2023

Higher School Certificate

Trial Examination

Chemistry

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- Calculators approved by NESA may be used
- A formulae sheet, data sheet and a Periodic Table are provided
- Write your student number and/or name at the top of every page

Total marks – 100

Section I – Pages 2–10
20 marks
- Attempt Questions 1–20
- Allow about 35 minutes for this section

Section II – Pages 11–32
80 marks
- Attempt Questions 21–35
- Allow about 2 hours and 25 minutes for this section

This paper MUST NOT be removed from the examination room

STUDENT NUMBER/NAME: .....

STUDENT NUMBER/NAME: .....

Section I

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

Select the alternative A, B, C or D that best answers the question and indicate your choice with a cross (X) in the appropriate space on the grid below.

	A	B	C	D
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	A	B	C	D
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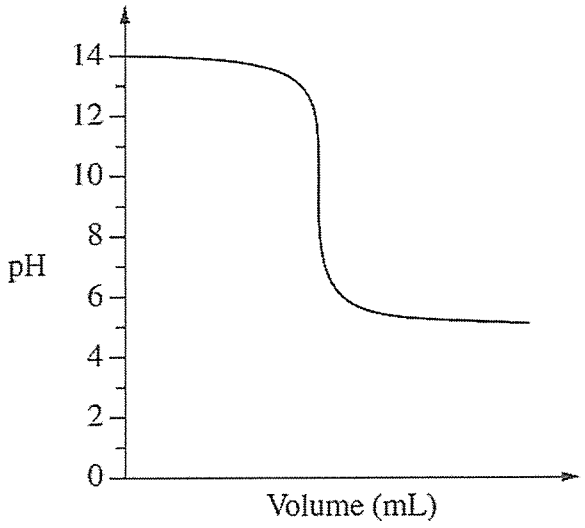
1 The graph shows the changes in pH during a titration.



Which indicator should be chosen for this titration?

A. Methyl orange (pH range 3.1 – 4.4)

B. Bromocresol green (pH range 4.5 – 5.2)

C. Bromothymol blue (pH range 6.0 – 7.6)

D. Phenolphthalein (pH range 8.3 – 10.0)

2 The reaction between diamond and graphite can be described by the following equilibrium at room temperature.

$$C(\text{diamond}) \rightleftharpoons C(\text{graphite}) \qquad \Delta G^{\circ} = -2.9 \text{ kJ mol}^{-1}$$

It has been estimated that it would take 3.0×10^{72} years for 1 g of diamond to change to 1 g of graphite.

Which of the following is true of this equilibrium?

	Spontaneous	*Activation energy*	*Equilibrium type*
A.	Yes	High	Dynamic
B.	Yes	High	Static
C.	Yes	Low	Static
D.	No	High	Dynamic

3 Consider the molecular structure shown below.

$$CH_3 — CH_2 — CH_2 — COO — CH_3$$

Which of the following identifies the molecule and the substances that could be used to synthesise the molecule?

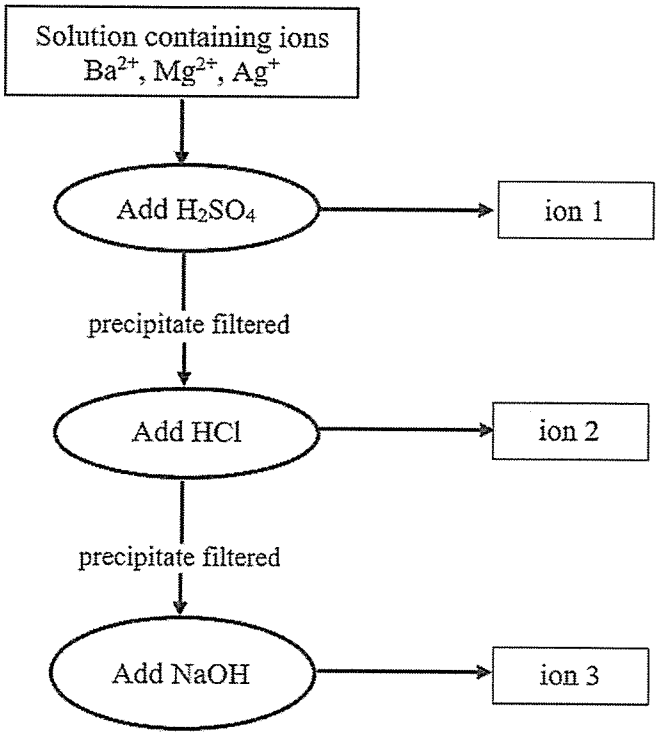
A. Butyl methanoate: butanol, methanoic acid

B. Butyl methanoate: butanoic acid, methanol

C. Methyl butanoate: methanol, butanoic acid

D. Methyl butanoate: methanoic acid, butanol

4 A solution contains three cations Ba^{2+}, Mg^{2+} and Ag^{+}. The flow chart indicates a plan a student used to confirm the identity of these cations.



Which of the following correctly identifies each ion?

	Ion 1	*Ion 2*	*Ion 3*
A.	Ba^{2+}	Ag^{+}	Mg^{2+}
B.	Mg^{2+}	Ag^{+}	Ba^{2+}
C.	Ag^{+}	Mg^{+}	Ba^{2+}
D.	Ba^{2+}	Mg^{2+}	Ag^{+}

5 Four organic compounds are identified by the numbers I, II, III, IV.

I – CH_3CH_2COOH
II – CH_3CH_2OH
III – $CH_3CH_2CONH_2$
IV – $CH_3CH_2NH_2$

Which alternative identifies the strongest acid and the strongest base in the list?

	Strongest acid	*Strongest base*
A.	I	III
B.	I	IV
C.	II	III
D.	II	IV

6 Chlorine gas (Cl_2) and carbon monoxide gas (CO) are placed into a sealed container and kept at a temperature of 25°C. Phosgene gas ($COCl_2$) is produced as follows:

$$Cl_2(g) + CO(g) \rightleftharpoons COCl_2(g)$$

Which statements about this reaction is correct?

A. All the Cl_2 and CO will be converted into $COCl_2$.

B. At a temperature of 25°C the $COCl_2$ will not form.

C. The forward reaction will continue to occur until the concentration of $COCl_2$ remains constant.

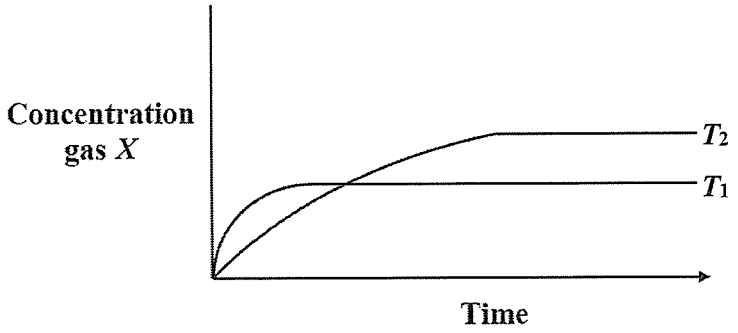
D. When the forward and reverse reactions become equal the concentration of the $COCl_2$ becomes constant.

7 The pK_a of hydrofluoric acid, HF, is 3.17 and the pK_a of methanoic acid, HCOOH, is 3.75.

Which of the following shows the strongest acid of the two and the strongest conjugate base of the two acids?

	Stronger acid	*Stronger conjugate base*
A.	HF	F^-
B.	HF	$HCOO^-$
C.	HCOOH	$HCOO^-$
D.	HCOOH	F^-

8 An equilibrium reaction is carried out at two different temperatures – T_1 and T_2. The concentration of the product gas X is recorded over time.



Based on this graph, which of the following statements is correct?

A. A greater concentration of gas X is constantly produced for temperature T_1.

B. Equilibrium is achieved at the same time for both temperatures.

C. The initial rate of reaction is greater for temperature T_1 than T_2.

D. Temperature T_2 is definitely higher than temperature T_1.

9 Consider the four organic compounds:

2-propanol, 1-butanol, butane, ethene.

Which of the following lists these compounds in order of increasing boiling point?

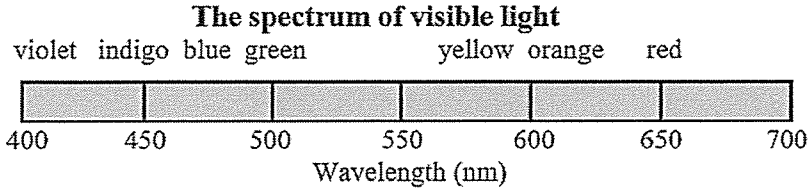
A. Ethene, butane, 2-propanol, 1-butanol

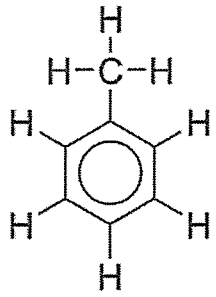
B. Butane, ethene, 2-propanol, 1-butanol

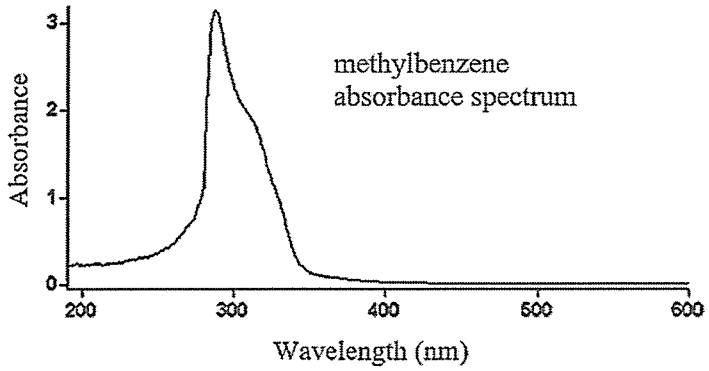
C. Ethene, butane, 1-butanol, 2-propanol

D. Ethene, 2-propanol, butane, 1-butanol

10 The spectrum of visible light, structural formula and UV absorption spectrum of methylbenzene is shown.







Based on the information, which statement about methylbenzene is correct?

A. A solution of methylbenzene would appear colourless.

B. A solution of methylbenzene would appear as an orange-red colour.

C. Methylbenzene only absorbs in the visible part of the electromagnetic spectrum.

D. Methylbenzene does not absorb wavelengths lower than 100 nm.

11 When a potassium chloride solution is added to a silver nitrate solution, a white precipitate may be produced.

Which of the following occurs when the reaction reaches equilibrium?

A. There would be no chloride ions in solution.

B. There would be no silver ions in solution.

C. If more chloride ions were added to the solution, more precipitate would form.

D. If more potassium ions were added to the solution, more precipitate would form.

12 Which of the following ionic compounds is NOT amphiprotic?

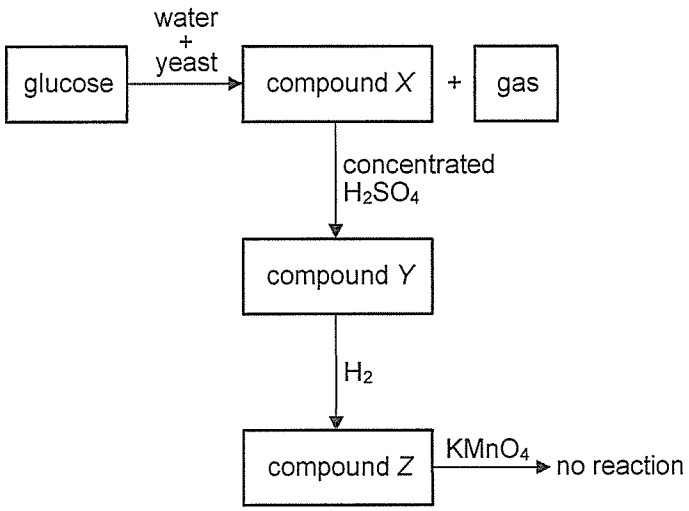
A. Sodium hydrogen carbonate, $NaHCO_3$

B. Potassium hydrogen sulfide, KHS

C. Sodium acetate, $NaCH_3COO$

D. Potassium dihydrogen phosphate, KH_2PO_4

13 The flow diagram represents a series of chemical reactions. Each compound formed was separated and purified before proceeding to the next step.



