Neap

Trial Examination 2021

HSC Year 12 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 Periodic Table are provided at the back of this paper

Total Marks: 100

Section I – 20 marks (pages 2–9)

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

Section II – 80 marks (pages 11–30)

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

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SECTION I

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

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

1 Hydrogen can be produced from methane. The equation for the reaction is shown.

$$2H_2O(g) + CH_4(g) \rightleftharpoons CO_2(g) + 4H_2(g)$$

What is the correct equilibrium expression (K_{eq}) for this reaction?

A. $\dfrac{[H_2O]^2[CH_4]}{[CO_2][H_2]^4}$

B. $\dfrac{[CO_2][H_2]^4}{[H_2O]^2[CH_4]}$

C. $\dfrac{2[H_2O][CH_4]}{[CO_2]\,4[H_2]}$

D. $\dfrac{[CO_2]\,4[H_2]}{2[H_2O][CH_4]}$

2 As the temperature of a particular reaction was increased, the rate of the reaction increased. Which statement best explains why this occurred?

A. The product molecules collided more frequently.
B. The product molecules collided with the correct orientation.
C. The reactant molecules collided with greater energy per collision.
D. The reactant molecules collided less frequently.

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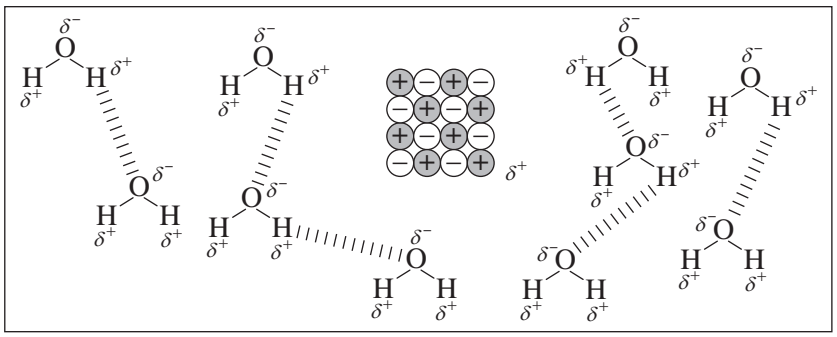
3 The diagram shows three stages of a process.

Stage I



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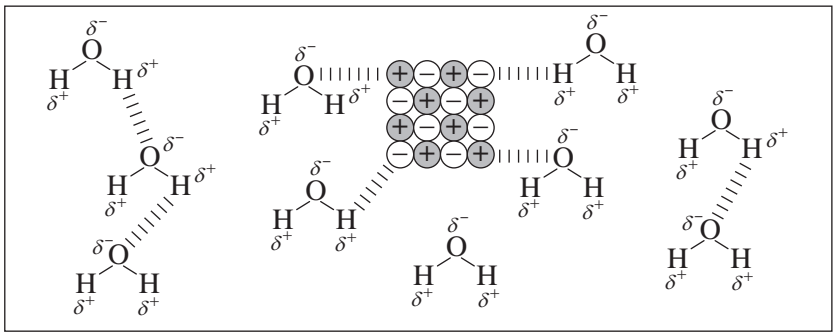
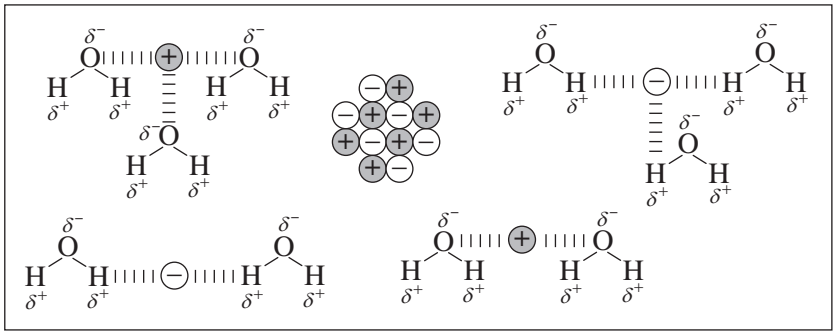
Stage II



Stage III



What process is shown?

A. the dissociation of an ionic substance

B. the dissociation of an acid

C. the dissociation of a base

D. the precipitation of a salt

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4 Hydrogen and iodine react according to the following equilibrium reaction.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g) \qquad \Delta H < 0$$

A mixture of hydrogen gas and iodine gas was placed in a container, sealed and allowed to reach equilibrium. Changes were made to the mixture and the mole amounts of reactants and product were measured.

I The volume of the container was increased with the temperature remaining constant.

II Hydrogen gas was added to the container with the volume and temperature remaining constant.

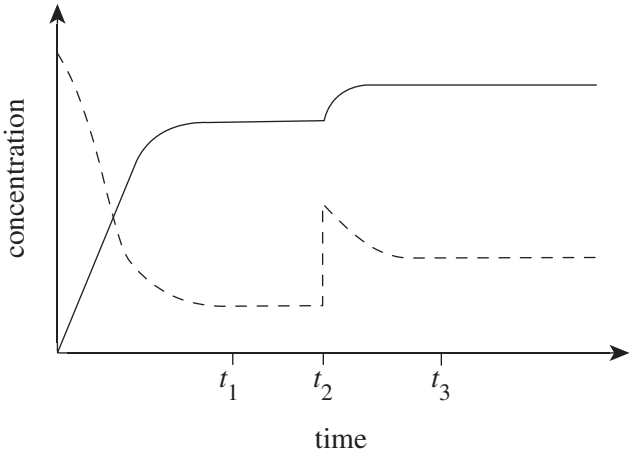
III An inert gas was added to the container with the volume increasing and temperature remaining constant.

IV The temperature of the gases was decreased with the volume remaining constant.

Which changes would result in an increase in the number of moles of hydrogen iodide formed?

A. I and III only
B. I and IV only
C. II and III only
D. II and IV only

5 The graph shows the progress of an equilibrium reaction (reactants $\rightleftharpoons$ products).



Which row of the table correctly identifies what is happening at t_1, t_2 and t_3?

	t_1	t_2	t_3
A.	at equilibrium	reactants added	new equilibrium position
B.	at equilibrium	products added	new equilibrium position
C.	no reaction occurring	reaction proceeding	reaction occurring
D.	only forward reaction occurring	forward and reverse reactions occurring	only reverse reaction occurring

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6 Which statement about 100.0 mL of 0.10 mol L^{-1} hydrochloric acid and 100.0 mL of 0.10 mol L^{-1} acetic (ethanoic) acid solutions is correct?

