheet, data sheet and Periodic Table are provided

Total marks: 100

Section I – 20 marks (pages 2–12)

- Attempt Questions 1–20
- Allow about 35 minutes for this section

Section II – 80 marks (pages 13–38)

- Attempt Questions 21–33
- Allow about 2 hour and 25 minutes for this section

Section I

20 marks
Attempt Questions 1–20
Allow about 35 minutes for this section

Use the multiple-choice answer sheet provided for Questions 1–20.

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1 Consider the following equilibrium system:

$$C\,(s) + H_2O\,(g) \rightleftharpoons CO\,(g) + H_2\,(g)$$

Which of the following would cause an increase in the concentration of carbon monoxide present at equilibrium?

(A) Adding C (s) to the reaction mixture.

(B) Adding H_2O (g) to the reaction mixture.

(C) Adding a catalyst to the reaction vessel.

(D) Increasing the volume of the reaction vessel.

2 Which of the following is an example of an acid/base conjugate pair?

(A) HCl / NaCl

(B) H_3PO_4 / HPO_4^{2-}

(C) SO_3 / HSO_3^-

(D) NH_3 / NH_2^-

3 How many structural isomers can be drawn for the molecular formula C_3H_6BrCl?

(A) 3

(B) 4

(C) 5

(D) 6

4 A certain oxide of chlorine can be formed by reaction of its elements. Under constant conditions of temperature and pressure, 3.0 L of this oxide forms when 3.0 L of chlorine gas reacts with 7.5 L of oxygen gas.

Which of the following acidic solutions is formed when this oxide of chlorine dissolves into water?

(A) hypochlorous acid, HOCl

(B) chlorous acid, $HClO_2$

(C) chloric acid, $HClO_3$

(D) perchloric acid, $HClO_4$

5 A precipitate forms when copper(II) nitrate and potassium carbonate solutions are mixed. Aqueous copper(II) ions absorb light of wavelength 775 nm with an absorption coefficient of $\varepsilon = 12.3$ L mol^{-1} cm^{-1}.

A sample of the solution from above the precipitate was measured to have an abosorbance of 0.437 at this wavelength in a 1 cm cuvette. What is the concentration of carbonate ions in this solution?

(A) 3.55×10^{-2} mol L^{-1}

(B) 6.54×10^{-4} mol L^{-1}

(C) 1.18×10^{-5} mol L^{-1}

(D) 3.94×10^{-9} mol L^{-1}

6 A teacher has prepared a class demonstration involving the following salts of the arsenate ion, AsO_4^{3-}. In each case, 5.00 g of the ionic solid was mixed 100.0 mL of distilled water in a beaker, stirred, and allowing to stand until the solution above the precipitate was saturated.

The saturated salt equilbrium systems prepared were as follows:

Beaker	**Arsenate salt**	K_{sp}
1	bismuth(III) arsenate	4.43×10^{-10}
2	cobalt(II) arsenate	6.80×10^{-29}
3	iron(III) arsenate	5.70×10^{-21}
4	magnesium arsenate	2.04×10^{-20}
5	silver(I) arsenate	1.03×10^{-22}

Which of the beakers contain the highest and lowest concentration of the arsenate ion?

	Lowest $[AsO_4^{3-}]$	**Highest $[AsO_4^{3-}]$**
(A)	Beaker 2	Beaker 1
(B)	Beaker 3	Beaker 1
(C)	Beaker 3	Beaker 4
(D)	Beaker 5	Beaker 4

7 Nitric acid can be used to test for the presence of the carbonate anion in a salt. Which of the following is an observation that would indicate that the carbonate anion is present?

(A) A colour change

(B) The formation of carbon dioxide gas

(C) The solution becomes cloudy

(D) Bubbles form

8 In preparing to carry out a titration of α-hydroxybutyric acid, a weak monoprotic acid, with potassium hydroxide, a student adds two drops of thymol blue indicator ($pK_a = 8.9$) to the solution in the 250.0 mL conical flask.

Which of the following occurs as a result?

	pH of Mixture	**Value of $[H_3O^+][OH^-]$**
(A)	Changes slightly	Changes slightly
(B)	Changes slightly	Does not change
(C)	Does not change	Changes slightly
(D)	Does not change	Does not change

9 Oxalic acid (ethanedioic acid, HOOCCOOH) is a weak diprotic acid while nitric acid (HNO_3) is a strong monoprotic acid. A scientist takes 25.00 mL aliquots of each acid solution and titrates them using the same standardised solution of potassium hydroxide, using an appropriate indicator.

The two acid solutions both have the same concentration, 0.250 mol L^{-1}.

Which of the following is a true statement regarding the volumes of potassium hydroxide solution required to reach the equivalence point with each of the acid solutions?

(A) The volumes of base required can only be compared if the base used is of comparable strength to the acid.

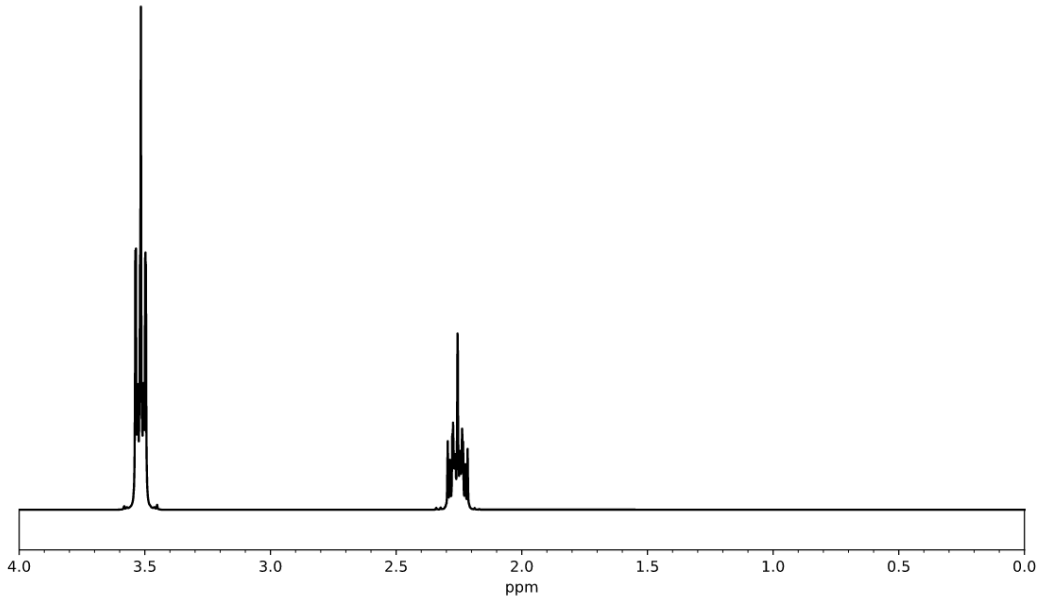
(B) The volume of base required to reach the end point with the nitric acid solution will be less than half the volume that is required with the oxalic acid solution.