To which class of organic compounds does compound *Z* belong?

A. Alkane

B. Alkene

C. Tertiary alcohol

D. Alkanoic acid

14 A few drops of nitric acid and a few drops of silver nitrate are added to a small volume of a solution containing a solid, *X*. A yellow precipitate forms.

Which ions are present in solid *X*?

A. Acetate

B. Chloride

C. Bromide

D. Iodide

15 What is the function of the hollow cathode lamp in an atomic absorption spectrometer?

A. Produce a specific wavelength of light that can be absorbed by free atoms in the gaseous state

B. Separate molecules in the tested sample so that free atoms are formed

C. Convert free atoms in the tested sample into gaseous ions

D. Produce a frequency of light that is absorbed by particular bonds of molecules in the sample being tested

16 What is the pH of a solution that has a hydroxide ion concentration of 4.32×10^{-8} L^{-1}?

A. 6.64

B. 7.36

C. 6.02

D. 7.58

17 Which of the following is a planar molecule?

A. CH_3OH

B. CH_3Cl

C. CH_2Cl_2

D. H_2CO

18 The Mond process is used to obtain pure nickel from an impure nickel mixture in a smelter. In one step of the process, nickel carbonyl is decomposed to give pure nickel, according to the following reaction.

$$\underset{\text{nickel tetracarbonyl}}{Ni(CO)_4(g)} \rightleftharpoons Ni(s) + 4CO(g) \qquad \Delta H = +163 \text{ kJ mol}^{-1}$$

Which is most significant in achieving a high yield of nickel in this reaction?

A. Operating the process at a low temperature

B. Using a suitable catalyst

C. Removing impurities from the nickel carbonate gas

D. Adding a metal mesh to the smelter to increase its surface area

19 What is the molar solubility of lead (II) hydroxide at 25°C?

A. 1.13×10^{-5} mol L^{-1}

B. 7.10×10^{-6} mol L^{-1}

C. 2.67×10^{-8} mol L^{-1}

D. 4.77×10^{-16} mol L^{-1}

20 A student mixes 20.0 mL of 5.00 mol L^{-1} sulfuric acid with an equal volume of 5.00 mol L^{-1} potassium hydroxide in a calorimeter. The temperature rose from 22.9°C to 48.1°C.

What is the experimental molar heat of neutralisation for this reaction?

A. –4.21 kJ mol^{-1}

B. –21.1 kJ mol^{-1}

C. –42.1 kJ mol^{-1}

D. –84.2 kJ mol^{-1}

STUDENT NUMBER/NAME: .....

Section II

80 marks
Attempt Questions 21–35
Allow about 2 hours and 25 minutes for this section

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.

Extra writing space is provided at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Question 21 (4 marks)

The phosphate buffer system operates in the internal fluids of all cells. The pH of an equimolar solution of sodium dihydrogen phosphate, NaH_2PO_4, and disodium hydrogen phosphate, Na_2HPO_4, is 6.8.

(a) Write a chemical equation that represents the equilibrium system described. **1**

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(b) Explain how this system operates as a buffer and account for what would happen if a small volume of 0.1 mol L^{-1} carbonic acid, H_2CO_3 was added to the solution. **3**

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Question 22 (3 marks)

Carbon monoxide (CO) is a poisonous and flammable gas that is used in the separation of metals from their oxides. It may be produced in the following manner. **3**

$$CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$$

At 600°C, 1.40 moles of carbon dioxide gas react with 1.0 mole of hydrogen gas in a 2.0 litre reaction vessel. At equilibrium, the vessel was found to contain 0.88 moles of carbon dioxide and 0.48 moles of hydrogen.

Use a correct expression to calculate the equilibrium constant (K_{eq}) for this reaction and what this indicates about the production of carbon monoxide gas at this temperature.

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Question 23 (6 marks)

Sulfuric acid is produced by a series of industrial reactions called the contact process. The four main chemical reactions are outlined below:

1.	Combustion of liquid sulfur	$S(l) + O_2(g) \rightarrow SO_2(g)$
2.	Catalytic oxidation of sulfur dioxide	$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
3.	Absorption of sulfur trioxide to form oleum	$SO_3(g) + H_2SO_4(l) \rightarrow H_2S_2O_7(l)$
4.	Conversion of oleum ($H_2S_2O_7$) to sulfuric acid	$H_2S_2O_7(l) + H_2O(l) \rightarrow 2H_2SO_4(l)$

(a) The location of which raw material needs to be considered when designing a contact process plant? **1**

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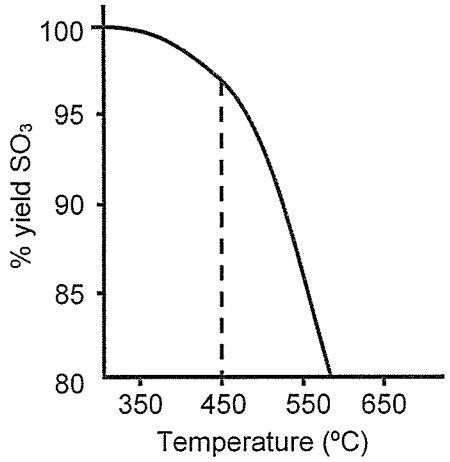
Question 23 continues on the next page

Question 23 (continued)

(b) The enthalpy change for reaction 2 is $\Delta H = -197$ kJ mol^{-1}. A graph of the percentage yield of SO_3 is shown. **3**



Account for TWO changes to the reaction conditions that would increase the rate of formation of sulfur trioxide gas and explain why the industrial production of SO_3 occurs at 450°C and not at a lower or higher temperature.

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(c) Outline ONE safety factor and ONE environmental factor that need to be considered when implementing the contact process. **2**

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End of Question 23

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Question 24 (4 marks)

(a) Draw structural formulas of TWO chain isomers with the molecular formula C_4H_9Br. **1**

(b) Write balanced equations to represent the production of C_4H_9Br from both a saturated and an unsaturated hydrocarbon and an equation showing how C_4H_9Br can be converted to an alcohol. **3**

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Question 25 (7 marks)

The pH of a 0.04 mol L^{-1} solution of an unknown soluble monoprotic acid, H*X*, was measured to be 3.04.

(a) Write a chemical equation that represents the ionisation of H*X* in water and calculate the K_a of the solution. **3**

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(b) Explain why *HX* should be classified as a *weak* acid. **2**

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(c) A student believed that *HX* was acetic acid, CH_3COOH. **2**

Identify the products formed if a sample of acetic acid completely reacted with aluminium carbonate.

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Question 26 (4 marks)

An investigation was carried out to analyse a commercial lawn fertiliser. A sample of 1.00 g of fertiliser containing 24.0% sulfur (S) in the form of sulfate (SO_4^{2-}) was dissolved in water. 100 mL of 0.20 mol L^{-1} barium chloride solution was then added and a precipitate formed.

(a) Calculate the theoretical percentage by mass of sulfate (SO_4^{2-}) in the fertiliser. **3**

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(b) Identify a potential error during this experiment that may have caused a higher percentage mass value to be obtained. **1**

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Question 27 (6 marks)

During this course you investigated the effect of temperature, concentration, volume and/or pressure on a system at equilibrium. **6**

Describe the procedure used for this investigation and account for the expected results. In your response, refer to:

- Equipment and the reagents used
- The balanced equilibrium equation you were investigating
- The safety precautions you used to minimise risk

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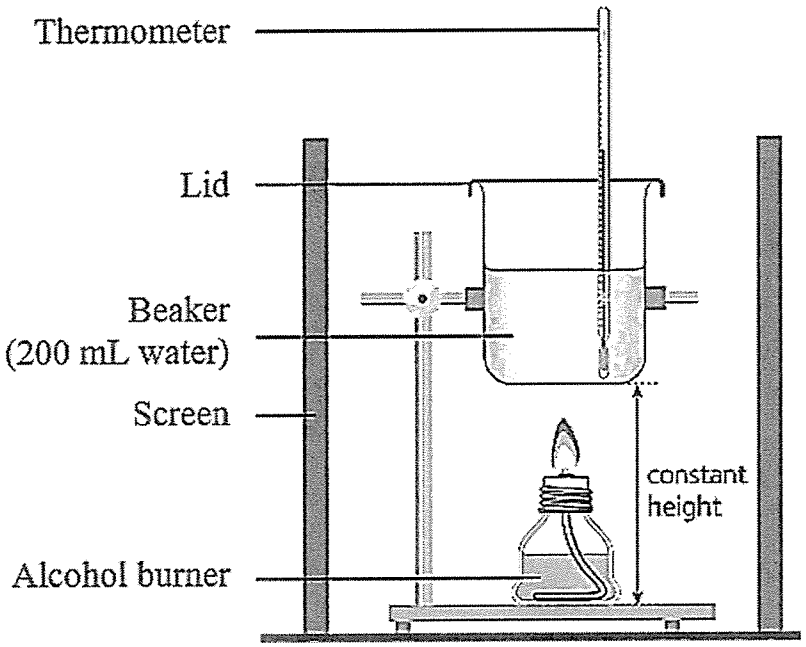
Question 28 (8 marks)

A group of students determined the molar heat of combustion of 1-pentanol ($C_5H_{11}OH$).



The following set of data was collected.

Initial mass of burner (g)	228.50
Final mass of burner (g)	228.32
Volume water in flask (mL)	200
Initial temperature (°C)	22.5
Final temperature (°C)	29.5
Specific heat water (J $g^{-1}°C^{-1}$)	4.18

Question 28 continues on the next page

Question 28 (continued)

(a) Based on the data collected, calculate the molar heat of combustion of 1-pentanol. **3**

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(b) Write a balanced chemical equation for this reaction and account for the calculated value for the heat of combustion of 1-pentanol differing from the recorded value in the S.I. Chemical Data Book. **3**

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Question 28 continues on the next page

Question 28 (continued)

(c) During the experiment a student accidently knocks over the unlit spirit burner spilling pentanol over the bench and floor. **2**

Describe procedures to safely correct this situation.

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End of Question 28

Question 29 (4 marks)

Photosynthesis involves a series of reactions that produce sugars from carbon dioxide and water. The overall reaction at 25°C is shown. Its entropy is $\Delta S° = -0.2120$ kJ mol^{-1} K^{-1}. **4**

$$6CO_2(g) + 6H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6O_2(g) \quad \Delta H° = +2803 \text{ kJ mol}^{-1}$$

Calculate the Gibbs free energy for this reaction and analyse this system in terms of its enthalpy, entropy and reversibility.