A. Each solution will react completely with 100.0 mL of 0.10 mol L^{-1} sodium hydroxide solution.

B. The solutions will have the same electrical conductivity.

C. Each solution will react at the same rate with 1.00 g of magnesium ribbon.

D. The concentration of H_3O^+ ions will be the same in both solutions.

7 A mixture was prepared containing equal amounts of 0.10 mol L^{-1} ammonia solution and 0.10 mol L^{-1} ammonium nitrate.

Which statement about this mixture is correct?

A. The mixture is strongly acidic.

B. The mixture has a pH of approximately 7.

C. The mixture will resist changes in pH when other solutions are added to it.

D. The mixture will not change in pH when other solutions are added to it.

8 The pH of two solutions, X and Y, of the same concentration were measured. The pH of solution X was 2.00 and the pH of solution Y was 4.00.

Which statement about solutions X and Y is correct?

A. Solution Y must contain a stronger acid than solution X.

B. The concentration of H^+ in solution X is two times greater than the concentration of H^+ in solution Y.

C. The concentration of H^+ in solution X is 100 times greater than the concentration of H^+ in solution Y.

D. The concentration of OH^- in solution Y is two times greater than the concentration of OH^- in solution X.

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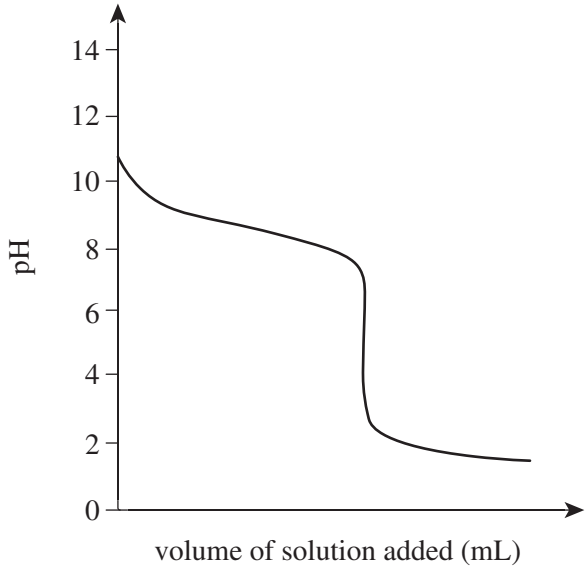
9 The graph shows how pH changes in the reaction between a particular acid and a particular base.



Which of the following is closest to the pH of the equivalence point?

A. 2

B. 5

C. 7

D. 10.5

10 The reaction $CN^- + H_2O \rightleftharpoons HCN + OH^-$ contains conjugate acid/base pairs.

Which of the following shows a conjugate acid/base pair in this reaction?

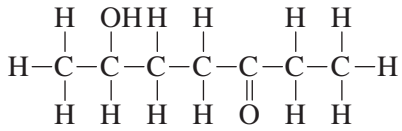
A. HCN/CN^-

B. CN^-/H_2O

C. H_2O/HCN

D. HCN/OH^-

11 The structure of a compound is shown.



What is the preferred IUPAC name of this compound?

A. 2-hydroxyheptan-5-one

B. 5-oxo-heptan-2-ol

C. heptan-2-ol-5-one

D. 6-hydroxyheptan-3-one

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12 Which of the following lists the compounds from lowest to highest boiling point?

A. 2-methylbutane, ethyl ethanoate, butan-1-ol, butanoic acid

B. ethyl ethanoate, 2-methylbutane, butanoic acid, butan-1-ol

C. 2-methylbutane, butan-1-ol, butanoic acid, ethyl ethanoate

D. butanoic acid, butan-1-ol, ethyl ethanoate, 2-methylbutane

13 A thermochemical reaction is shown.

$$CH_3CH_2CH_2CH_2OH(g) + 7.5O_2(g) \rightarrow 5CO_2(g) + 5H_2O(l) \qquad \Delta H = -2676 \text{ kJ mol}^{-1}$$

How much heat is released when 1.00 g of butanol is reacted?

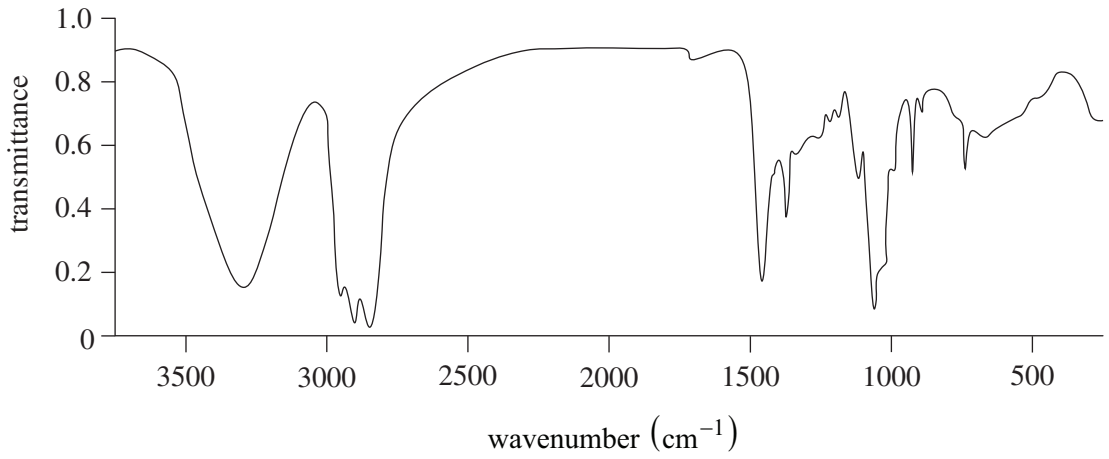
A. 30.4 kJ

B. 36.1 kJ

C. 145 kJ

D. 198 kJ

14 An infrared spectrum is shown.



Which compound gives rise to this spectrum?

A. hexan-1-ol

B. hexan-2-one

C. hexanal

D. hexanoic acid

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15 Consider the isomeric alcohols.

butan-1-ol butan-2-ol 2-methylpropan-2-ol 2-methylpropan-1-ol

Which of the following instrumental methods would most effectively differentiate between these isomeric alcohols?

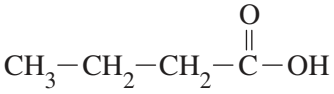
A. atomic absorption spectroscopy

B. ultraviolet-visible spectrophotometry

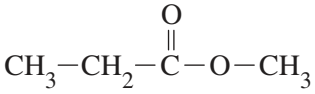
C. infrared spectroscopy

D. ^{1}H NMR spectroscopy

16 The structures of butanoic acid and methyl propanoate are shown.



butanoic acid



methyl propanoate

Which statement best explains why butanoic acid has a higher boiling point than methyl propanoate?