(C) The volume of base required to reach the end point with the nitric acid solution will be exactly half the volume that is required with the oxalic acid solution.

(D) The volume of base required to reach the end point with the nitric acid solution will be more than half the volume that is required with the oxalic acid solution.

10 A university student found a bottle labelled with only the molecular formula $C_3H_6Cl_2$. She collected its ^1H NMR spectrum, shown below, to identify the compound.

Note: You may wish to consult the table of ^1H NMR chemical shift data that is provided on page 34.



Which of the following isomers would give rise to this ^1H NMR spectrum?

(A) 1,1-dichloropropane

(B) 1,2-dichloropropane

(C) 1,3-dichloropropane

(D) 2,2-dichloropropane

11 Which of the following combinations of chemicals could be used to prepare a buffer solution with a pH that is above 7 at 298 K?

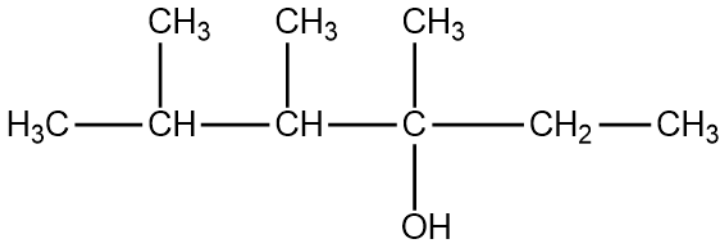
(A) 1-aminopropane and hydrochloric acid

(B) ethanoic acid and sodium hydroxide

(C) hydrochloric acid and potassium hydroxide

(D) methanoic acid and nitric acid

12 Consider the structure of the following alkanol.



Which of the following substances would ***not*** be present in the product mixture formed when this alkanol is treated with concentrated sulfuric acid?

(A) 2,3,4-trimethyl-2-hexene

(B) 2,3,4-trimethyl-3-hexene

(C) 3,4,5-trimethyl-2-hexene

(D) 2-ethyl-3,4-dimethyl -1-pentene

13 Consider the exothermic equilibrium system that can be used to test for iron(III) cations:

$$Fe^{3+}(aq) + SCN^{-}(aq) \rightleftharpoons FeSCN^{2+}(aq)$$

What happens to the concentrations of the iron(III) and thiocyanatoiron(III) cations when sodium hydroxide solid is dissolved into the mixture? You may assume that any change in the total volume of the solution is negligible.

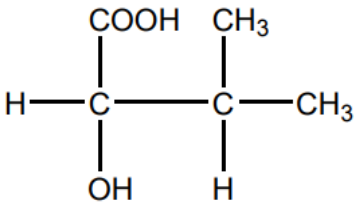
(A) Both the concentrations of Fe^{3+} and $FeSCN^{2+}$ will increase

(B) The concentration of Fe^{3+} increases and the concentration of $FeSCN^{2+}$ decreases

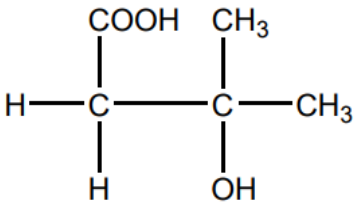
(C) The concentration of Fe^{3+} decreases and the concentration of $FeSCN^{2+}$ increases

(D) Both the concentrations of Fe^{3+} and $FeSCN^{2+}$ will decrease

14 Consider the substances **A** and **B**, which are structural isomers of $C_5H_{10}O_3$.



A



B

An HSC student is asked to determine whether a provided sample is isomer **A** or **B**. The student is required to collect information using any one of the following chemical tests and spectroscopic techniques.

- Test with bromine water
- Test with acidified potassium permanganate solution
- Test with sodium carbonate solution
- Test with zinc metal and hydrochloric acid
- Collect the IR spectrum of each compound
- Collect the ^{1}H NMR spectrum of each compound

How many of these, carried out as stand-alone tests, would provide sufficient information for the HSC student to determine whether the provided sample is **A** and **B**?

(A) 2

(B) 3

(C) 4

(D) 5

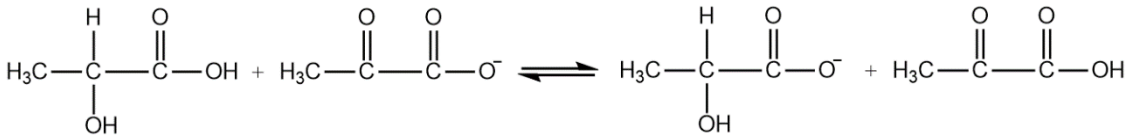
Use the following information in addressing the next two questions:

- Lactic acid is a weak monoprotic acid that is produced biochemically from the anaerobic respiration of glucose that occurs during intense exercise.

- Once the exercise is complete and blood oxygen levels rise, lactic acid is oxidised to pyruvic acid, another weak monoprotic acid.

- Hartmann's solution contains potassium chloride, sodium chloride, calcium chloride, and sodium lactate. It is sometimes used to treat metabolic acidosis.

15 The following equilibrium system is established when both lactic acid and pyruvic acid are present in an aqueous solution:



Which of the following expressions gives the equilibrium constant, K, for this system?

(A) $K = K_a$ (lactic acid) + K_a (pyruvic acid)

(B) $K = K_a$ (pyruvic acid) × K_a (lactic acid)

(C) $K = K_a$ (lactic acid) ÷ K_a (pyruvic acid)

(D) $K = K_a$ (pyruvic acid) ÷ K_a (lactic acid)

16 Which of the following is the IUPAC name for the organic compound in Hartmann's solution?

(A) sodium ethan-1-ol-1-carboxylate

(B) sodium ethan-1-one-1-carboxylate

(C) sodium 2-hydroxypropanoate

(D) sodium 2-oxopropanoate

17 A key step in the Ostwald process, used industrially for the production of nitric acid from ammonia, involves the following equilibrium:

$$4\ NH_3\ (g)\ +\ 5\ O_2\ (g) \rightleftharpoons 4\ NO\ (g)\ +\ 6\ H_2O\ (g) \qquad \Delta H° = -950\ kJ\ mol^{-1}$$

The process is undertaken at 900 °C in the presence of a platinum-rhodium catalyst.

Which of the following best describes the effect of heating the system?

(A) The forward reaction occurs at an increased rate while the reverse reaction occurs at a decreased rate, thereby increasing the yield.

(B) The reverse reaction occurs at an increased rate while the forward reaction occurs at a decreased rate, thereby decreasing the yield.

(C) Both the forward and reverse reactions occur at an increased rate, but the forward rate increases by more than the reverse rate, thereby increasing the yield.