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Question 30 (3 marks)

The *white smoke reaction* is a neutralisation reaction between the vapours of concentrated solutions of hydrochloric acid and ammonia. It is given its name due to the production of fine white salt crystals that are momentarily suspended in air when the vapours react, giving the appearance of white smoke. **3**

Justify why this reaction can only be explained by the Brønsted-Lowry definition of acids and bases and not the Arrhenius definition. Include a chemical equation in your answer.

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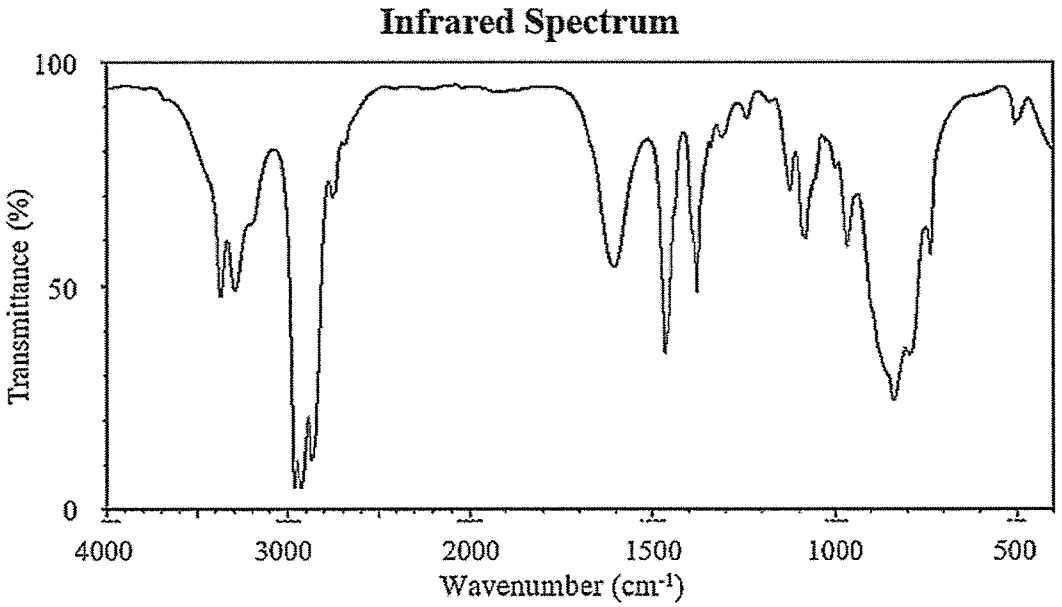
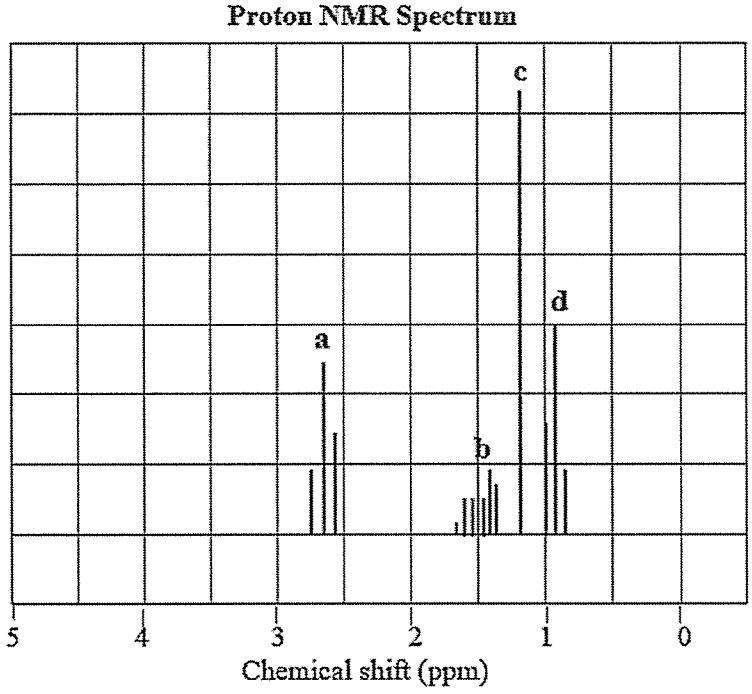
Question 31 (6 marks)

A molecule of an organic compound has three carbon atoms. It does not react with potassium dichromate solution but does react with hydrochloric acid.

The infrared and high-resolution proton NMR spectra of this compound are shown.





Question 31 continues on the next page

Question 31 (continued)

(a) Determine and draw the structural formula of this compound. Use the information Provided, including the four proton NMR signals (a, b, c and d), to explain your reasoning. **5**

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Structural formula:

(b) Write the equation for the reaction of this compound with hydrochloric acid. **1**

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End of Question 31

Question 32 (8 marks)

(a) Compare the structure, properties and uses of TWO named addition polymers. **4**

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Question 32 continues on the next page

Question 32 (continued)

(b) Polylactic acid (PLA), polyhydoxyalkanoate (PHA) and polyethylene terephthalate (PET) are important polymers that are often blended with natural fibres to produce clothing materials. **4**

Explain why all these polymers are called polyesters and account, in terms of bonding, for their strength, durability and resistance to stretching.

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End of Question 32

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Question 33 (4 marks)

1.00 gram of lead (II) nitrate is dissolved in distilled water. The solution is made up to a volume of 100.0 mL. It is then added to 100.0 mL of a 0.001 mol L^{-1} solution of potassium iodide. **4**

Write a net ionic equation for this investigation and predict whether a precipitate would form when the two solutions are mixed. Include all calculations in your answer.

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Question 34 (6 marks)

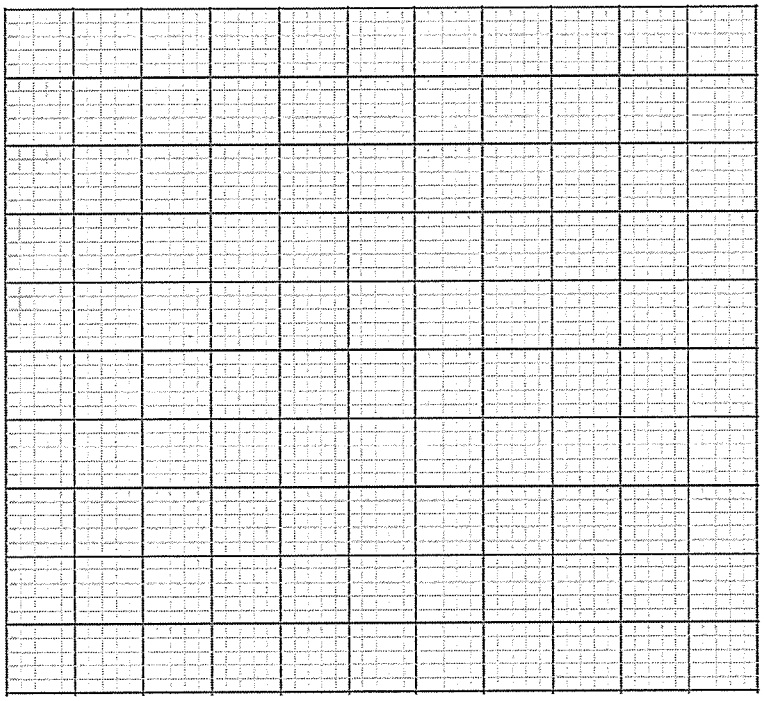
A conductivity titration was performed to determine the concentration of a hydrochloric acid solution. A 25.0 mL sample of the acid was placed into a conductivity cell. 6

A burette was then used to slowly dispense volumes of 0.500 mol L^{-1} sodium hydroxide.

Conductivity readings were taken per 1 mL of sodium hydroxide added. Data was recorded in the following table.

Vol 0.5 mol L^{-1} NaOH (mL)	0	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
Conductivity (S cm^{-1})	3.4	3.1	2.6	2.1	1.8	1.4	1.1	1.6	1.8	2.3	2.7

Graph the data in the table using intersecting lines of best fit and perform relevant calculations to determine the concentration of the hydrochloric acid solution.



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Question 35 (7 marks)

To understand the properties of the various types of organic substances it is useful to analyse particular functional groups in the molecules of compounds. Consider the three common functional groups: 7

- Carbon-carbon double bond
- Hydroxyl group
- Carboxylic acid group

Critically evaluate how qualitative tests are used to obtain information about the presence of these groups in organic compounds and how NMR and infrared spectral analysis are used to obtain information about the structure of compounds that have these groups.

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Section II extra writing space

If you use this space, clearly indicate which question you are answering.

NSW INDEPENDENT TRIAL EXAMS – 2023
CHEMISTRY TRIAL HSC EXAMINATION
MARKING GUIDELINES

Section I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
D	B	C	A	B	D	B	C	A	A	C	C	A	D	A	A	D	C	B	C

Section II

Question 21(a)

Criteria	Mark
• Writes a correct chemical equilibrium equation that includes states	1

Sample answer: $H_2PO_4^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HPO_4^{2-}(aq)$

Question 21(b)

Criteria	Mark
• Gives reasons why this system operates as a buffer • Explains why the addition of carbonic acid will not significantly change the pH of the solution by referring to Le Chatelier's principle	3
• Gives a reason why this system operates as a buffer • Describes how the addition carbonic acid initially increases the concentration H_3O^+ OR causes a shift in the equilibrium position of the system	2
• Provides a relevant piece of information related to buffering	1

Sample answer: In living things, a slight change in pH can greatly affect the chemistry of living cells. The mixture of sodium dihydrogen phosphate and disodium hydrogen phosphate is an example of a buffer system because it regulates blood and cell pH by resisting changes to pH when small amounts of acid or base are added. These changes are based on Le Chatelier's principle that says that if a chemical system at equilibrium is disturbed, the system will adjust itself to minimise the disturbance.

Consequently, the addition of a small volume of 0.1 mol L^{-1} carbonic acid would initially increase the concentration of H_30^+ but will force the equilibrium to shift to favour the reactants to counteract the change, resulting in a reduction in H_30^+ concentration. The pH of the solution will thus be maintained.

Question 22

Criteria	Mark
• Writes the correct equilibrium constant expression • Calculates the correct K_{eq} value • Makes a correct statement relating the K_{eq} value to the production of gas	**3**
• Writes a relevant equilibrium constant expression and calculates its K_{eq} value • Makes a correct statement relating the K_{eq} value to the production of gas	**2**
• Writes a relevant equilibrium constant expression and calculates its K_{eq} value OR • Makes a correct statement relating the K_{eq} value to the production of gas	**1**

Sample answer:

	$[CO_2]$	$[H_2]$	$[CO]$	$[H_2O]$
Initial	0.7	0.5	0	0
Change	0.7 – 0.44	0.5 – 0.24	0.26	0.26
Equilibrium	0.44	0.24	0.26	0.26

$$K_{eq} = \frac{[CO][H_2O]}{[CO_2][H_2]} = (0.26) \times (0.26)/[0.44] \times [0.24] = 0.64$$

As $K_{eq} < 1$, the equilibrium lies towards the reactants side. Carbon monoxide gas production is not favoured.