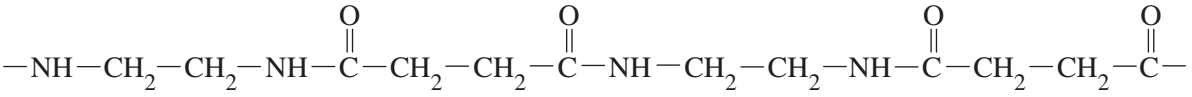
A. Butanoic acid has more covalent bonds than methyl propanoate.

B. Butanoic acid has a smaller size than methyl propanoate.

C. Butanoic acid has dipole–dipole forces.

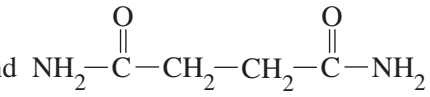
D. Butanoic acid has hydrogen bonds.

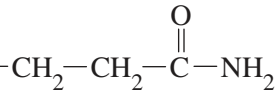
17 A portion of a polymer chain is shown.

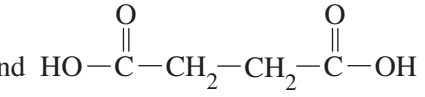


Which of the following pairs of monomers would react to form this polymer?

A. $CH_2{-}CH_2$ and HNCO

B. $HO{-}CH_2{-}CH_2{-}OH$ and 

C. $CH_2{=}CH_2$ and 

D. $NH_2{-}CH_2{-}CH_2{-}NH_2$ and 

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18 Which of the following molecules has bond angles closest to 180°?

A. ethane

B. ethanol

C. ethyne

D. ethene

19 Which of the following compounds is the most basic?

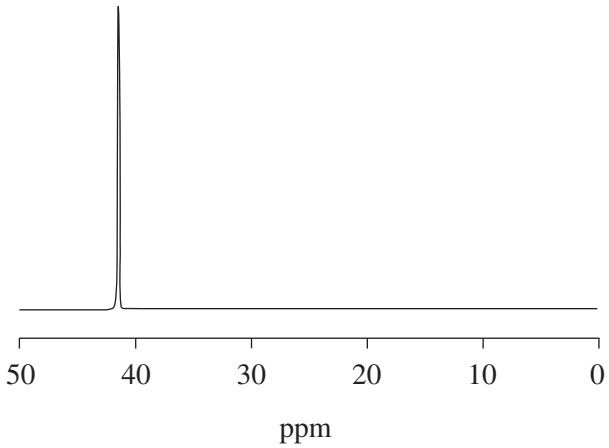
A. $CH_3—CH_2—CH_2—CH_2—OH$

B. $CH_3—CH_2—CH_2—CH_2—NH_2$

C. $CH_3—CH_2—\overset{\overset{O}{\|}}{C}—O—CH_2—CH_3$

D. $CH_3—CH_2—CH_2—CH_2—\overset{\overset{O}{\|}}{C}—O—H$

20 A ^{13}C NMR spectrum is shown.



Which compound gives rise to this spectrum?

A. chloroethane

B. 1-chloropropane

C. 1,2-dichloroethane

D. 1,3-dichloropropane

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HSC Year 12 Chemistry

Section II Answer Booklet

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

Instructions

- 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 on pages at the back of this booklet. If you use this space, clearly indicate which question you are answering.

Please turn over

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Question 21 (4 marks)
A non-equilibrium system is shown. **4**

$$C_8H_{18}(l) + 12\frac{1}{2}O_2(g) \rightarrow 8CO_2(g) + 9H_2O(l)$$

Discuss why this is a non-equilibrium system with reference to the effect of Gibbs free energy, enthalpy and entropy.

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Question 22 (7 marks)
Nitrogen dioxide can dimerise to form dinitrogen tetroxide according to the following equation.

$$2NO_2(g) \rightleftharpoons N_2O_4(g) \qquad \Delta H = -52 \text{ kJ mol}^{-1}$$

(a) Using Le Châtelier's principle, explain what would happen to the position of equilibrium if the pressure were increased with all other conditions remaining the same. **2**

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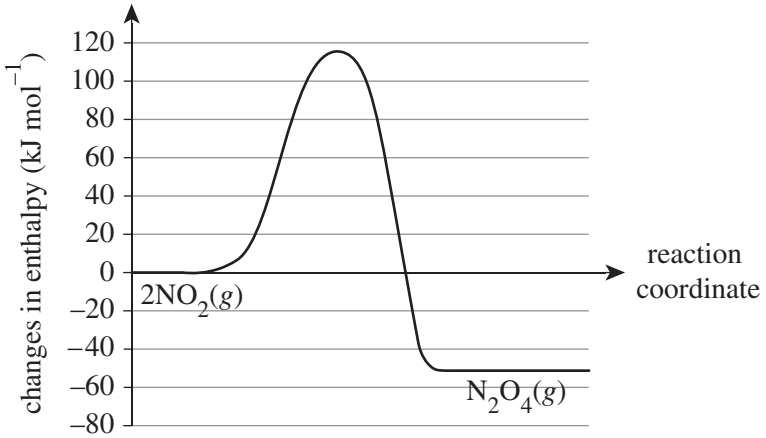
(b) The energy profile diagram for this reaction is shown. **2**



Determine the activation energies of the forward and reverse direction for $2NO_2(g) \rightleftharpoons N_2O_4(g)$.

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(c) Explain the effect of increasing the temperature on this equilibrium, all other conditions being kept constant. **3**

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Question 23 (6 marks)

Iron(III) ions and thiocyanate ions react to form a complex ion according to the following equation. **6**

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

10.0 mL of a 0.00200 mol L^{-1} solution of iron(III) was added to 10.0 mL of a 0.00200 mol L^{-1} solution of thiocyanate ions and mixed. The mixture was tested after a period of time and the concentration of the iron thiocyanate complex was found to be 1.45×10^{-4} mol L^{-1}. Under the conditions used, the theoretical value of the equilibrium constant (K_{eq}) is 2.05×10^{2}.

Determine in which direction the reaction must proceed to reach equilibrium. Include the relevant calculations in your answer.

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Question 24 (7 marks)

A student was looking for an alternative to the cleaning agent they used at home. They found the information shown.