(D) Both the forward and reverse reactions occur at an increased rate, but the reverse rate increases by more than the forward rate, thereby decreasing the yield.

18 A solution is known to contain three metal cations. A white precipitate forms when hydrochloric acid is added to the solution. The mixture is filtered and it is found that the residue does not dissolve in ammonia.

The filtrate is then tested with sulfuric acid and no precipitate forms, but a precipitate is formed when sodium hydroxide is added. This solid is isolated by filtration and ammonia is added, resulting in a dark blue solution and a white solid.

Based on these results, which of the following could be the three cations in the original solution?

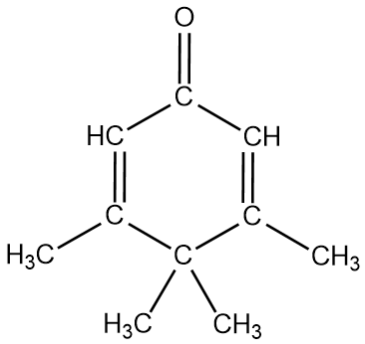
(A) Ag^+, Ca^{2+}, and Cu^{2+}

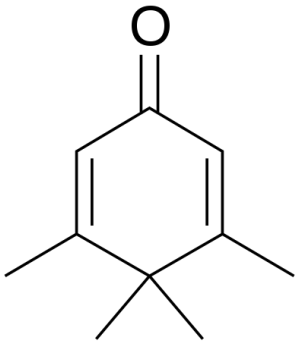
(B) Ba^{2+}, Cu^{2+}, and Pb^{2+}

(C) Ag^+, Cu^{2+}, and Mg^{2+}

(D) Cu^{2+}, Mg^{2+}, and Pb^{2+}

19 The structural formula of a ketone with molecular formula $C_{10}H_{14}O$ is shown in two forms below. The IUPAC name for this compound is 3,4,4,5-tetramethylcyclohexa-2,5-dienone, though it is usually called penguinone as its structure somewhat resembles a penguin.





Which of the following is a true statement concerning the number of hydrogen and carbon environments that would be observed in the ^{1}H and ^{13}C NMR spectra of penguinone?

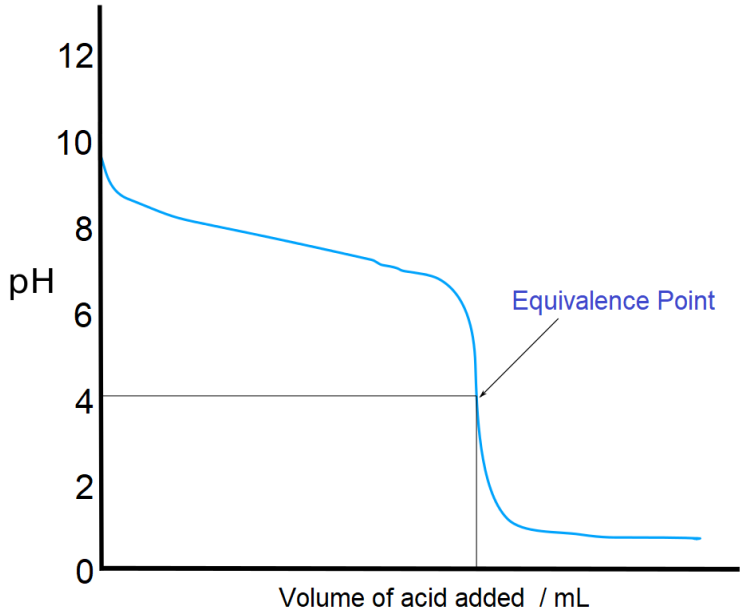
(A) The number of carbon environments in penguinone exceeds the number of hydrogen environments by one.

(B) The number of carbon environments in penguinone exceeds the number of hydrogen environments by two.

(C) The number of carbon environments in penguinone exceeds the number of hydrogen environments by three.

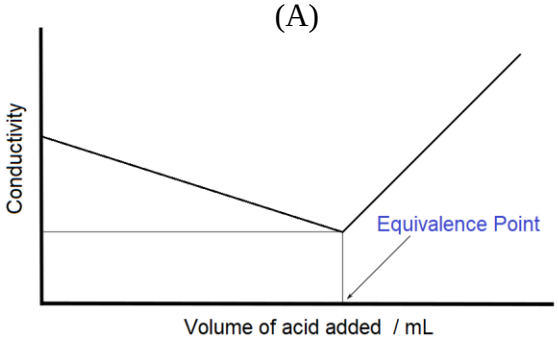
(D) The number of carbon environments in penguinone exceeds the number of hydrogen environments by four.

20 A titration was conducted using a probe that measured both conductivity and pH. The pH curve obtained is shown below.

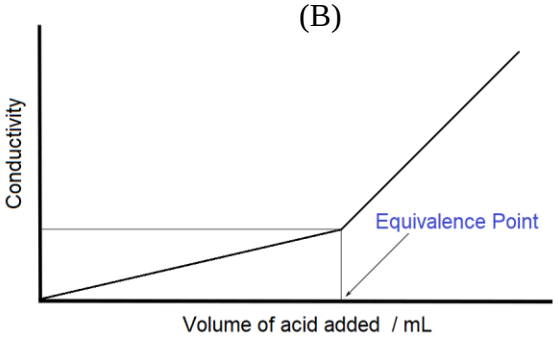


Which of the following conductivity titration curves would be expected for this system?

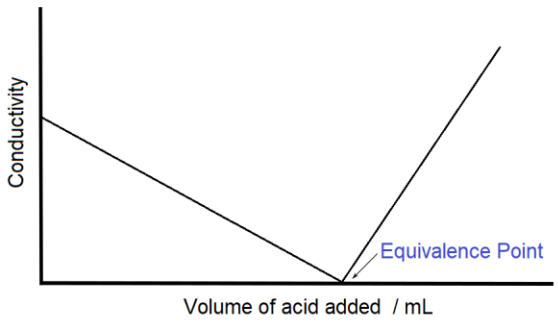
(A)



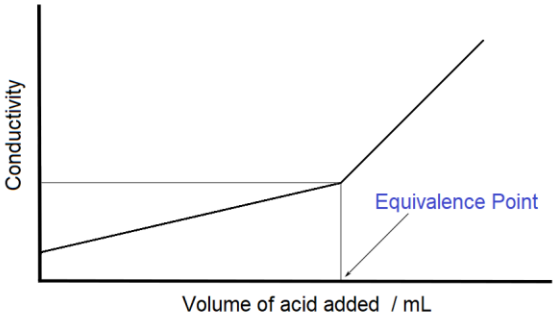
(B)



(C)



(D)



Student Number: ……

Username: ……

Name: ……

Chemistry
Section II Answer Booklet

80 marks
Attempt Questions 21–33
Allow about 2 hours and 25 minutes for this section

Instructions

- Write your student number, username and name on the top right of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Show all relevant working in questions involving calculations.
- If you require extra writing space, please ask for a writing booklet. If you use a writing booklet, clearly indicate which questions you are answering.