Question 23(a)

Criteria	Mark
• Identifies the raw material to be considered in the contact process	1

Sample answer: Sulfur

Question 23(b)

Criteria	Mark
• Accounts for TWO changes to the reaction conditions that would increase the rate of formation of sulfur trioxide • Explains why the industrial production of SO_3 occurs at 450°C by referring to Le Chatelier's principle	3
• Accounts for ONE change to the reaction conditions that would increase the rate of formation of sulfur trioxide • Explains why the industrial production of SO_3 occurs at 450°C by referring to Le Chatelier's principle OR • Accounts for TWO changes to the reaction conditions that would increase the rate of formation of sulfur trioxide	2
• Accounts for ONE change to the reaction conditions that would increase the rate of formation of sulfur trioxide gas OR • Explains why the industrial production of SO_3 occurs at 450°C by referring to Le Chatelier's principle	1

Sample answer: *(Two only required)* Raising the temperature would increase the 'rate' of the reaction (not the yield) because reactant particles gain kinetic energy and therefore have a greater chance of successful collisions. Increasing the pressure on this system would increase the concentration of all gases, increase the chances of successful collisions and by Le Chatelier's principle, drive the equilibrium reaction to the right. *Other answers could include increasing the concentration of reactants or using a catalyst (in this case vanadium oxide).* This reaction is exothermic so, by Le Chatelier's principle, a higher temperature would decrease the yield even though it would increase the rate of the reaction. At 450°C the reaction produces a sufficiently high yield of approximately 98%. A lower temperature would improve on this yield, but it would take an unacceptably long time to obtain the product.

Question 23(c)

Criteria	Mark
• Outlines ONE safety factor AND ONE environmental factor that need to be considered when implementing the contact process	2
• Outlines ONE safety factor OR ONE environmental factor that need to be considered when implementing the contact process	1

Sample answer: Sulphur can react to form toxic gases such as sulfur dioxide and hydrogen sulphide. Sulphur dioxide inflames the lungs, may cause respiratory illness and irritate any existing heart disease.

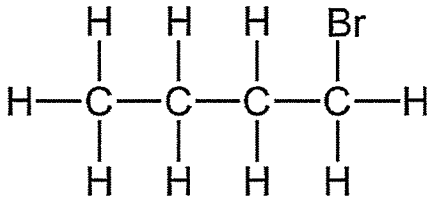
Concentrated sulfuric acid is very dangerous and can cause burns to skin and eyes and corrode paper, metals and other materials. If it is ingested, this chemical may cause organ damage and possibly death. PPE (personal protective equipment) must be worn when handling sulfuric acid, as even in aerosol form, the acid can cause significant harm. *(One only required.)*

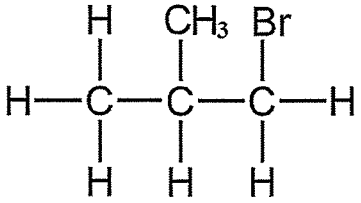
Sulphur dioxide is a chief air pollutant as the gas reacts with water and atmospheric oxygen to form acid rain. Acid rain acidifies soils, lakes and streams, accelerates corrosion of buildings and reduces visibility. The formation of liquid oleum (reaction 3) avoids a very exothermic reaction between SO_3 and water and makes transport of this liquid safer.

Question 24(a)

Criteria	Marks
• Draws TWO chain isomers with the molecular formula C_4H_9Br	1

Sample answer:





Question 24(b)

Criteria	Marks
• Writes THREE correct and appropriate equations	3
• Writes TWO correct and appropriate equations	2
• Writes ONE correct and appropriate equation	1

Sample answer:

$C_4H_{10} + Br_2 \rightarrow C_4H_9Br + HBr$

$C_4H_8 + HBr \rightarrow C_4H_9Br$

$C_4H_9Br + NaOH \rightarrow C_4H_9OH + NaBr$

Question 25(a)

Criteria	Mark
• Writes a correct chemical equation that includes states • Correctly calculates the K_a of the HX solution	3
• Writes a correct chemical equation that includes states • Provides a correct process to calculate a K_a of the HX solution OR • Correctly calculates the K_a of the HX solution	2
• Provides a correct process to calculate a K_a of the HX solution	1

Sample answer:

$HX(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + X^-(aq)$

$pH = 3.04$

$\therefore [H^+] = 10^{-3.04} = 9.12 \times 10^{-4}$

$$K_a = \frac{[H^+][X^-]}{[HX]} = \frac{X^2}{0.04 - X} = \frac{(9.12 \times 10^{-4})^2}{0.04 - 9.12 \times 10^{-4}}$$

$= 2.13 \times 10^{-5}$ ($K_a = 2.08 \times 10^{-5}$ if X is assumed very small and removed from the denominator)

Question 25(b)

Criteria	Mark
• Correctly explains why HX is a weak acid by considering the calculated K_a, position of equilibrium and/or degree of ionisation or correct equation	2
• Describes the equilibrium position of the ionisation of HX with respect to the K_a calculated or correct equation	1

Sample answer: A strong acid fully ionises and has a very large K_a. The K_a for the ionisation of HX is 2.08×10^{-5}, which means the equilibrium position favours the reactants. Therefore, HX only partly ionises to form an equilibrium. This means that HX is a weak acid.

Question 25(c)

Criteria	Mark
• Correctly identifies the products formed from the reaction of acetic acid with aluminium carbonate	2
• Correctly identifies some of the products formed from the reaction of acetic acid with aluminium carbonate	1

Sample answer: Aluminium acetate, water and carbon dioxide

Question 26(a)

Criteria	Marks
• Calculates the correct percentage by mass of sulfate	3
• Uses a correct process to calculate a percentage by mass of sulfate	2
• Provides a correct calculation or process to calculate a percentage by mass of sulfate	1

Sample answer:

$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$

mass S = 0.24 g

$\therefore$ n S = m/M = 0.24/32.07 = 7.48×10^{-3}

$\therefore$ n $SO_4^{2-} = 7.48 \times 10^{-3}$

$\therefore$ mass $SO_4^{2-} = n \times M = 7.48 \times 10^{-3} \times (32.07 + 64) = 0.7186036$

$\therefore$ % mass $SO_4^{2-} = (0.7186036/1.00) \times 100 = 71.9\%$

Question 26(b)

Criteria	Marks
• Identifies a relevant error that may have caused a higher percentage mass value	1

Sample answer: Incomplete washing of precipitate to remove excess $BaCl_2$, hence making the precipitate heavier OR incomplete drying of precipitate so the precipitate is still moist and hence heavier. (*One only required.*)

Question 27

Criteria	Mark
• Provides thorough details of a suitable procedure • Identifies appropriate equipment used • Identifies appropriate reagents used • Writes a balanced chemical equation • Discusses suitable safety precautions	6
• Provides details of a suitable procedure • Identifies appropriate equipment used • Identifies appropriate reagents used • Writes a balanced chemical equation • Discusses some suitable safety precautions	4–5
• Outlines a suitable procedure • Identifies some appropriate equipment OR reagents used AND • Writes a chemical equation OR • Discusses a safety precaution	2–3
• Identifies a suitable investigation and provides some additional and relevant details	1

Sample answer:

Investigation: The effect of a temperature change on cobalt (II) chloride hydrate – $CoCl_2.6H_2O$

Procedure:

- Add 1.0 gram of cobalt chloride to a small test tube and add 5.0 mL of distilled water. Repeat this for two other test tubes.
- Observe and record the colour of test tube one and use it as a reference.
- To test tube two, add 5 drops of 1.0 mol L^{-1} HCl. Observe and record its colour.
- To test tube three, gently heat to boiling by passing through a Bunsen burner flame. Observe and record the colour change as the solution returns to room temperature.

Equation: $[Co(H_2O)_6]^{2+}(aq) + 4Cl^-(aq) + \text{heat} \rightleftharpoons [CoCl_4]^{2-} + 6H_2O(l)$

Pink Blue

Safety procedures:

- Cobalt chloride may irritate the skin and eyes. Use protective gloves, eyewear, and an apron.
- Hydrochloric acid is corrosive. Wash down any spillages on your skin or your working area.

Question 28(a)

Criteria	Mark
• Correctly calculates the molar heat of combustion of 1-pentanol using correct units	3
• Uses TWO correct processes to calculate a molar heat of combustion	2
• Uses ONE correct process to calculate a molar heat of combustion	1

Sample answer:

$\Delta H = mC\Delta T = 200 \times 4.18 \times (29.5 - 22.5) = -5852 \text{ J} = 5.852 \text{ kJ}$

Mass pentanol burnt = 228.50 – 228.32 = 0.18 g

Moles pentanol = m/M = 0.18/[(12.01 × 5) + (1.008 × 12) + 16]

= 0.0020421

$\therefore \Delta H_C = 5.852/0.0020421 = 2865.7 \text{ kJ mol}^{-1}$

Question 28(b)

Criteria	Mark
• Writes a correct and balanced chemical equation for the reaction • States a minimum of TWO relevant reasons that account for the calculated value for the enthalpy change differing from the actual value	3
• Writes a correct and balanced chemical equation for the reaction • States a relevant reason that accounts for the calculated value for the enthalpy change differing from the actual value OR • States a minimum of TWO relevant reasons that account for the calculated value for the enthalpy change differing from the actual value	2
• Writes a correct and balanced chemical equation for the reaction OR • States a relevant reason that accounts for the calculated value for the enthalpy change differing from the actual value	1

Sample answer: $C_5H_{11}OH(l) + 7½O_2(g) \rightarrow 5CO_2(g) + 6H_2O(l)$

The combustion reaction is incomplete. Some carbon monoxide and soot would be produced, which means that less than the maximum energy is released per mole. In addition, some heat is lost to the surrounding air despite the presence of an insulating screen.

Question 28(c)

Criteria	Marks
• Describes a minimum of TWO appropriate procedures to safely correct the situation	2
• Describes an appropriate procedure to safely correct the situation	1

Sample answer: (Two only required.)

Pentanol is a volatile and flammable liquid hydrocarbon. It can be absorbed through the skin. Consequently, it is important that the spill be dealt with quickly and efficiently by students wearing personal protective equipment (gloves, lab coat and safety glasses) and that the laboratory be well ventilated.

Any source of ignition (e.g., Bunsen burner) should be immediately turned off and removed. The spill should be isolated and/or absorbed using any safe absorbent material such as towels, sawdust or inert powder. This material should then be placed in a spill bag for disposal as hazardous waste. Any remaining residue can be mopped up with soap and water.

Question 29

Criteria	Mark
• Correctly calculates the Gibbs free energy for the reaction • Identifies in some detail the relationship between the Gibbs free energy and its components – enthalpy change and entropy change • Explains why the reaction is not reversible	**4**
• Correctly calculates the Gibbs free energy for the reaction AND • Identifies a correct relationship between the Gibbs free energy and its enthalpy change and entropy change • Explains why the reaction is not reversible	**3**
• Calculates a Gibbs free energy for the reaction AND • Identifies a correct relationship between the Gibbs free energy and its enthalpy change and entropy change OR • Explains why the reaction is not reversible	**2**
• Provides a correct calculation process OR some correct analysis of the components of this reaction	**1**

Sample answer:

$$\begin{aligned}\Delta G^\circ &= \Delta H^\circ - T\Delta S^\circ \\ &= +2803 - (298 \times -0.212) \\ &= +2866 \text{ kJ mol}^{-1}\end{aligned}$$

The photosynthesis reaction requires energy (from the sun) for it to proceed. It is endothermic and has a relatively high positive change in enthalpy. The reaction also has a high negative entropy as more order is created when 12 particles become 7 particles and glucose is a more structured compound.

A high positive enthalpy change and a high negative entropy change confirms the high positive change in Gibbs free energy that was calculated. To reach an equilibrium ΔG must equal zero. Consequently, this reaction does not easily form an equilibrium. In addition, it does not form an equilibrium as photosynthesis is normally carried out in an open system. Products of numerous individual steps are not retained within the system.