> *Vinegar – an alternative to harsh chemical cleaning agents?*
>
> Vinegar is a solution of acetic (ethanoic) acid in water. Vinegar has been used as a cleaning agent for centuries. Studies have shown that the vinegar needs to have a concentration of 7–12% w/v* before it is an effective cleaning agent. Vinegar that has this concentration can be used as an alternative to synthetic cleaning agents.
>
> $^{*}\ \text{w/v} = \dfrac{\text{weight}}{\text{volume}} \times 100$

The student showed this information to their Chemistry class, and the class decided to analyse a sample of 'white vinegar' from the supermarket to determine the concentration of acetic acid (CH_3COOH).

A conductimetric titration was carried out.

A 25.00 mL sample was taken of the vinegar and diluted to 250 mL in a volumetric flask. A 25.0 mL portion of this diluted solution was titrated using standardised 0.120 mol L^{-1} sodium hydroxide solution. The conductivity of the diluted vinegar solution was taken.

1.00 mL of NaOH solution was then added in increments, the mixture stirred, and the new conductivity was taken after each addition.

The results of the titration are shown in the table.

NaOH added (mL)	*Conductivity (S m^{-1})*
0	130
1.0	110
2.0	104
3.0	97
4.0	90
5.0	84
6.0	76
7.0	70
8.0	65
9.0	70
10.0	98
11.0	122
12.0	148
13.0	171
14.0	198
15.0	220

Question 24 continues on page 16

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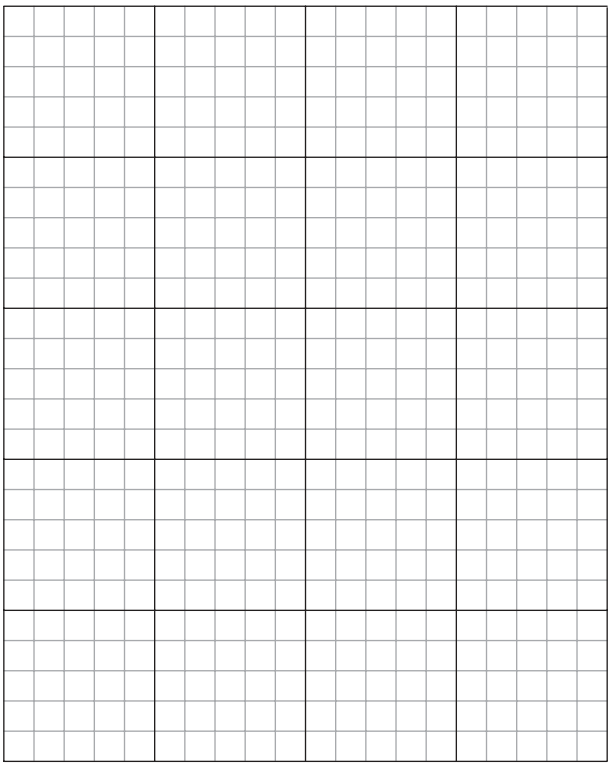
Question 24 (continued)

By drawing a best-fit conductivity graph of the data in the table and performing relevant calculations, determine whether the vinegar was of the required concentration to be an effective cleaning agent. **7**



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End of Question 24

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Question 25 (5 marks)

A student added 1.78 g of $Ca(OH)_2(s)$ to 0.250 L of 0.200 mol L^{-1} $HNO_3(aq)$. The mixture was carefully stirred until no further reaction occurred.

(a) Assuming that the total volume of the solution remains unchanged, calculate the pH of the resulting solution. **3**

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(b) Explain how nitric acid can be regarded as both an Arrhenius acid and a Brønsted–Lowry acid. **2**

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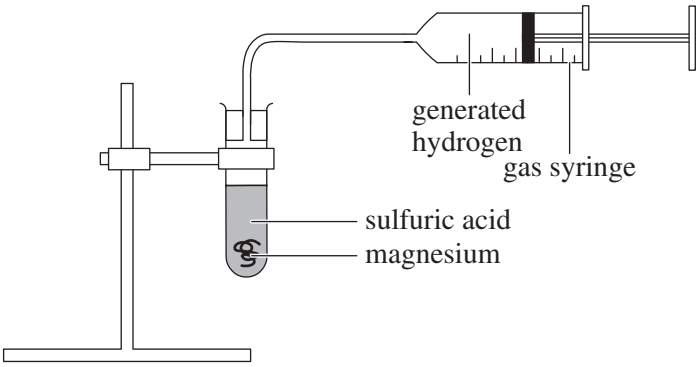
Question 26 (5 marks)

Magnesium reacts vigorously with mineral acids to produce a salt and hydrogen gas in an exothermic reaction.

A student reacted 0.361 g of magnesium with excess sulfuric acid and measured the volume of hydrogen generated. When the magnesium had completely reacted, there was 385 mL of gas in the syringe. The apparatus used by the student is shown.



(a) Write a balanced chemical equation for this reaction between magnesium and sulfuric acid. **1**

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(b) Calculate the volume of hydrogen that is generated at 25.0°C and 100 kPa. **3**

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(c) Assuming that the method was valid and the gas syringe was accurate, give ONE reason why there might be a difference between theoretical yield and the amount recorded. **1**

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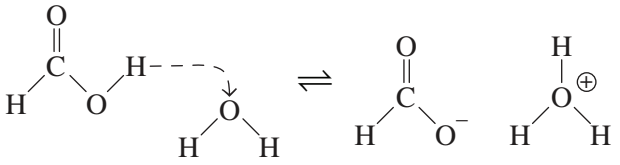
Question 27 (4 marks)

Formic acid is an organic acid, found in the venom of ants and bees. The diagram shows a molecule of formic acid dissociating in water.



(a) Determine the dissociation constant of a 0.100 mol L^{-1} formic acid solution that has a pH of 2.38. **3**

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(b) Use the dissociation constant calculated in part (a) to identify the strength of this acid. **1**

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Question 28 (3 marks)

In an aqueous solution, the colourless weak acid p-nitrophenol ($C_6H_5NO_3$) undergoes hydrolysis to produce yellow-coloured p-nitrophenoxide ions. The absorbance of this solution was measured at 410 nm and found to be 0.433 when using a sample cell with a pathlength of 1.00 cm. Only p-nitrophenoxide ions absorb at this wavelength. Its molar attenuation coefficient, at this wavelength, is 18 600 L mol^{-1} cm^{-1}.