Please turn over

Question 21 (4 marks)

Esters are used widely as fragrances, flavouring agents, and as solvents. 2-Propyl propanoate can be prepared by refluxing a mixture of 2-propanol and propanoic acid in the presence of sulfuric acid. The table below gives the boiling points for all the volatile chemicals present in the reaction mixture at equilibrium.

Substance	**Boiling Point / °C**
2-propanol	83
propanoic acid	141
2-propyl propanoate	108
water	100

(a) State one reason why distillation is not an appropriate way to extract the ester product from the reaction mixture. **1**

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(b) Justify a procedure whereby pure 2-propyl propanoate could be obtained in good yield. **3**

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Question 22 (4 marks)

The table below lists the properties of several acid-base indicators.

Indicator	**Colour Change (Low pH – High pH)**	**pK_a**
methyl red	red – yellow	5.1
bromothymol blue	yellow – blue	7.0
phenolphthalein	colourless – pink	9.3

(a) To obtain accurate results from a volumetric analysis, the indicator chosen should have a pK_a value near that of the pH of the equivalence point of the system being studied. Explain why acid-base indicators change colour in a pH range that is centred on their pK_a value. **2**

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(b) Explain the effect of adding too much indicator on the accuracy and validity of a titration experiment. **2**

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Question 23 (3 marks)

Fuels like petrol, diesel, ethanol, and petrol / ethanol blends are widely used in for road vehicles. Discuss advantages and disadvantages of these fuels in terms of their societal implications. **3**

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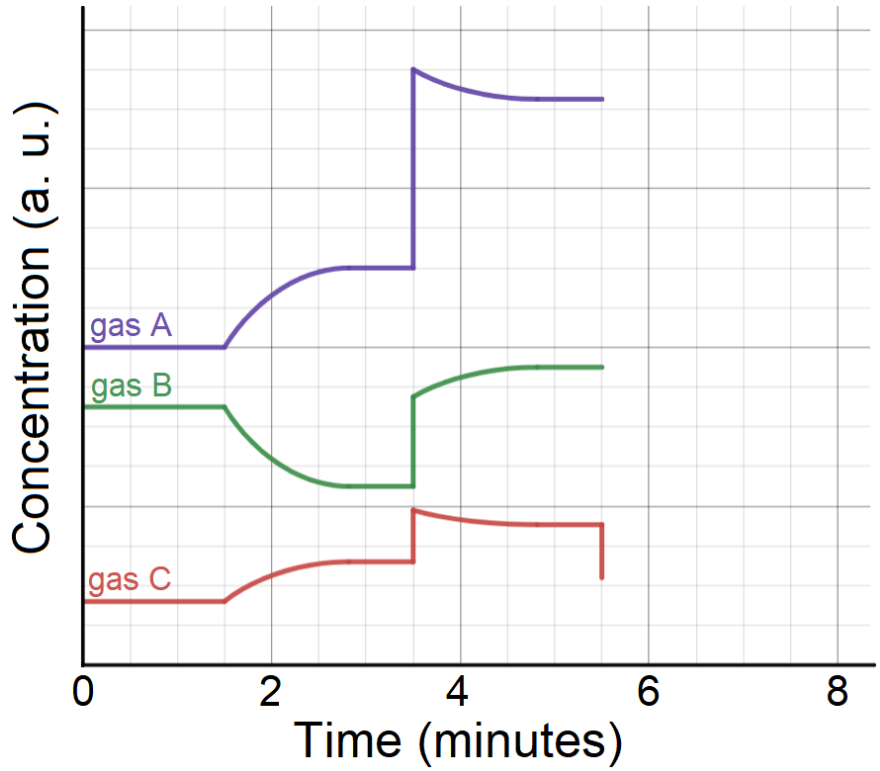
Question 24 (6 marks)

Gases **A**, **B**, and **C** are present in a mixture at equilibrium. The graph below shows the changes in their concentrations over time.



(a) Find the equation for this synthesis equilibrium system. **1**

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(b) The concentration of **C** suddenly falls at t = 5.5 minutes. **1**

Sketch on the graph above the changes in concentration of each gas, immediately following this change, given that the system returns to equilibrium within 2 minutes of the disturbance.

Question 24 continues on page 18

Question 24 (continued)

(c) The synthesis reaction is exothermic. Identify the disturbances that occur at 1.5 and 3.5 minutes, and justify the effect each has on the equilibrium system. **2**

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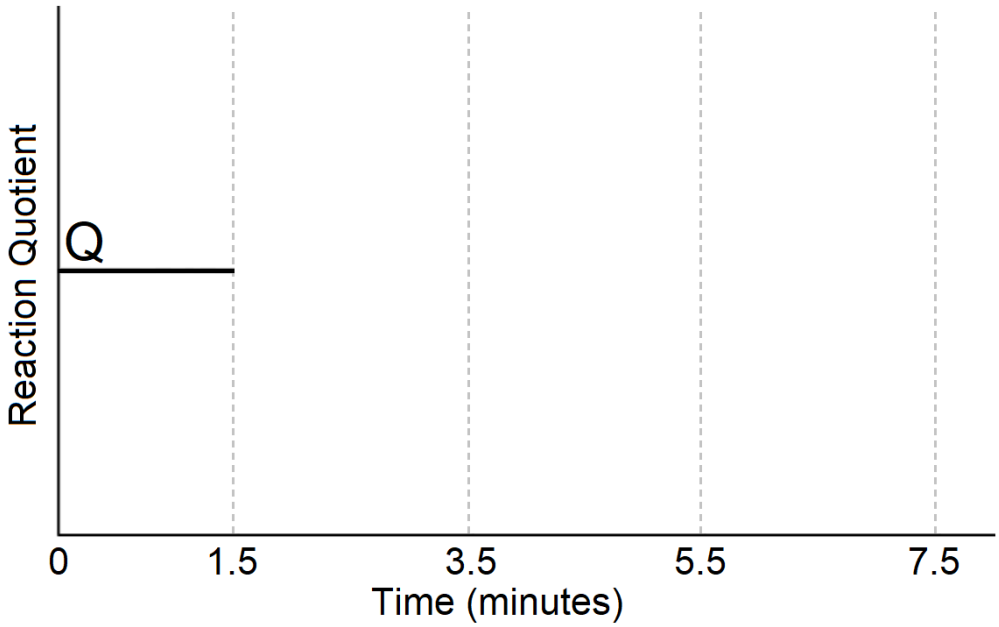
(d) On the following diagram, sketch the graph showing the changes in the reaction quotient with time for the above equilibrium system. **2**



End of Question 24

Question 25 (4 marks)

Two compounds, **A** and **B**, both have the same molecular formula, C_3H_7Br.