Question 30

Criteria	Mark
• Correctly justifies why the white smoke reaction is explained using the Brønsted-Lowry definition of acids and bases, while the Arrhenius definition cannot be used • Includes a correct chemical equation that describes the white smoke reaction	3
• Outlines a correct reason why the white smoke reaction is explained using the Brønsted-Lowry definition of acids and bases • Include a correct chemical equation that describes the white smoke reaction	2
• Provides a correct reason why the white smoke reaction occurs based on Brønsted-Lowry theory	1

Sample answer:

$$HCl(aq) + NH_3(aq) \rightarrow NH_4Cl(s)$$

The white smoke reaction involves a transfer of protons from the hydrochloric acid to the ammonia molecule resulting in the formation of the ammonium chloride salt. This process is explained by the Brønsted-Lowry definitions of acids and bases, which defines acids as proton donors, and bases as proton acceptors. The Arrhenius definition of acids and bases requires a solvent to create a solution in which acids can donate hydrogen ions, and bases hydroxide ions. The white smoke reaction does not involve an ionising solvent, so cannot be explained by the Arrhenius definition of acids and bases.

Question 31(a)

Criteria	Mark
• Draws the structural formula of the compound • Gives detailed reasons for the choice based on the IR spectrum • Gives detailed reasons for the choice based on the H1 NMR spectrum	5
• Draws the structural formula of the compound • Gives reasons for the choice based on the IR spectrum • Gives reasons for the choice based on the H1 NMR spectrum	3–4
• Provides some correct and relevant information about the compound related to ONE or BOTH spectra	1–2

Sample answer:

Infrared spectrum

The most prominent infrared absorption lines occur between wavenumbers 3200 to 3500 cm^{-1} which is typical of the 'twin peaks' of the functional group in primary amines. Another strong signal occurs between wave numbers 2800 to 3100 cm^{-1}. This is due to absorptions caused by C–H bonds. This information and the absence of another specific functional group indicates that the compound is most probably a primary amine.

Proton NMR spectrum

There are four separate hydrogen environments. In the spectrum, signal 'd' has the smallest chemical shift of approximately 0.92 ppm and suggests that these hydrogens are the most shielded, and therefore, furthest away from the deshielding effects of an electronegative atom (such as N). Its triplet split indicates the presence of an adjacent CH_2 group.

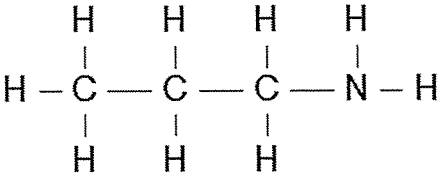
Signal 'b' at around 1.45 ppm is a sextet split and suggests that it may be bonded between a CH_2 and a CH_3 group (where n = 5 + 1).

Signal 'a' is a triplet and suggests the most deshielded group – a CH_2 group attached to a CH_2 group on one side and attached to the nitrogen atom of the amine group on the other side. Signal 'c' is a singlet because the amine group proton resonance is not split by the adjacent CH_2 protons. This information is summarised below.

Signal letter	d	b	a	c
Group	CH_3 –	CH_2 –	CH_2 –	NH_2
Chemical shift	0.92	1.45	2.65	1.24
Splits	3	6	3	1

Together, the signals in both spectra indicate that the compound is propanamine.

Structural formula:



Question 31(b)

Criteria	Mark
• Writes the correct equation for the reaction with hydrochloric acid	1

Sample answer: $CH_3CH_2CH_2NH_2 + HCl \rightarrow CH_3CH_2CH_2NH_3^+ + Cl^-$

Question 32(a)

Criteria	Marks
• Identifies TWO addition polymers • Compares in some detail the structure, properties and uses of the addition polymers	4
• Identifies TWO addition polymers • Compares the structure, properties and uses of the addition polymers	3
• Identifies at least ONE addition polymer • Compares any TWO of the structure, properties and uses of the addition polymers	2
• Provides some relevant information that compares two addition polymers	1

Sample answer:

Polyethylene (PE) is an addition polymer produced when many ethylene monomer units (CH_2=CH_2) join to form a long carbon chain. Polyvinyl chloride (PVC) is an addition polymer produced when many chloroethene monomer units (CH_2=CHCl) join to also form a long carbon chain.

The monomers used to produce these two polymers both contain a double bond which "opens up" to allow the monomer units to join to form long carbon chains. The difference is that, for PVC, the monomer has a chlorine atom replacing one of the hydrogen atoms in ethylene. This means that every second carbon atom in the PVC chain has a chlorine atom attached. In the PE chain only hydrogen atoms are attached.

As both polymers contain long chains of carbon atoms, they have many properties in common. Both polymers are non-conductors of electricity (hence their use for electrical insulation) and both produce water resistant materials (hence their use in producing water-tight containers). The presence of the larger chlorine atoms along the PVC polymer chain increases bonding strength.

This results in the PVC polymer being more rigid and less flexible than the PE polymer. Polyethylene is therefore used to produce more flexible items such as plastic bags, clingwrap, water bottles and non-conductive coatings on flexible electrical wires. PVC is used in the production of more rigid products such as stormwater pipes, buckets, bins, and protective electrical conduit.

Question 32(b)

Criteria	Marks
• Provides information on why the polymers are called polyesters • Thoroughly relates the properties of strength, durability and stretching resistance to bonding with an emphasis on the role of the ester group	4
• Provides information on why the polymers are called polyesters • Relates the properties of strength, durability and stretching resistance to bonding with an emphasis on the role of the ester group	3
• Provides some information on why the polymers are called polyesters • Provides some relevant information on how the properties of polyesters are related to bonding	2
• Indicates why the polymers are called polyesters OR • Provides some relevant information relating properties of polyesters to bonding	1

Sample answer: These compounds are called polyesters because they are produced from monomers that bond by forming ester linkages usually, as in PET, through the reaction between the hydroxyl group of an acid and an alcohol group of another monomer.

Polyesters are relatively strong plastics because their molecules contain ester groups which are polar.

So, apart from dispersion forces, there are stronger dipole-dipole attractions between polymer chains. These extra forces not only increase strength but, especially in the case of fibres in clothing and carpet etc., make them more resistant to wear. Having stronger bonds between polymers chains decreases stretchability so that materials do not easily deform.

Question 33

Criteria	Mark
• Provides a correctly balanced net ionic equation • Uses appropriate processes to calculate the ionic product (Q_{sp}) for the reaction • Correctly predicts that no precipitate will form by comparing Q_{sp} to the reaction's K_{sp}	4
• Provides a correctly balanced net ionic equation • Uses appropriate processes to calculate the ionic product (Q_{sp}) for the reaction	3
• Provides a correctly balanced ionic equation • Uses SOME appropriate processes to calculate an ionic product (Q_{sp}) for the reaction	2
• Provides a correctly balanced ionic equation • Uses an appropriate process to calculate an ionic product (Q_{sp})	1

Sample answer:

$Pb^{2+}(aq) + 2I^-(aq) \rightleftharpoons PbI_2(s)$

n $Pb(NO_3)_2$ = m/M = 1/(207.2 + 28.02 + 96) = 3.02×10^{-3}

$\therefore [Pb^{2+}]$ in total solution = n/V = $3.02 \times 10^{-3}/0.2 = 0.0151$

n KI = c × V = 0.001 × 0.1 = 0.0001

$\therefore [I^-] = 0.0001/0.2 = 0.0005$

Q_{sp} $PbI_2 = [Pb^{2+}][I^-]^2 = 0.0151 \times 0.0005^2 = 3.8 \times 10^{-9}$

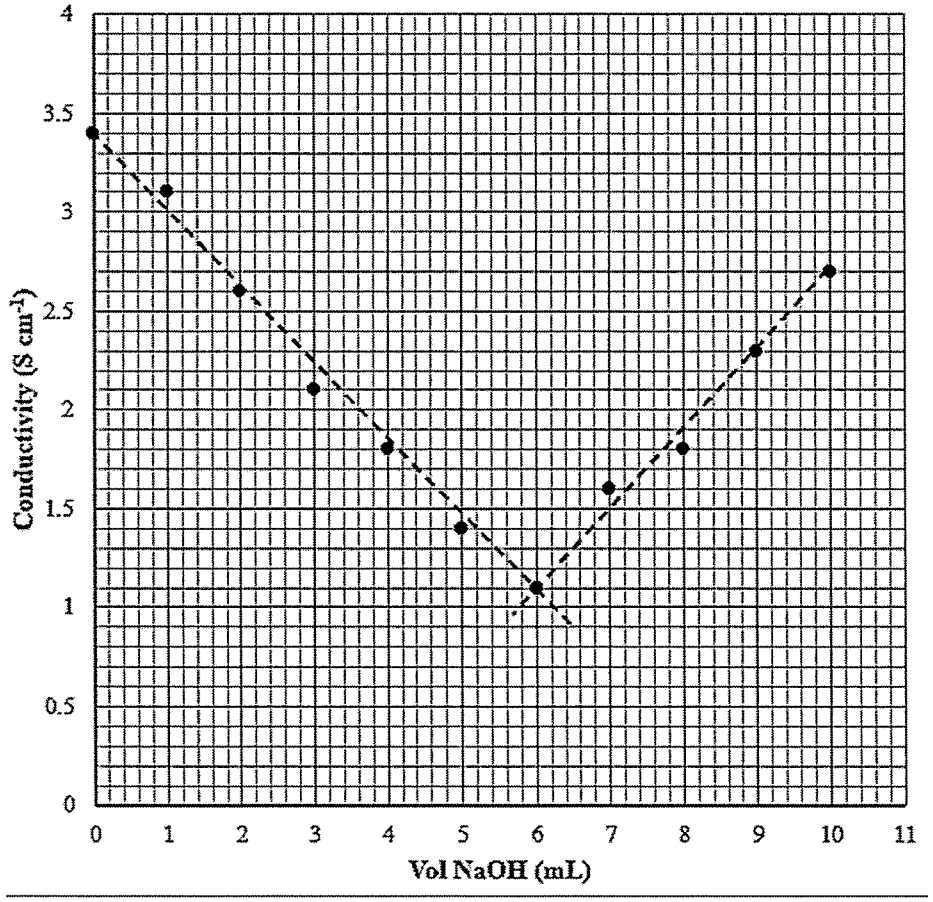
K_{sp} $PbI_2 = [Pb^{2+}][I^-]^2 = 9.8 \times 10^{-9}$

$Q_{sp} < K_{sp}$ No precipitate will form.