(a) Complete the equilibrium equation. **1**

$$C_6H_5NO_3(aq) + H_2O(l) \rightleftharpoons \boxed{}(aq) + \boxed{}(aq)$$

(b) Determine the concentration of p-nitrophenoxide in the solution. **2**

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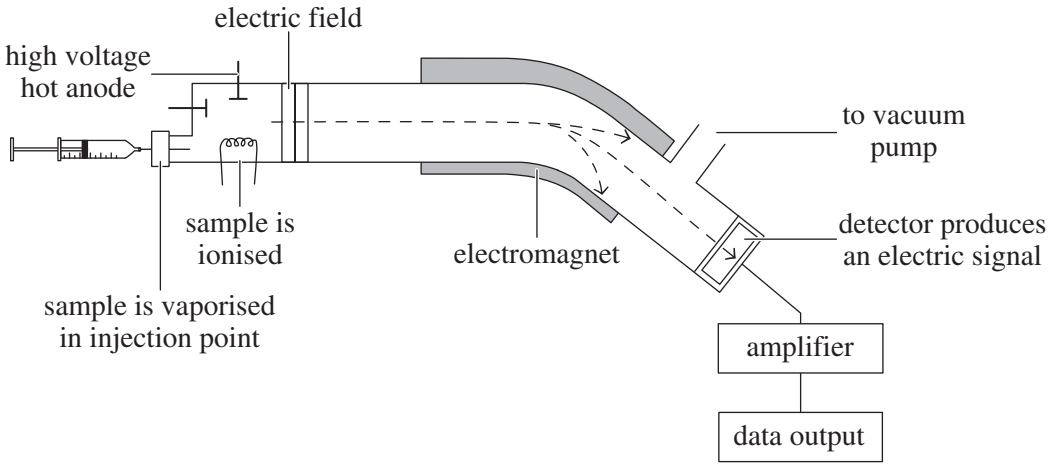
Question 29 (6 marks)

Mass spectroscopy is a technique that measures the mass-to-charge ratio (m/z) of charged particles. The instrument used is called a mass spectrometer, in which electric signals produce a mass spectrum on a screen. The diagram shows a mass spectrometer.



A sample is injected into the mass spectrometer and the particles pass through an electric field, and then through a magnetic field.

(a) (i) What is the purpose of the electric field? **1**

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(ii) What is the purpose of the magnetic field? **1**

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Question 29 continues on page 22

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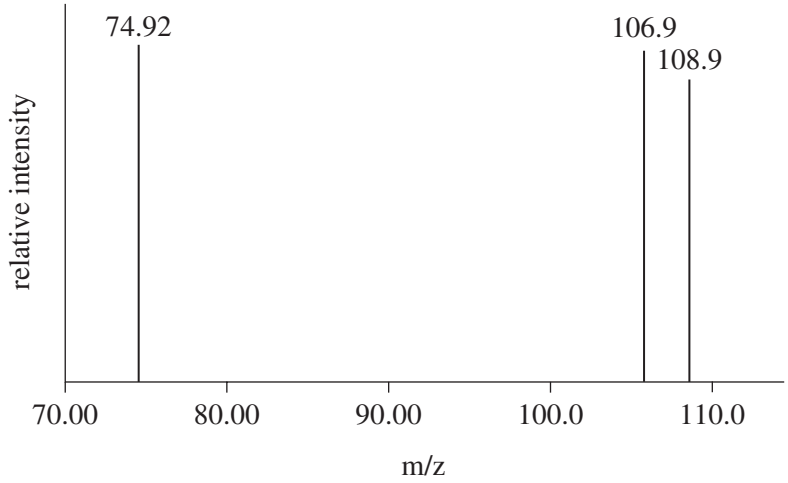
Question 29 (continued)

A common use for mass spectroscopy is to identify elements and their isotopes.

(b) The mass spectrum of a mixture of elements is shown. **2**



What elements are present and how many isotopes does each element have?

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Question 29 continues on page 23

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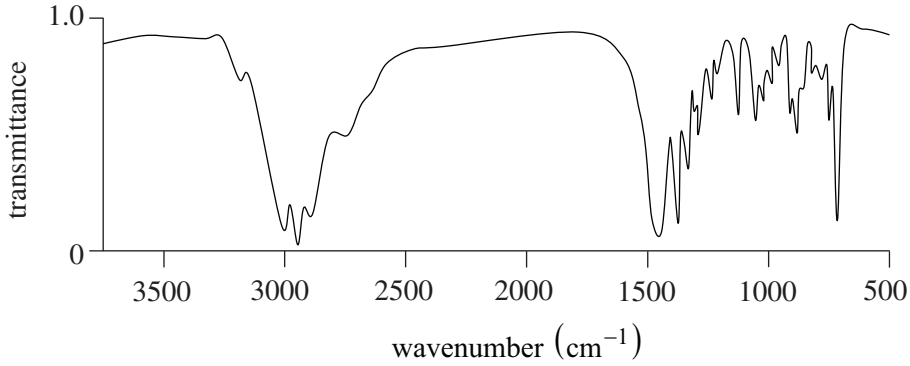
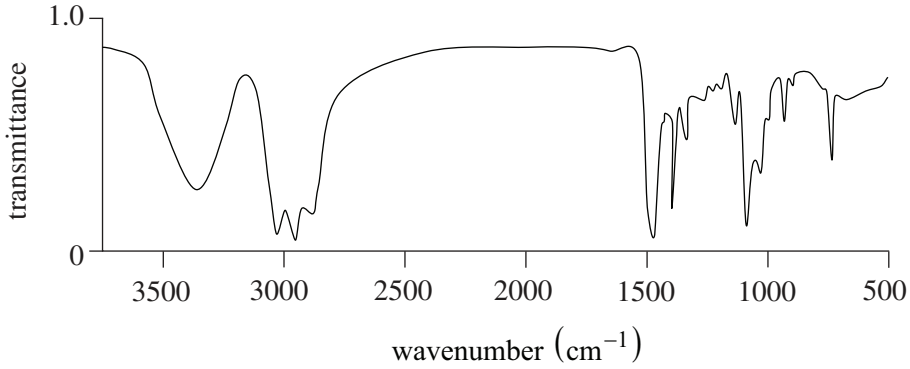
Question 29 (continued)

(c) Mass spectroscopy is often used with other spectroscopic techniques to identify the components of mixtures. Infrared spectroscopy is one such technique that aids in identifying the functional groups contained within a molecule. The infrared spectra of hexane and hexan-1-ol are shown. **2**

Infrared spectrum for hexane



Infrared spectrum for hexan-1-ol



Identify the bonds in hexan-1-ol that account for the differences between the two IR spectra and identify the relevant absorption peaks.