The boiling points of **A** and **B** are 71 °C and 59 °C, respectively. **A** can be converted into **B** via an intermediate compound, **C**, which is a gas at room temperature.

(a) Outline a reaction sequence to convert **A** to **B**. **1**

(b) Account for the difference in boiling points of **A**, **B**, and **C**. **2**

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(c) Suggest a reason why the conversion of **B** to **A** is more difficult to achieve in good yield. **1**

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Question 26 (3 marks)

A dilute aqueous solution of a strong base has a pH of 10.54 at 25 °C. **3**

A student quantitatively transferred a 25.00 mL sample of this solution into a 250.0 mL volumetric flask and then filled it to the graduation mark using distilled water.

The student predicts that the resulting solution should have a pH of 9.54 but states that this result proves that the concentration of hydronium ions will have increased.

Are the student's predictions correct? Account for any correct predictions and identify the error in any incorrect predictions.

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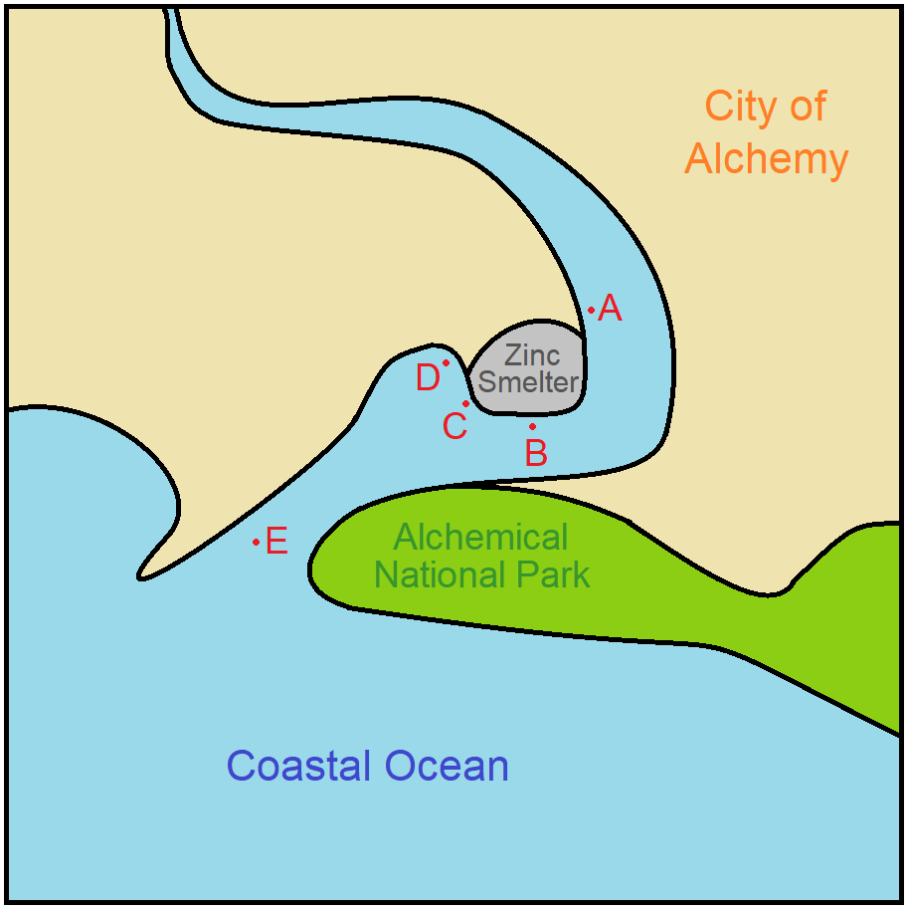
Question 27 (7 marks)

Cadmium sulfide is often present in ores rich in zinc sulfide. An environmental group in the City of Alchemy is concerned that a local zinc smelter is releasing cadmium pollution into river. They approached the ACME Chemical Analysis Company to investigate and prepare a report.

The map below shows the location of the city, the zinc smelter, and the river that flows out into the Coastal Ocean. ACME collected water samples from the four sites marked.



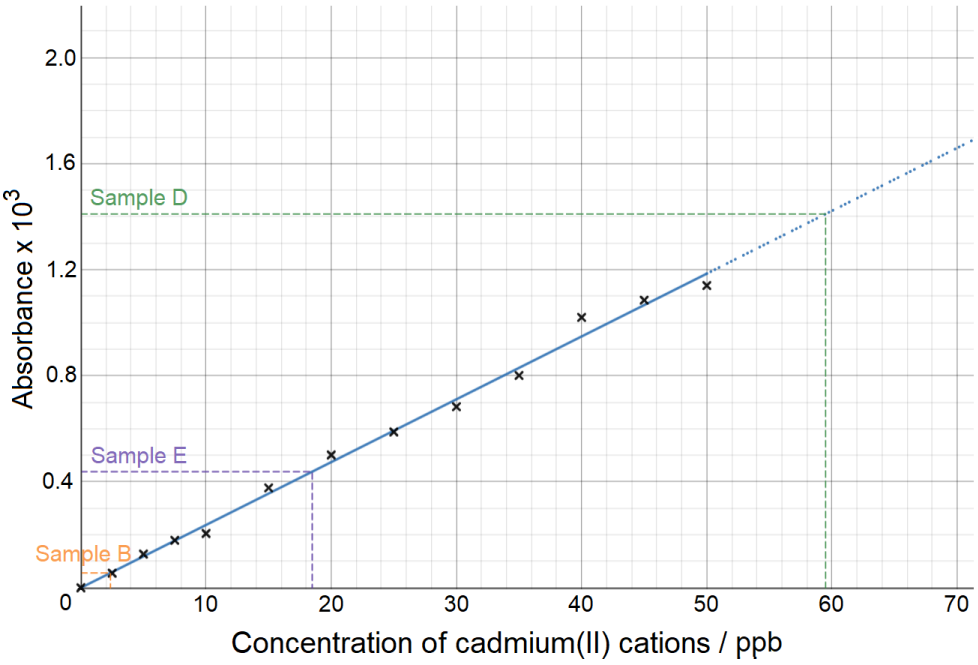
The ACME team prepared a standard solution of cadmium(II) nitrate and used it to calibrate an Atomic Absorption Spectrometer. The calibration data set was plotted. Statistical analysis showed that the line of best fit for the data was

$$A = 23.7c \times 10^{-6}$$

where A is the measured absorbance of a sample and c is the concentration of the cadmium(II) ions in the sample, in parts per billion.

Question 27 continues on page 22

Question 27 (continued)



The ACME team used their model to determine the concentration of cadmium(II) ions at each of the five sites where water samples were taken, as shown in the table below.