Question 34

Criteria	Mark
• Provides TWO intersecting lines of best fit • Points are accurately plotted • Scales are appropriate • Scales are correctly labelled with names and units • Correctly calculates the concentration of hydrochloric acid with units	6
• Provides a substantially correct graph • Correctly calculates a concentration of hydrochloric acid using appropriate steps	4–5
• Provides a mostly correct graph • Calculates a concentration of hydrochloric acid using an appropriate step	3
• Provides a mostly correct graph OR • Correctly calculates a concentration of hydrochloric acid using appropriate steps	2
• Provides some relevant information	1

Sample answer:



$HCl + NaOH \rightarrow NaCl + H_2O$

Equivalence point – 6.00 mL of 0.500 mol L^{-1} sodium hydroxide is added

n NaOH = c × V = 0.5 × 0.006 = 3.0×10^{-3}

∴ n HCl = 3.0×10^{-3}

∴ [HCl] = n/V = $3.0 \times 10^{-3}/0.025 = 0.120$ mol L^{-1}

Question 35

Criteria	Mark
• Extensively describes how information about the presence of the three groups is obtained by referring to THREE qualitative tests • Extensively describes how information about the structure of molecules containing these groups is obtained by referring to NMR and IR spectral analysis • Makes a judgment(s) about the information obtained	7
• Thoroughly describes how information about the presence of the three groups is obtained by referring to THREE qualitative tests • Thoroughly describes how information about the structure of molecules containing these groups is obtained by referring to NMR and IR spectral analysis • Makes a judgment(s) about the information obtained	5–6
• Soundly describes how information about the presence of the three groups is obtained by referring to TWO qualitative tests • Soundly describes how information about the structure of molecules containing these groups is obtained by referring to NMR OR IR spectral analysis OR • Soundly describes how information about the presence of the three groups is obtained by referring to TWO qualitative tests • Makes a judgment about the information obtained OR • Soundly describes how information about the structure of molecules containing these groups is obtained by referring to NMR OR IR spectral analysis • Makes a judgment about the information obtained	3–4
• Provides some relevant information about how the presence OR structure of organic molecules containing any of the three groups is obtained	1–2

Sample answer:

Alkenes (e.g., ethylene) are 'unsaturated' compounds and unlike alkanes, contain highly reactive carbon-carbon double bonds. These C=C bonds undergo addition reactions. In this process the double bond is 'opened up' and a new chemical group can be added to each C atom without breaking the carbon chain. Consequently, when a halogen such as chlorine or bromine reacts with an alkene, an addition reaction takes place. Normally, bromine water is used to test for the presence of alkenes as it decolourises when added to alkenes under dark or light conditions.

Alcohols contain the hydroxyl group and the presence of these compounds is normally determined by oxidation. Primary alcohols react with oxidising agents such as acidified potassium permanganate ($KMnO_4$) or potassium dichromate ($K_2Cr_2O_7$) to form aldehydes and then further oxidise to alkanoic acids. Secondary alcohols oxidise to ketones only and tertiary alcohols do not oxidise. These oxidising agents are used because during oxidation a colour change can be easily observed.

Question 35 continues on the next page

Carboxylic acids change the colour of many indicators and react with active metals to produce hydrogen gas (confirmed by the 'pop test'). These acids also react with alcohols to produce strong smelling esters.

A simple common test for these weak acids is to react them with carbonates or hydrogen carbonates.

The production of CO_2 is confirmed by effervescence or when the bubbled gas turns limewater cloudy.

The nuclei of atoms containing odd numbers of nuclear particles spin. Spinning nuclei develop magnetic fields which causes them to behave like tiny bar magnets. In the presence of an external magnetic field, nuclei with spin can line up either in the same direction as the field (lower energy) or in the opposite direction (higher energy). When nuclei are inside an NMR spectrometer, radio waves are applied to provide the energy to 'flip' the nuclei into a higher-energy state. Over time, the nuclei tend to flip back into a lower energy spin and thus release a pulse of energy. This pulse is measured and displayed in graphical form as an NMR spectrum. For example, the hydroxyl group has a chemical shift of 50 – 90 ppm and the acid group has a chemical shift of 160 – 185 ppm. The difference in energy between the higher and lower energy spin states depends on the type of nucleus and the chemical environment surrounding the nucleus.

Two common types of NMR spectroscopy used are carbon-13 NMR spectroscopy, which is useful in investigating the carbon atoms inside organic molecules, and hydogen-1 NMR spectroscopy, which can give information about the structure of any molecule containing hydrogen atoms. With information based on the environments of these atoms and shielding, an NMR spectrum is produced that provides information about the number, position and type of hydrogen and carbon nuclei in an organic compound.

In infrared spectroscopy an IR lamp passes infrared waves through a sample of a compound. Some frequencies make some of the bonds in the compound's molecules vibrate. When these bonds vibrate, they absorb energy from the IR light source. A detector recreates these as a spectrum with each absorbance peak representing a particular bond vibrating. In this way, IR spectroscopy provides information about the functional groups and type of bonds between atoms. For example, the C=C group generally occurs between 1620 and 1680 cm^{-1}; the O–H group (in alcohols) occurs between 3230 and 3550 cm^{-1} and the O–H group (in carboxylic acids) occurs between 2500 and 3000 cm^{-1}.

Atoms and molecules are small, but chemists have successfully used chemical tests and technologies such as NMR and infrared analysis to prove the presence of certain chemical groups and determine their structure.

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MAPPING GRID

Question	Marks	Content	Syllabus Outcomes	Target performance bands
Section I				
1	1	Mod 6 Quantitative Analysis	12-5, 12-13	2-3
2	1	Mod 5 Static and Dynamic Equilibrium Mod 5 Factors that affect Equilibria	12-12	2-3
3	1	Mod 7 Nomenclature Mod 7 Reactions of Organic Acids and Bases	12-7, 12-14	3-4
4	1	Mod 8 Analysis of Inorganic Substances	12-5, 12-15	3-4
5	1	Mod 7 Reactions of Organic Acids and Bases	12-14	3-4
6	1	Mod 5 Factors that affect Equilibria	12-4, 12-12	3-4
7	1	Mod 6 Quantitative Analysis	12-4, 12-13	4-5
8	1	Mod 5 Factors that affect Equilibria	12-5, 12-12	3-4
9	1	Mod 7 Hydrocarbons	12-6, 12-14	4
10	1	Mod 8 Analysis of Inorganic Substances	12-4, 12-15	4-5
11	1	Mod 5 Solution Equilibria	12-12	4-5
12	1	Mod 6 Using Brønsted-Lowry Theory	12-13	4-5
13	1	Mod 7 Hydrocarbons Mod 7 Alcohols Mod 7 Reactions of Organic Acids and Bases	12-5, 12-6, 12-14	4-5
14	1	Mod 8 Analysis of Inorganic Substances	12-15	4
15	1	Mod 8 Analysis of Inorganic Substances	12-15	5-6
16	1	Mod 6 Using Brønsted-Lowry Theory	12-5, 12-16, 12-13	5
17	1	Mod 7 Hydrocarbons Mod 7 Reactions of Organic Acids and Bases	12-7, 12-14	5
18	1	Mod 5 Factors that affect Equilibrium Mod 8 Chemical Synthesis and Design	12-5, 12-6, 12-12, 12-15	4-6
19	1	Mod 5 Solution Equilibria	12-4, 12-5, 12-12	5-6
20	1	Mod 6 Properties of Acids and Bases	12-4, 12-13	5-6

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MAPPING GRID

Question	Marks	Content	Syllabus Outcomes	Target performance bands
Section II				
21(a)	1	Mod 6 Using Brønsted-Lowry Theory	12-13	2-3
21(b)	3	Mod 6 Quantitative Analysis	12-13	3-4
22	3	Mod 5 Calculating the Equilibrium Constant	12-4, 12-5, 12-12	3-5
23(a)	1	Mod 8 Chemical Synthesis and Design	12-15	3-4
23(b)	3	Mod 5 Factors that affect Equilibrium Mod 8 Chemical Synthesis and Design	12-5, 12-12, 12-15	3-5
23(c)	2	Mod 8 Chemical Synthesis and Design	12-15	3-5
24(a)	1	Mod 7 Nomenclature	12-7, 12-14	2-4
24(b)	3	Mod 7 Products of Reactions involving Hydrocarbons Mod 7 Alcohols	12-7, 12-14	3-5
25(a)	3	Mod 6 Using Brønsted-Lowry Theory Mod 6 Quantitative Analysis	12-4, 12-6, 12-13	3-5
25(b)	2	Mod 6 Using Brønsted-Lowry Theory	12-7, 12-13	3-4
25(c)	2	Mod 6 Properties of Acids and Bases	12-13	4
26(a)	3	Mod 8 Analysis of Inorganic Substances	12-4, 12-15	4-6
26(b)	1	Mod 8 Analysis of Inorganic Substances	12-5, 12-15	4
27	6	Mod 5 Factors that affect Equilibria	12-3, 12-12	3-6
28(a)	3	Mod 7 Alcohols	12-4, 12-14	4-6
28(b)	3	Mod 7 Alcohols	12-5, 12-7, 12-14	4-6
28(c)	2	Mod 7 Hydrocarbons	12-2, 12-3, 12-7, 12-14	2-4
29	4	Mod 5 Static and Dynamic Equilibrium	12-4, 12-5, 12-7, 12-12	4-6
30	3	Mod 6 Properties of Acids and Bases	12-7, 12-13	3-5
31(a)	5	Mod 8 Analysis of Organic Substances	12-5, 12-6, 12-15	4-6
31(b)	1	Mod 7 Reactions of Organic Acids and Bases Mod 8 Analysis of Organic Substances	12-4, 12-15	5-6
32(a)	4	Mod 7 Polymers	12-7, 12-14	3-5
32(b)	4	Mod 7 Polymers	12-7, 12-14	4-6
33	4	Mod 5 Solution Equilibria	12-4, 12-5, 12-12	5-6
34	6	Mod 6 Quantitative Analysis	12-4, 12-6, 12-7, 12-13	3-6
35	7	Mod 8 Analysis of Organic Substances	12-5, 12-7, 12-15	4-6

INDEPENDENT TRIAL EXAMS

ABN 95 111 569 629 info@ite.nsw.edu.au PO BOX 188 Kurmond NSW 2757

Attention Curriculum Coordinator / Deputy Principal

RE: 2023 TIMEFRAMES AND ORDER FORMS

In 2023, our 32nd year of operation, our specialist teams will develop 150 Black Line Master exams composed of 61 Trial HSC, 57 Preliminary HSC and 32 Years 7 to 10 Final Exams. In the order of 40,000 Black line Masters are distributed annually to ALL NSW High Schools. All Exams are prepared by recognised course experts and are released with questions, answers, marking guides and mapping grids.

To ensure security for all schools, our 2023 exams, including Years 7-10, will be express post delivered as printed hard copies. Year 7-10 exams will also be provided electronically, predominantly as Word files – instructions for obtaining soft copies will be included with the express post delivery.

Printed past paper workbooks and emailed past papers from 2000 to 2022 are available in all courses. Full details on our website www.ite.nsw.edu.au.

For over 20 years, we have been supporters of the Children's Cancer Institute for scientific research into the early detection of relapse in children with leukaemia. In total over $650,000 donated from 2000 to 2022. We encourage schools to support the Children's Cancer Institute - *www.ccia.org.au*.

We have expanded our support programs to the conservation of threatened species.

Specifically, the repopulation of extinct in the wild Spix's macaw into secured habitat in Brazil. *www.spixs-macaw.org*

Trial HSC examinations

Delivery date: Tuesday July 18, 2023 (week 1, term 3).

- All Trial HSC exams will be sent Express Post, addressed to the Deputy Principal.
- To ensure security, we do not distribute electronic copies of current year Trial HSC examinations.
- Security Period ends Friday 2pm August 25, 2023 (end of week 6, term 3).
- CSSA Trial Exam Period is July 31 – August 14, 2023.

Year 11 Preliminary examinations

Delivery Date: Tuesday August 22, 2023 (week 6, term 3).

- All Year 11 Preliminary exams will be sent Express Post, addressed to the Deputy Principal.
- To ensure security, we do not distribute electronic copies of current Year 11 Preliminary examinations.
- Security Period ends Wednesday 2pm September 20, 2023 (week 10, term 3).