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End of Question 29

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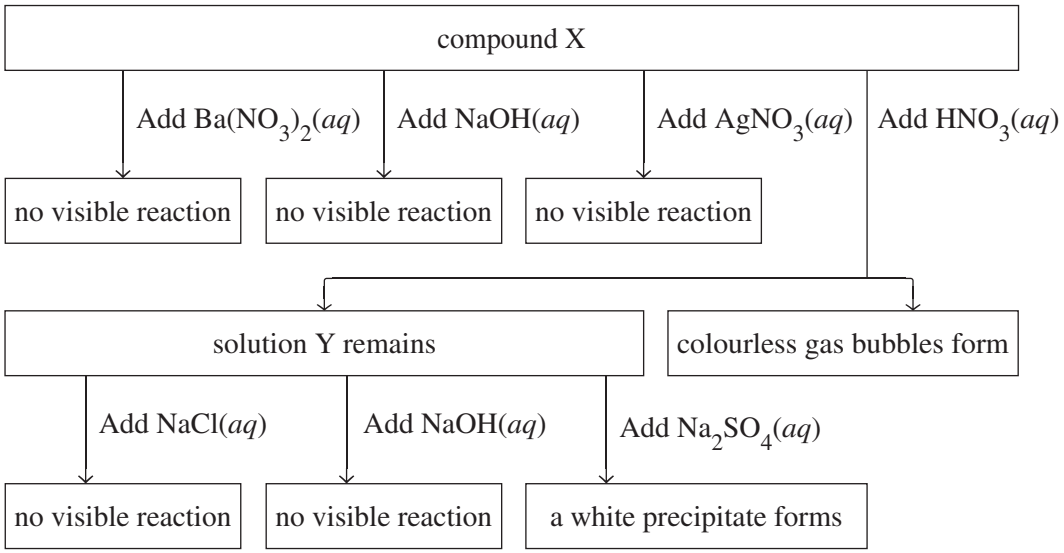
Question 30 (4 marks)

Compound X is an insoluble white ionic compound. A student performed a series of experiments on compound X to determine its identity. A flow chart is shown summarising their results. **4**



Use the information provided to identify compound X and justify your choice. Include net ionic equations where appropriate.

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Question 31 (7 marks)

Compound B is formed when an alcohol, compound A, is reacted with reagent X as shown in the equation.

$$\underset{\text{compound A}}{C_4H_9OH} + \text{reagant X} \xrightarrow{\text{heat}} \underset{\text{compound B}}{C_4H_8O_2}$$

(a) (i) Identify whether compound A is a primary, secondary or tertiary alcohol, and explain your choice. **2**

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.....

(ii) Identify a reagent that could function as reagent X. **1**

.....

But-1-ene is the only alkene produced when compound A is reacted under appropriate conditions.

(b) Identify the systematic name of compound B and draw its structural formula. **2**

.....

(c) Compound C, a sweet-smelling liquid, is one of two products formed when compound A reacts with compound B in the presence of a catalytic amount of sulfuric acid. **2**

Identify the systematic name of compound C and draw its structural formula.

.....

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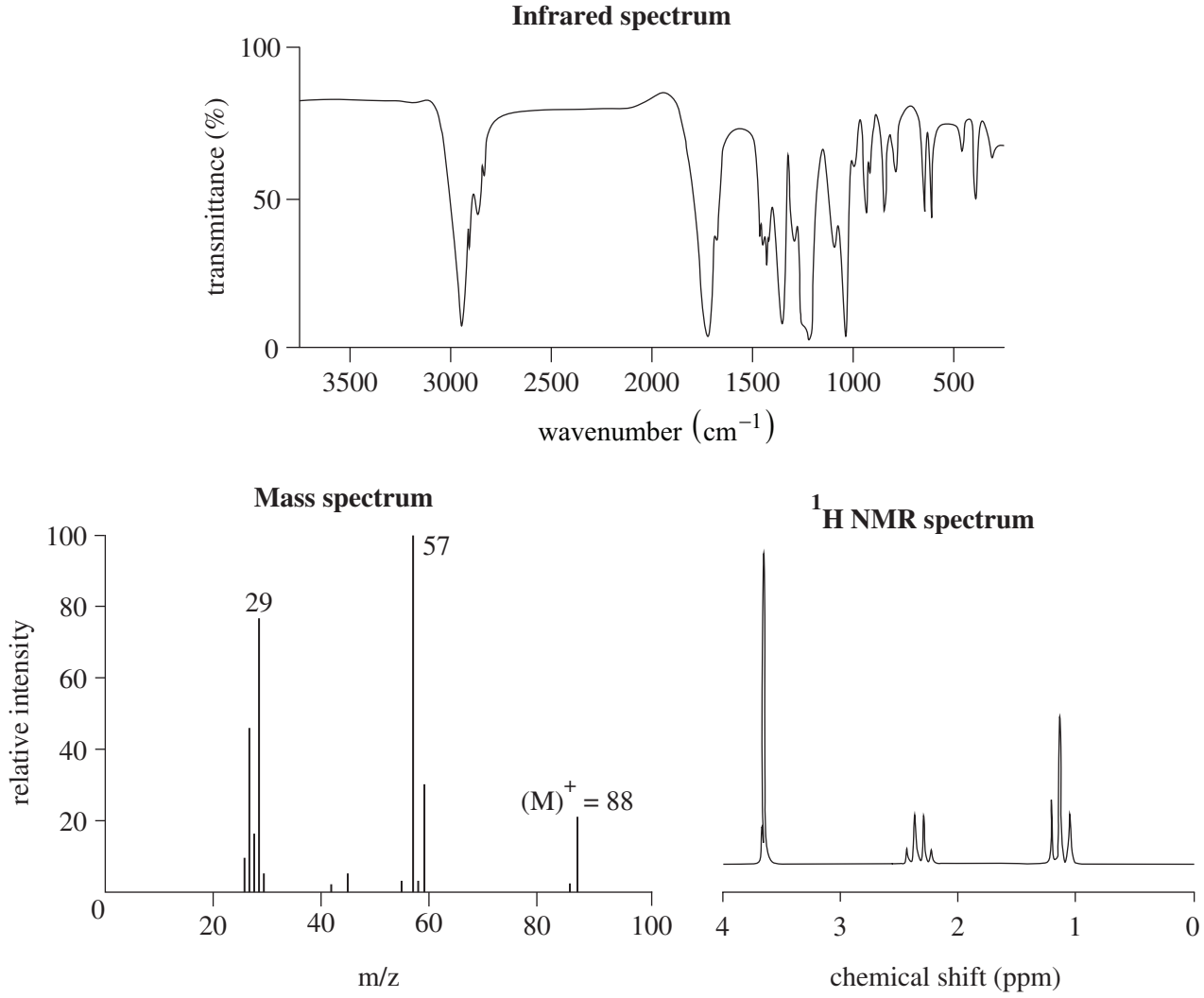
Question 32 (8 marks)

Compound X was found to have the molecular formula $C_4H_8O_2$. To confirm the molecular structure of the compound, mass spectrometry, infrared spectroscopy and ^{1}H NMR spectrometry were performed. The resulting spectra are shown.