Water Sample	Absorbance × 10^3	Concentration / ppb
A	0.0020	0.084
B	0.056	2.4
C	3.51	148
D	1.41	59.5
E	0.438	18.5

When the cadmium(II) ion concentration in coastal water exceeds 0.9 nmol L^{-1}, it is considered very likely that there is a terrestrial source of cadmium nearby.

The Australian Guidelines for Drinking Water (version 3.6, March 2021) mandate a maximum cadmium content of 2.0 μg L^{-1}. Note that 1 μg L^{-1} = 1 ppb.

Question 27 continues on page 23

Question 27 (continued)

Assess the validity of the conclusion that the zinc smelter is releasing high concentrations of cadmium pollution and discuss how ACME's investigation could be improved **7**

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End of Question 27

Question 28 (8 marks)

The Volhard titration is used to determine the concentration of chloride ions in a water sample. It involves the following steps:

1. An excess amount of silver nitrate solution is added to the water sample.
2. The precipitate is removed by filtration.
3. An acidic buffer is added to the system, along with a suitable indicator.
4. The solution is titrated against potassium thiocyanate (KSCN).
5. A pink-red colour appears in the white suspension at the end point.

(a) In one analysis, 100.0 mL of 0.1234 mol L^{-1} silver nitrate was added to a 75.00 mL water sample. After filtration, the end point of the titration was reached when 37.47 mL of 0.04971 mol L^{-1} potassium thiocyanate had been added. **3**

Calculate the concentration of chloride ions in the water sample in parts per million.

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(b) Explain why iron(III) nitrate is a suitable indicator for this titration. **1**

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Question 28 continues on page 25

Question 28 (continued)

(c) Account for the need to carry out the titration in the presence of an acidic buffer and identify an acidic buffer system that could be used here, without reducing the accuracy of the results obtained. **2**

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(d) The K_{sp} of silver thiocyanate is 1.03×10^{-12}. **2**

Inaccurate results are obtained if step 2 of the procedure is skipped.

Explain why the presence of solid silver chloride during the titration step leads to inaccurate results.

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End of Question 28

Question 29 (5 marks)

Solid sodium hydrogencarbonate is a useful chemical for reducing the risk associated with certain hazardous chemicals in both laboratory and domestic settings.

(a) A student adds 1.00 g of sodium hydrogencarbonate to 200 mL of deionised water and stirs the mixture until all the solid dissolves. **3**

Identify all chemical species (molecular and ionic) present in the resulting solution. Use suitable chemical equations to explain your answer.

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(b) Sodium hydrogencarbonate can be used to mitigate the risk associated with accidental spills of some chemicals. **2**

Identify one acid and one base that would be present in many households where spills could be treated with sodium hydrogencarbonate. Explain why such spills are more appropriately treated with sodium hydrogencarbonate in solid form, rather than using a solution.

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Question 30 (8 marks)

Alice conducts a series of experiments involving the enthalpy changes that occur when solid sodium hydroxide is added to acidic solutions. She prepares nine beakers, each with different mixtures of a sulfuric acid solution of unknown concentration and water, as outlined in the table below. The mixtures were allowed to stand until each was at the same temperature, 21.3 °C.

Alice then added 1.50 g of sodium hydroxide to the first beaker, stirred the mixture, and recorded the maximum temperature reached. The same procedure was followed for each of the other beakers. You may assume that any change in the volume of the solution due to the sodium hydroxide solution is negligible, and that the specific heat capacity of each solution is the same as that of water.

Beaker	**Volume of H_2SO_4 added / mL**	**Volume of H_2O added / mL**	**Maximum Temperature / °C**
1	0.0	80.0	26.3
2	10.0	70.0	27.4
3	20.0	60.0	28.6
4	30.0	50.0	29.7
5	40.0	40.0	31.0
6	50.0	30.0	32.1
7	60.0	20.0	32.5
8	70.0	10.0	32.4
9	80.0	0.0	32.6

(a) Use the data from Beaker 1 to determine the molar enthalpy of solution of sodium hydroxide. **2**

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Question 30 continues on page 27

Question 30 (continued)

(b) Predict the effect of increasing temperature on the solubility of sodium hydroxide in water and explain your answer in terms of Gibbs free energy. **1**

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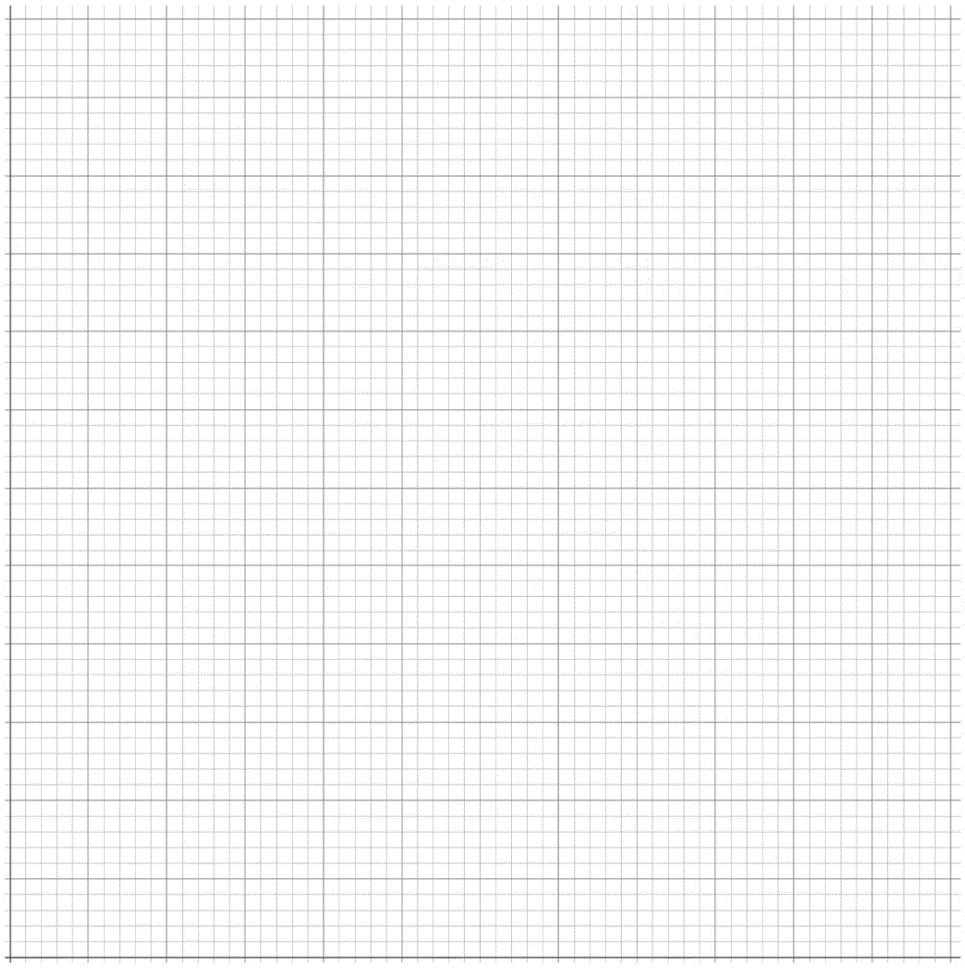
(c) Using the grid provided below, draw a graph representing the temperature data provided in the table above. **2**