Years 7 to 10 Final Exams

Delivery Date: October 9-13, 2023 (week 1, term 4).

- Printed copies of all Year 7 to 10 exams will be sent Express Post, addressed to the Deputy Principal, including instructions for downloading soft copies.
- Security Period ends Friday 2pm November 10, 2023 (end week 5, term 4).

All NSW high schools will be invoiced (+10% GST and postage) by November, for all 2023 exams.

Please distribute this note together with order forms to faculties, subject coordinators and/or head teachers. Email completed order forms to orders@ite.nsw.edu.au

Your school's continued support is appreciated.

Kind regards,

The Management, Coordinators, and numerous examination contributors of
NSW Independent Trials Pty. Ltd.

INDEPENDENT TRIAL EXAMS

ABN 95 111 569 629 info@ite.nsw.edu.au PO BOX 188 Kurmond NSW 2757

2023 ORDER FORM

DELIVERY DATES	
	Trial HSC – Tuesday 18 July 2023
	Year 11 Prelim – Tuesday 22 August 2023

School:

Order Number or Contact Name:

Deputy Principal/Curriculum Coordinator Email Address:

SCIENCE

INDIVIDUAL BLACKLINE MASTERS	HSC TRIAL @ $69	Y11 PRELIM @ $67
Physics		
Chemistry		
Biology		
Earth and Enviro. Science		
Investigating Science		
Science Extension		

OR

DISCOUNTED BULK BLACKLINE MASTERS	COST	MARK CHOICES
All 11 Science Exams (HSC and Prelim)	$340	

MATHS

INDIVIDUAL BLACKLINE MASTERS	HSC TRIAL @ $69	Y11 PRELIM @ $67
Mathematics Extension 2		
Mathematics Extension 1		
Mathematics Advanced		
Mathematics Standard		
Mathematics Standard 2		
Mathematics Standard 1		

OR

DISCOUNTED BULK BLACKLINE MASTERS	COST	MARK CHOICES
All 8 HSC and Prelim Mathematics Exams (HSC and Prelim)	$340	

ENGLISH

INDIVIDUAL BLACKLINE MASTERS	HSC TRIAL @ $69	Y11 PRELIM @ $67
English Extension 1		
English Advanced		
English Standard		
English Studies		
English EAL/D		

OR

DISCOUNTED BULK BLACKLINE MASTERS	COST	MARK CHOICES
All 10 English Exams (HSC and Prelim)	$325	

PDHPE

INDIVIDUAL BLACKLINE MASTERS	HSC TRIAL @ $69	Y11 PRELIM @ $67
PDHPE		
Sport, Lifestyle and Recreation		
Community and Family Studies		
Exploring Early Childhood		

OR

DISCOUNTED BULK BLACKLINE MASTERS	COST	MARK CHOICES
Both PDHPE Exams	$115	
Both Sport, Life. & Rec. Exams	$115	
Both Com. & Fam. Studies Exams	$115	
Both Exploring Early Childhood Exams	$115	

TECHNOLOGIES

INDIVIDUAL BLACKLINE MASTERS	HSC TRIAL @ $69	Y11 PRELIM @ $67
Software Design & Development		
Information Processes and Technology		
Design and Technology		
Food Technology		
Textiles and Design		
Engineering Studies		
Industrial Technology– Timber		
Industrial Technology- Automotive		
Industrial Technology- Electronics		
Industrial Technology- Graphics		
Industrial Technology- Metal		
Industrial Technology- Multimedia		
Agriculture		

OR

DISCOUNTED BULK BLACKLINE MASTERS	COST	MARK CHOICES
All 4 Computing Exams (HSC and Prelim)	$225	
Both Design and Tech Exams	$115	
Both Food Technology Exams	$115	
Both Textiles and Design Exams	$115	
Both Engineering Studies Exams	$115	
Both Industrial Tech.- Timber Exams	$115	
Both Industrial Tech.- Automotive Exams	$115	
Both Industrial Tech.- Electronics Exams	$115	
Both Ind. Tech.- Graphics Exams	$115	
Both Ind. Tech.- Metal Exams	$115	
Both Ind. Tech.- Multimedia Exams	$115	
Both Agriculture Exams	$115	

Freight charged at cost. All prices ex-GST – add 10%. Orders to: orders@ite.nsw.edu.au

INDEPENDENT TRIAL EXAMS

ABN 95 111 569 629 info@ite.nsw.edu.au PO BOX 188 Kurmond NSW 2757

2023 ORDER FORM

DELIVERY DATES	
	Trial HSC – Tuesday 18 July 2023
	Year 11 Prelim – Tuesday 22 August 2023

School:

Order Number or Contact Name:

Deputy Principal/Curriculum Coordinator Email Address:

HSIE

INDIVIDUAL BLACKLINE MASTERS	HSC TRIAL @ $69	Y11 PRELIM @ $67
Economics		
Business Studies		
Legal Studies		
Geography		
Snr. Geography Broadsheets Same for both HSC and Prelim 30 sent if no numbers indicated	Number @$1.30	
Ancient History		
Modern History		
History Extension 1		
Society and Culture		
Studies of Religion I		
Studies of Religion II		
Studies in Catholic Thought (I unit)		
Studies in Catholic Thought (2 unit)		
Aboriginal Studies		

OR

DISCOUNTED BULK BLACKLINE MASTERS	COST	MARK CHOICES
Economics, Business Studies, Legal Studies All 6 Exams (HSC and Prelim)	$320	
Both Geography Exams Please indicate broadsheet numbers at left	$115	
All 5 History Exams (HSC and Prelim)	$320	
Both Society and Culture Exams	$115	
All 4 Studies of Religion Exams (HSC and Prelim)	$225	
All 4 Studies in Catholic Thought Exams (HSC and Prelim)	$225	
Both Aboriginal Studies Exams	$115	

CREATIVE ARTS

Music 1 + CD @ $15 each		
Music 2 + CD @ $15 each		
Visual Arts		
Visual Arts Colour Plates 30 sent if no numbers indicated	Number @$1.30	
Drama		
Dance		

All 4 Music Exams (HSC and Prelim) Plus 4 CD's @$15 each	$225	
Both Visual Arts Exams Please indicate colour plate numbers at left	$115	
Both Drama Exams	$115	
Both Dance Exams	$115	

VET

Hospitality Food/Beverage		
Hospitality Kitchen/Cookery		
Retail Services		
IDT		
Business Services		
Construction		
Primary Industries		
Entertainment		
Manufacturing and Engineering		
Electrotechnology		

Both Hospitality Food/Beverage Exams	$115	
Both Hospitality Kitchen/Cookery Exams	$115	
Both Retail Services Exams	$115	
Both IDT Exams	$115	
Both Business Services Exams	$115	
Both Construction Exams	$115	
Both Primary Industries Exams	$115	
Both Entertainment Exams	$115	
Both Manufacturing & Engineering Exams	$115	
Both Electrotechnology Exams	$115	

Freight charged at cost. All prices ex-GST – add 10%. Orders to: orders@ite.nsw.edu.au

INDEPENDENT TRIAL EXAMS

ABN 95 111 569 629 info@ite.nsw.edu.au PO BOX 188 Kurmond NSW 2757

2023 YEAR 7-10 ORDER FORM

DELIVERY DATES	Hard copies and download instructions by express post Week 1, Term 4 October 9-13, 2023

School Name:

Order Number or Contact Name:

Deputy Principal/Curriculum Coordinator Email Address:

INDIVIDUAL EXAMS $59 EACH **OR** **DISCOUNTED BULK PACKS**

SCIENCE

Year 7	Year 8	Year 9	Year 10

All 4 Science Exams Years 7-10	$205	

MATHS

Year 7	Year 8	Year 9	Year 10 5.1	Year 10 5.2	Year 10 5.3

All 6 Maths Exams Years 7-10	$255	

ENGLISH

Stage 4	Stage 5

Both English Exams Stage 4 and Stage 5	$105	

HISTORY

Year 7	Year 8	Year 9	Year 10

All 4 History Exams Years 7-10	$205	

GEOGRAPHY

Year 7	Year 8	Year 9	Year 10	Broadsheets (mailed) $1.30 each (70 sent if no number indicated)	
				Stage 4 (Yr7,8)	Stage 5 (Yr9,10)

All 4 Geography Exams Years 7-10 (Indicate total Broadsheets at left)	$205	

PDHPE

Stage 4	Stage 5

Both PDHPE Exams Stage 4 and Stage 5	$105	

MUSIC

Stage 4 (plus $15 CD)	Stage 5 (plus $15 CD)

Both Music Exams Stage 4 and 5 plus $15 per CD	$105	

YEAR 10 EXAMS

Physical Activity and Sports Studies (PASS)	
Information and Software Technology	
Design and Technology	
Food Technology	
Industrial Technology - Timber	

Textiles Technology	
Commerce	
Visual Arts	
Number of Colour Plates (mailed) $1.30 each (30 sent if no number is indicated)	

Freight charged at cost. All prices ex-GST – add 10%. Orders to: orders@ite.nsw.edu.au

INDEPENDENT TRIAL EXAMS

ABN 95 111 569 629 info@ite.nsw.edu.au PO BOX 188 Kurmond NSW 2757

Attention Curriculum Coordinator / Deputy Principal

RE: PAST PAPER WORKBOOKS AND EMAILED PAST EXAMS

Our past exams as available as both printed Past Paper Workbooks and emailed exams.

Emailed Past Exams

- Our past exams for Trial HSC, Year 11 Preliminary and Years 7-10 are available back to the 2000-2001 syllabus changes at $13 per emailed examination. Emailed exams may be cut and pasted to create revision, topic, term or half-yearly examinations.

  Please note Geography has separate stimulus colour broadsheets which are mailed hard copies. Similarly, Music and Visual Arts are hard copy only due to included CDs and colour plates respectively.

Printed Past Paper Workbooks

- We offer printed "Past Paper Workbooks" at $10 per student. For $10 each student receives a book containing any 3 of our past exams and a second book containing the corresponding solutions and marking criteria. Details are included on the attached "Past Paper Workbooks" flyer/order form.

For over 20 years, we have been supporters of the Children's Cancer Institute for scientific research into the early detection of relapse in children with leukaemia. In total over $650,000 donated from 2000 to 2022. We encourage schools to support the Children's Cancer Institute - www.ccia.org.au

We have expanded our support programs to include the conservation of threatened species. Specifically, the repopulation of the extinct in the wild Spix's macaw into secured habitat in Brazil - www.spixs-macaw.org

Please distribute this note together with the order forms to faculties, subject coordinators and/or head teachers. Email completed order forms to *orders@ite.nsw.edu.au*.

Your school's continued support is appreciated.

Kind regards,

NSW Independent Trials Pty. Ltd.

INDEPENDENT TRIAL EXAMS

ABN 95 111 569 629 info@ite.nsw.edu.au PO BOX 188 Kurmond NSW 2757

PAST TRIAL HSC AND YEAR 11 PRELIMINARY EMAILED EXAM ORDER FORM

$13 per emailed exam

School Name: Order Number:

Contact Name: Email address:

Please supply the following NSW Independent Trial Exams, including suggested answers, marking criteria/guidelines and mapping grids.
Please X boxes for each required paper. All schools invoiced (+10% GST) NSW Independent Trials Pty. Ltd. ABN 95 111 569 629 within a few days of delivery.