(a) What does the peak at m/z = 88 in the mass spectrum indicate? **1**

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Question 32 continues on page 27

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Question 32 (continued)

(b) Use the spectra provided to identify compound X. Justify your answer with reference to the data provided. **7**

End of Question 32

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Question 33 (5 marks)

(a) C_3H_5Cl has several structural isomers containing an alkene functional group. **3**

Complete the table by stating the systematic names and drawing the structural formulae of THREE structural isomers of C_3H_5Cl.

Systematic name	*Structural formula*

(b) A chemical test can be performed quickly in a school laboratory to distinguish between cyclohexanol and 1-methylcyclohexanol. **2**

Identify the reagent used in this test and describe the expected observations.

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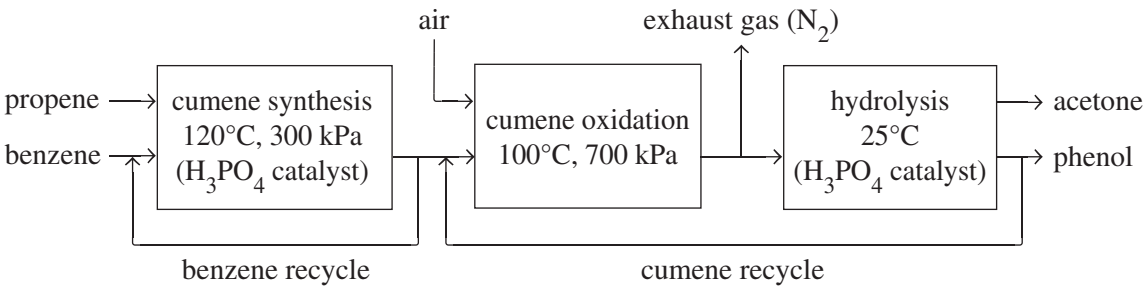
Question 34 (4 marks)

A chemist has proposed a reaction process for the industrial production of phenol, a compound used in the manufacture of a wide range of industrial chemicals. This process has been shown to result in 98% conversion of benzene to phenol. The process is shown in the flow chart. **4**



Using the information provided, outline THREE factors that may have been considered in the design of this industrial process.

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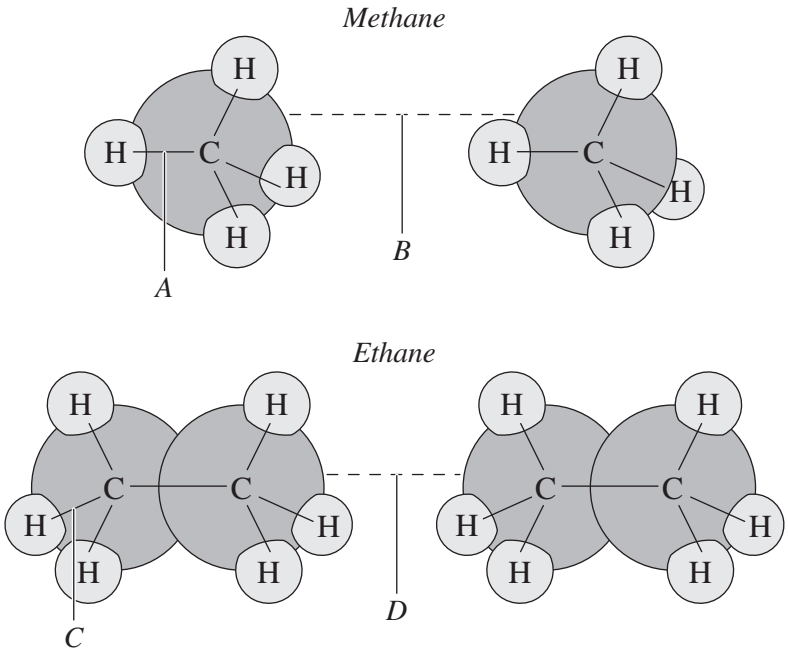
Question 35 (5 marks)

The diagrams show the bonding within and between methane and ethane molecules. **5**



Compare the strengths of bonds *A* and *C* AND compare the strengths of bonds *B* and *D*. In your response, evaluate the significance of these bonds in determining the physical properties of the homologous series represented in the diagrams.

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End of paper

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Section II extra writing space

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

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Section II extra writing space

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

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FORMULAE SHEET

$$n = \frac{m}{MM} \qquad c = \frac{n}{V} \qquad PV = nRT$$

$$q = mc\Delta T \qquad \Delta G^\circ = \Delta H^\circ - T\Delta S^\circ \qquad \text{pH} = -\log_{10}\left[\text{H}^+\right]$$

$$pK_a = -\log_{10}\left[K_a\right] \qquad A = \varepsilon lc = \log_{10}\frac{I_o}{I}$$

Avogadro constant, N_A ..... 6.022×10^{23} mol^{-1}

Volume of 1 mole ideal gas: at 100 kPa and

at 0°C (273.15 K) ..... 22.71 L

at 25°C (298.15 K) ..... 24.79 L

Gas constant ..... 8.314 J mol^{-1} K^{-1}

Ionisation constant for water at 25°C (298.15 K), K_w ..... 1.0×10^{-14}

Specific heat capacity of water ..... 4.18×10^3 J kg^{-1} K^{-1}

DATA SHEET

Solubility constants at 25°C

Compound	K_{sp}
Barium carbonate	2.58×10^{-9}
Barium hydroxide	2.55×10^{-4}
Barium phosphate	1.3×10^{-29}
Barium sulfate	1.08×10^{-10}
Calcium carbonate	3.36×10^{-9}
Calcium hydroxide	5.02×10^{-6}
Calcium phosphate	2.07×10^{-29}
Calcium sulfate	4.93×10^{-5}
Copper(II) carbonate	1.4×10^{-10}
Copper(II) hydroxide	2.2×10^{-20}
Copper(II) phosphate	1.40×10^{-37}
Iron(II) carbonate	3.13×10^{-11}
Iron(II) hydroxide	4.87×10^{-17}
Iron(III) hydroxide	2.79×10^{-39}
Iron(III) phosphate	9.91×10^{-16}