Question 30 continues on page 29

Question 30 (continued)

(d) Determine the concentration of sulfuric acid used by Alice in this experiment. **1**

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(e) Find the molar enthalpy change for the reaction of hydronium ions with hydroxide ions in aqueous solution. **2**

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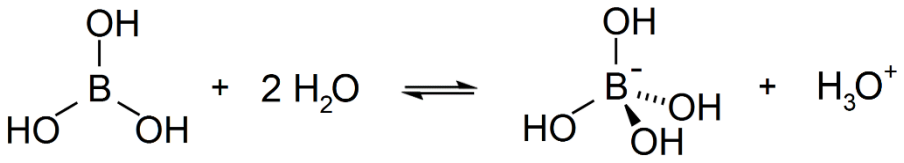
End of Question 30

Question 31 (5 marks)

Boric acid, $B(OH)_3$, reacts with water to form the following equilibrium system.



The equilibrium constant for this reaction is 3.8×10^{-10} at 298 K.

(a) Calculate the pH of a 0.10 mol L^{-1} aqueous solution of boric acid at 298 K. **2**

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(b) Assess the usefulness of Brønsted–Lowry theory in improving our understanding the behaviour of acids and bases in aqueous solution. **3**

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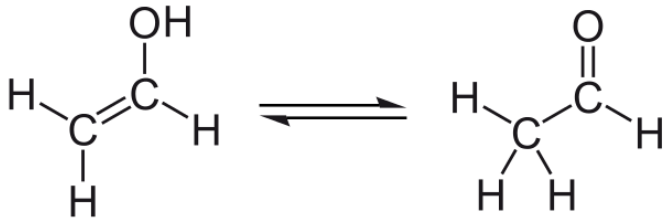
Question 32 (8 marks)

Vinyl alcohol (ethenol) undergoes a rearrangement reaction to form acetaldehyde (ethanal). The two compounds form an equilibrium system.



At 298 K, the equilibrium constant for this system is 1.67×10^6 and the enthalpy change is –42.7 kJ mol^{-1}.

(a) State the type of isomer relationship illustrated in this reaction. **1**

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(b) Identify TWO effects that heating while have on this system and justify your answer. **2**

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Question 32 continues on page 32

Question 32 (continued)

(c) If a sample of vinyl alcohol is prepared, what percentage of vinyl alcohol molecules remain once the system reaches equilibrium? **2**

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(d) Polyvinyl alcohol is an addition polymer, but it is prepared from vinyl acetate ($CH_3COOCHCH_2$) rather than from vinyl alcohol. Suggest a reason for this approach and illustrate how it may be achieved using chemical equations. **3**

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End of Question 32

Question 33 (15 marks)

W, **X**, and **Y** are three organic compounds, each of which contains only the elements carbon, hydrogen, and oxygen. **Z** is a salt of compound **Y**.

Compound W

- reacts with sodium metal to give a strong base and hydrogen gas
- does ***not*** react with concentrated sulfuric acid
- decolourises acidified potassium dichromate solution and, in the process, produces two other compounds, **X** and **Y**

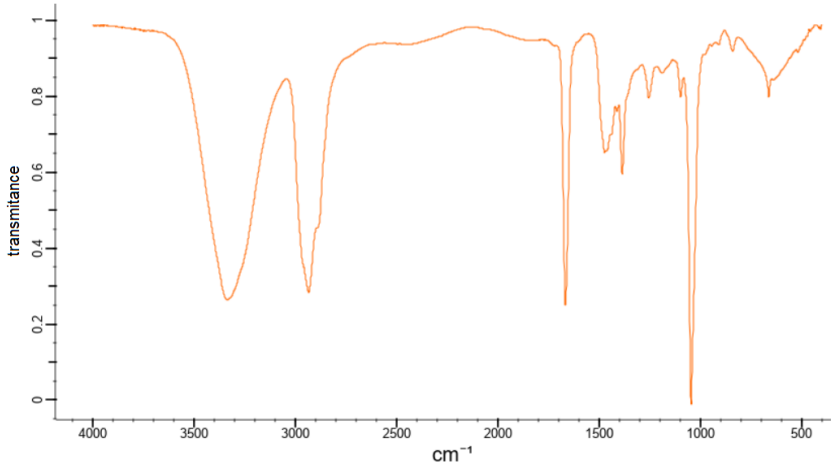
Compound X

- gives a positive silver mirror test, producing **Z** as the only organic product
- can be oxidised to give **Y**

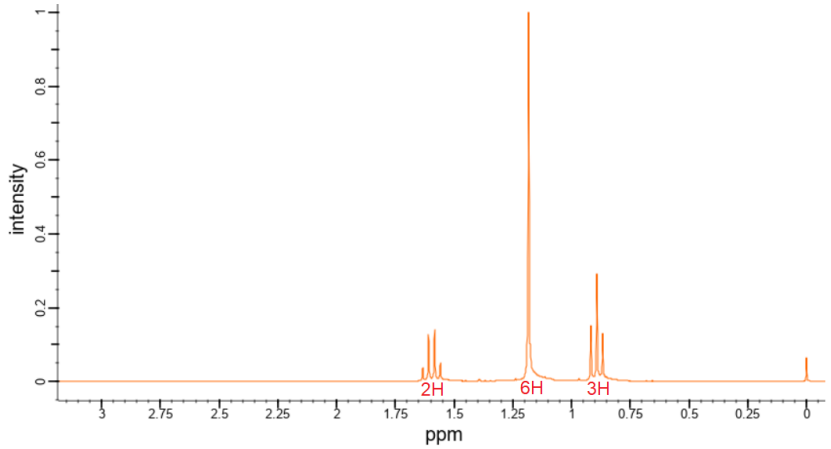
Compound Y

- contains 62.0% carbon and 10.4% hydrogen, by mass
- has a single molecular ion peak in its mass spectrum, at $m / z = 116$

IR Spectrum of Compound W



^{1}H NMR Spectrum of Compound Y for signals below 3 ppm



Question 33 continues on page 34

Question 33 (continued)

The following chemical shift data relating to ^1H NMR spectroscopy may be useful in answering this question.