		Trial HSC Exams																					Year 11 Preliminary Exams																						
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Science	Physics																																													
	Chemistry																																													
	Biology																																													
	Earth and Environmental Science																																													
	Investigating Science																																													
	Science Extension																																													
	Marine Studies																																													
Maths	Mathematics Extension 2																																													
	Mathematics Extension 1																																													
	Mathematics Advanced (2 Unit)																																													
	Mathematics Standard																																													
	Mathematics Standard 2																																													
	Mathematics Standard 1																																													
English	English Extension 1																																													
	English Advanced																																													
	English Standard																																													
	English Studies																																													
	English EAL/D																																													

Orders to: orders@ite.nsw.edu.au

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PAST TRIAL HSC AND YEAR 11 PRELIMINARY EMAILED EXAM ORDER FORM

$13 per emailed exam

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Contact Name: _____ Email address: _____

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		Trial HSC Exams																				Year 11 Preliminary Exams																							
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
PDHPE	PDHPE																																													
	Sport, Lifestyle and Rec. Studies																																													
	Community and Family Studies																																													
	Exploring Early Childhood																																													
Technologies	Software Design and Development																																													
	Information Processes and Technology																																													
	Design and Technology																																													
	Food Technology																																													
	Textiles and Design																																													
	Engineering Studies																																													
	Industrial Technology - Timber																																													
	Industrial Technology - Automotive																																													
	Industrial Technology - Electronics																																													
	Industrial Technology - Graphics																																													
	Industrial Technology - Metal																																													
	Industrial Technology - Multimedia																																													
	Agriculture																																													
Creative Arts	Drama																																													
	Dance																																													
	Music 1 (plus CD @ $15 each)																																													
	Music 2 (plus CD @ $15 each)																																													
	Visual Arts																																													
	Colour plates – $1.30 each – indicate quantity																																													

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PAST TRIAL HSC AND YEAR 11 PRELIMINARY EMAILED EXAM ORDER FORM

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		Trial HSC Exams																					Year 11 Preliminary Exams																							
		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
HSIE	Economics																																														
	Business Studies																																														
	Legal Studies																																														
	Ancient History																																														
	Modern History																																														
	History Extension 1																																														
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	Aboriginal Studies																																														
	Geography																																														
	Broadsheets $1.30 each – indicate quantity.																																														
VET	Hospitality																																														
	Retail Services																																														
	Information and Digital Technology																																														
	Business Services																																														
	Construction																																														
	Primary Industries																																														
	Entertainment																																														
	Manufacturing and Engineering																																														
	Electrotechnology																																														

Orders to: orders@ite.nsw.edu.au

INDEPENDENT TRIAL EXAMS

ABN 95 111 569 629 info@ite.nsw.edu.au PO BOX 188 Kurmond NSW 2757

PAST YEAR 7 TO 10 EMAILED EXAM ORDER FORM

$13 per emailed exam

School Name:
Contact Name:

Order Number:
Email address:

Please supply the following NSW Independent Trial Exams, including suggested answers, marking criteria/guidelines and mapping grids.
Please X boxes for each required paper. All schools invoiced (+10% GST) by NSW Independent Trials Pty. Ltd. ABN 95 111 569 629 within a few days of delivery.

	Year 7									Year 8 - Stage 4									Year 9									Year 10 – Stage 5																									
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2014	2015	2016	2017	2018	2019	2020	2021	2022	2014	2015	2016	2017	2018	2019	2020	2021	2022	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Science																																																				
Maths																																																				
Maths 5.1																																																			
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Agricultural Technology																																																			

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PAST YEAR 7 TO 10 EMAILED EXAM ORDER FORM

$13 per emailed exam

School Name:
Contact Name:
Order Number:
Email address:

Please supply the following NSW Independent Trial Exams, including suggested answers, marking criteria/guidelines and mapping grids.
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	Year 7									Year 8 - Stage 4									Year 9									Year 10 – Stage 5																								
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2014	2015	2016	2017	2018	2019	2020	2021	2022	2014	2015	2016	2017	2018	2019	2020	2021	2022	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Commerce																																																		
History																																																		
Geography																																																		
Broadsheets (mailed) @ $1.30 each – indicate quantity																																																	
Religion																																																		
Aboriginal Studies																																																		
Dance																																																		
Drama																																																		
Music plus $15 CD mailed																																																	
Visual Arts																																																		
Colour Plates (mailed) @ $1.30 each – indicate quantity																																																	
Visual Design																																																		
Colour Plates (mailed) @ $1.30 each – indicate quantity																																																	
Photo and Digital Media																																																		
Colour Plates (mailed) @ $1.30 each – indicate quantity																																																	

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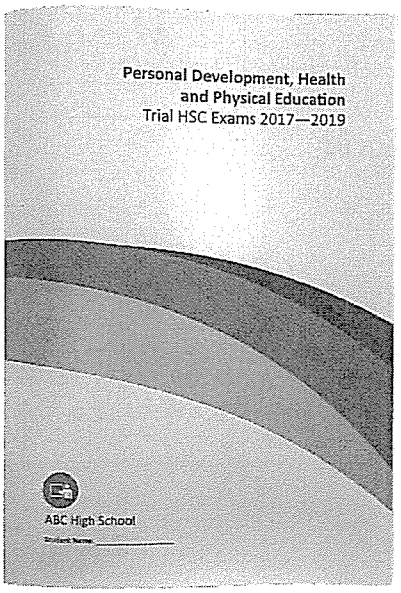

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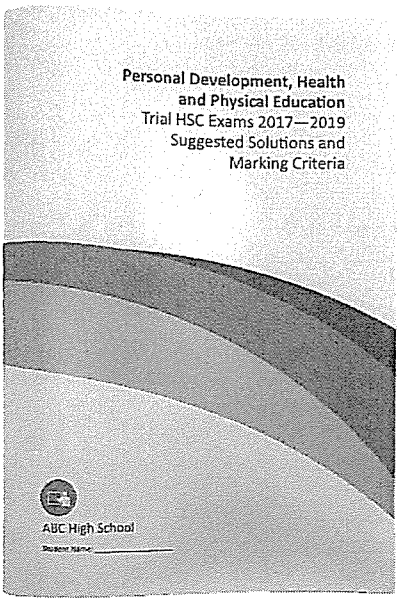

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WHICH COURSE?

WHICH EXAMS?

☐ Trial HSC Exams **OR**

☐ Yr 11 Prelim exams

WHICH YEARS?

☐ Latest 3 years **OR**

☐ 20__, 20__, and 20__

HOW MANY BOOKLETS?

Minimum 10 copies of each set

YOUR SCHOOL Please attach your school logo file

YOUR NAME AND EMAIL

YOUR ORDER NUMBER

Prefer your books printed differently? Perhaps different courses in the one set, junior exams, or exams and answers together? Email your ideas and we'll try to accommodate.

* Geography and Visual Arts $13.90 per set, as they include colour stimulus for each exam. Music requires extra resources, please email your requirements. Prices exclude GST. Freight charged at cost.

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INDEPENDENT TRIAL EXAMS
NEW SOUTH WALES

PAST PAPER WORKBOOKS

YOUR SCHOOL Please attach your school logo file

YOUR NAME AND EMAIL

YOUR ORDER NUMBER

	WHICH COURSE?	WHICH EXAMS?	WHICH YEARS?	HOW MANY BOOKLETS?
1		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set
2		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set
3		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set
4		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set
5		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set
6		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set
7		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set
8		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set
9		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set
10		☐ Trial HSC Exams **OR** ☐ Yr 11 Prelim exams	☐ Latest 3 years **OR** ☐ 20__, 20__, and 20__	Minimum 10 copies of each set

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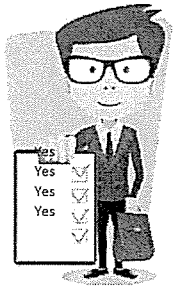

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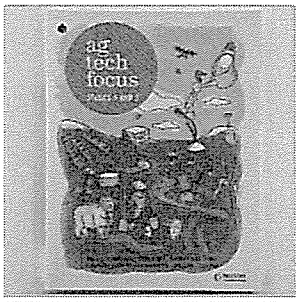

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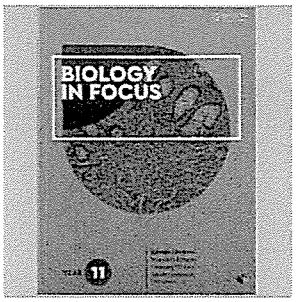

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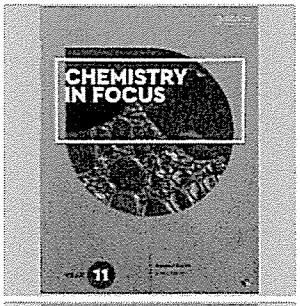

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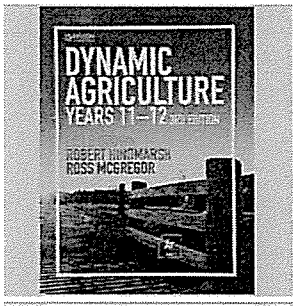

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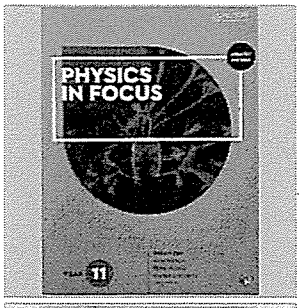

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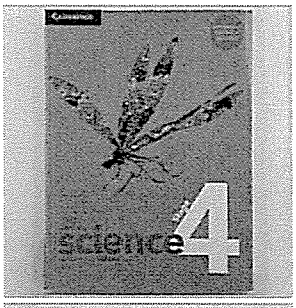

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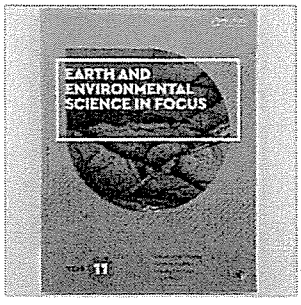

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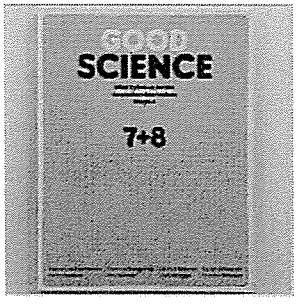

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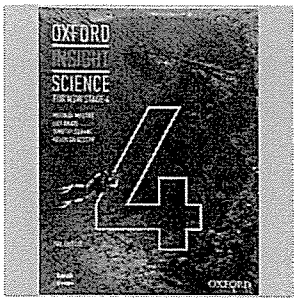

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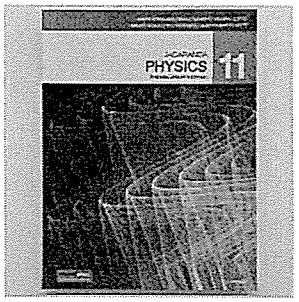

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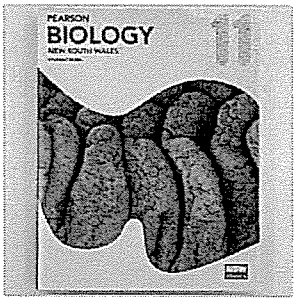

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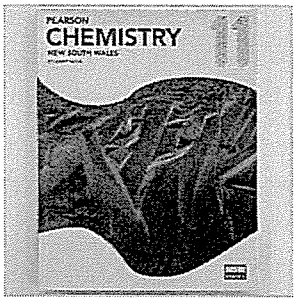

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