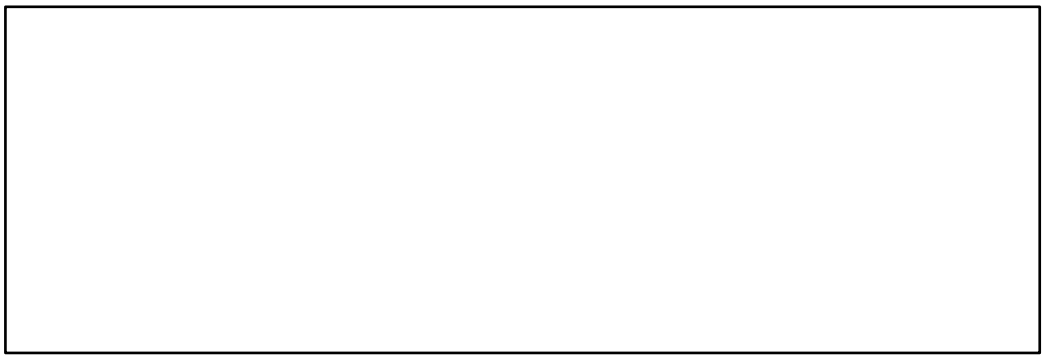
^1H NMR chemical shift data

Type of proton		δ/ppm
$Si(CH_3)_4$	(TMS)	0
R—CH_3		0.7–1.3
R—CH_2—R		1.2–1.5
R—CHR_2		1.5–2.0
H_3C—CO—	(aldehydes, ketones or esters)	2.0–2.5
—CH—CO—	(aldehydes, ketones or esters)	2.1–2.6
H_3C—O—	(alcohols or esters)	3.2–4.0
—CH—O—	(alcohols or esters)	3.3–5.1
R_2—CH_2—O—	(alcohols or esters)	3.5–5.0
R—OH		1–6
R_2C=CHR	(alkene)	4.5–7.0
R—CHO	(aldehyde)	9.4–10.0
R—COOH		9.0–13.0

Question 33 continues on page 35

Question 33 (continued)

(a) Use the information provided above to determine the structure of compound **Y** and justify your answer. **7**



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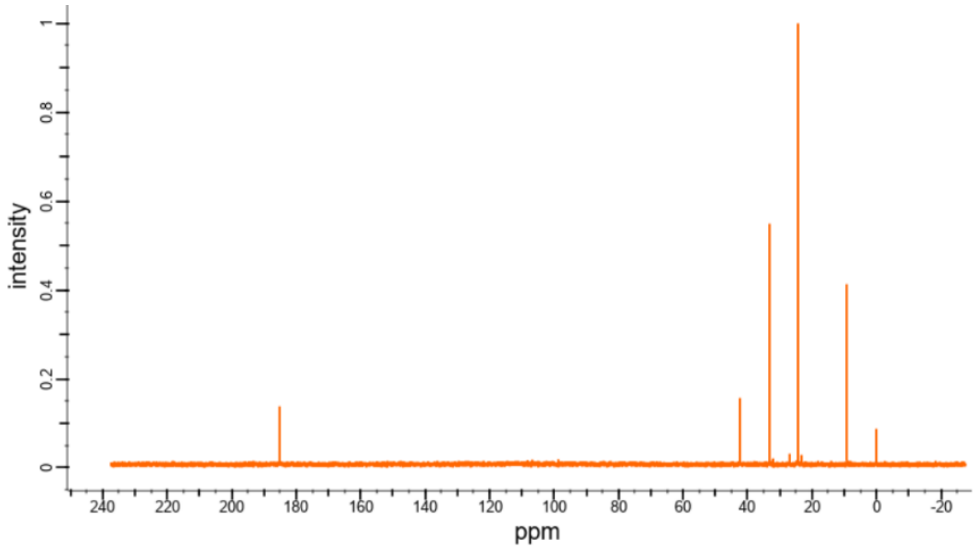
Question 33 continues on page 36

Question 33 (continued)

(b) The ^{13}C NMR spectrum of compound **Y** is shown below. Identify one similarity and one difference between this spectrum and the expected ^{13}C NMR spectrum of compound **Z**. **2**



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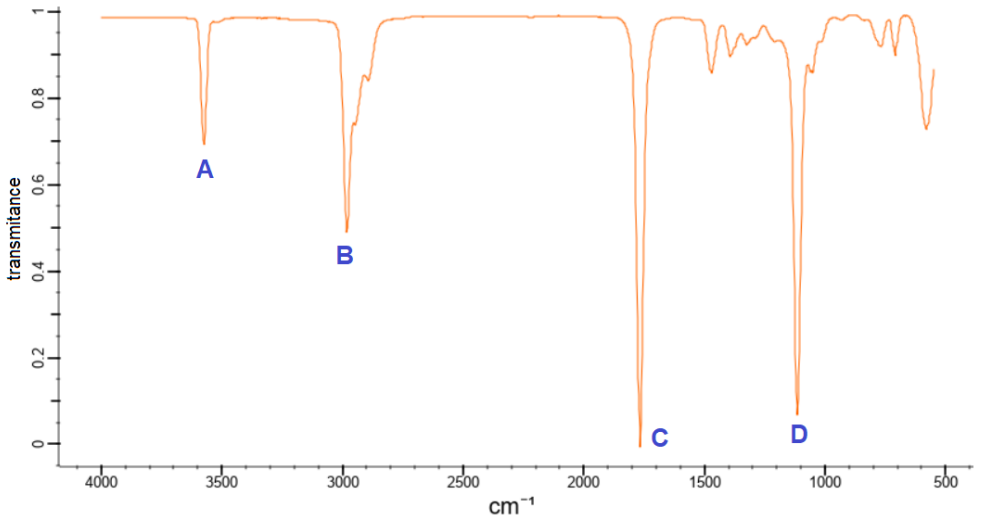
Question 33 continues on page 37

Question 33 (continued)

(c) The gas-phase IR spectrum of Compound **Y** is shown below. **3**



Discuss this spectrum, including identifying the peaks marked as **A**, **B**, **C**, and **D**, and account for the unusual appearance of peak **A**.

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Question 33 continues on page 38

Question 33 (continued)

(d) The silver mirror test is conducted as follows: Solutions of silver nitrate and sodium hydroxide are mixed, forming a precipitate of silver oxide. Ammonia is then added dropwise until all the precipitate re-dissolves. **3**

When compound **X** is added to the solution, the resulting redox reaction produces elemental silver that forms a "silver mirror" film on the inside wall of the reaction vessel. Compound **Y** is also produced.

Give the IUPAC name for compound **Y**, identify the oxidant in this system, and use chemical equations to account for its presence in the reaction mixture.

Compound **Y**

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Oxidant

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Chemical equations to account for presence

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End of paper

https://boredofstudies.org/threads/bos-trials-maths-and-chemistry-2021.397055/page-3