Compound	K_{sp}
Lead(II) bromide	6.60×10^{-6}
Lead(II) chloride	1.70×10^{-5}
Lead(II) iodide	9.8×10^{-9}
Lead(II) carbonate	7.40×10^{-14}
Lead(II) hydroxide	1.43×10^{-15}
Lead(II) phosphate	8.0×10^{-43}
Lead(II) sulfate	2.53×10^{-8}
Magnesium carbonate	6.82×10^{-6}
Magnesium hydroxide	5.61×10^{-12}
Magnesium phosphate	1.04×10^{-24}
Silver bromide	5.35×10^{-13}
Silver chloride	1.77×10^{-10}
Silver carbonate	8.46×10^{-12}
Silver hydroxide	2.0×10^{-8}
Silver iodide	8.52×10^{-17}
Silver phosphate	8.89×10^{-17}
Silver sulfate	1.20×10^{-5}

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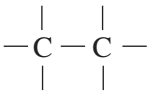
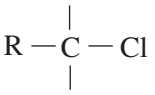
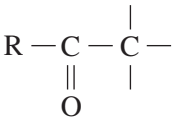
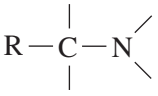
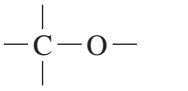
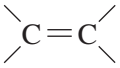
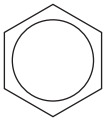
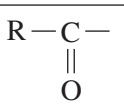
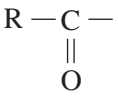
Infrared absorption data

Bond	Wavenumber/cm^{-1}
N—H (amines)	3300–3500
O—H (alcohols)	3230–3550 (broad)
C—H	2850–3300
O—H (acids)	2500–3000 (very broad)
C≡N	2220–2260
C═O	1680–1750
C═C	1620–1680
C—O	1000–1300
C—C	750–1100

^{13}C NMR chemical shift data

Type of carbon	δ/ppm
	5–40
 Cl or Br	10–70
	20–50
	25–60
 alcohols, ethers or esters	50–90
	90–150
R—C≡N	110–125
	110–160
 esters or acids	160–185
 aldehydes or ketones	190–220

UV absorption

(This is not a definitive list and is approximate.)

Chromophore	λ_{max} (nm)
C—H	112
C—C	135
C═C	162

Chromophore	λ_{max} (nm)
C≡C	173 178 196 222
C—Cl	173
C—Br	208

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Some standard potentials

$K^+ + e^-$	$\rightleftharpoons$	$K(s)$	–2.94 V
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	$Ba(s)$	–2.91 V
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	$Ca(s)$	–2.87 V
$Na^+ + e^-$	$\rightleftharpoons$	$Na(s)$	–2.71 V
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	$Mg(s)$	–2.36 V
$Al^{3+} + 3e^-$	$\rightleftharpoons$	$Al(s)$	–1.68 V
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	$Mn(s)$	–1.18 V
$H_2O + e^-$	$\rightleftharpoons$	$\frac{1}{2} H_2(g) + OH^-$	– 0.83 V
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	$Zn(s)$	– 0.76 V
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	$Fe(s)$	– 0.44 V
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	$Ni(s)$	– 0.24 V
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	$Sn(s)$	– 0.14 V
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	$Pb(s)$	– 0.13 V
$H^+ + e^-$	$\rightleftharpoons$	$\frac{1}{2} H_2(g)$	0.00 V
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(aq) + 2H_2O$	0.16 V
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	$Cu(s)$	0.34 V
$\frac{1}{2} O_2(g) + H_2O + 2e^-$	$\rightleftharpoons$	$2OH^-$	0.40 V
$Cu^+ + e^-$	$\rightleftharpoons$	$Cu(s)$	0.52 V
$\frac{1}{2} I_2(s) + e^-$	$\rightleftharpoons$	I^-	0.54 V
$\frac{1}{2} I_2(aq) + e^-$	$\rightleftharpoons$	I^-	0.62 V
$Fe^{3+} + e$	$\rightleftharpoons$	Fe^{2+}	0.77 V
$Ag^+ + e^-$	$\rightleftharpoons$	$Ag(s)$	0.80 V
$\frac{1}{2} Br_2(l) + e^-$	$\rightleftharpoons$	Br^-	1.08 V
$\frac{1}{2} Br_2(aq) + e^-$	$\rightleftharpoons$	Br^-	1.10 V
$\frac{1}{2} O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O	1.23 V
$\frac{1}{2} Cl_2(g) + e^-$	$\rightleftharpoons$	Cl^-	1.36 V
$\frac{1}{2} Cr_2O_7^{2-} + 7H^+ + 3e^-$	$\rightleftharpoons$	$Cr^{3+} + \frac{7}{2} H_2O$	1.36 V
$\frac{1}{2} Cl_2(aq) + e^-$	$\rightleftharpoons$	Cl^-	1.40 V
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	1.51 V
$\frac{1}{2} F_2(g) + e^-$	$\rightleftharpoons$	F^-	2.89 V

Aylward and Findlay, *SI Chemical Data* (5th Edition) is the principal source of data for the standard potentials. Some data may have been modified for examination purposes.

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PERIODIC TABLE OF THE ELEMENTS

KEY

atomic number
symbol
standard atomic weight
name

79 Au 197.0 gold

1 H 1.008 hydrogen																	**2 He** 4.003 helium
3 Li 6.941 lithium	**4 Be** 9.012 beryllium											**5 B** 10.81 boron	**6 C** 12.01 carbon	**7 N** 14.01 nitrogen	**8 O** 16.00 oxygen	**9 F** 19.00 fluorine	**10 Ne** 20.18 neon
11 Na 22.99 sodium	**12 Mg** 24.31 magnesium											**13 Al** 26.98 aluminium	**14 Si** 28.09 silicon	**15 P** 30.97 phosphorus	**16 S** 32.07 sulfur	**17 Cl** 35.45 chlorine	**18 Ar** 39.95 argon
19 K 39.10 potassium	**20 Ca** 40.08 calcium	**21 Sc** 44.96 scandium	**22 Ti** 47.87 titanium	**23 V** 50.94 vanadium	**24 Cr** 52.00 chromium	**25 Mn** 54.94 manganese	**26 Fe** 55.85 iron	**27 Co** 58.93 cobalt	**28 Ni** 58.69 nickel	**29 Cu** 63.55 copper	**30 Zn** 65.38 zinc	**31 Ga** 69.72 gallium	**32 Ge** 72.64 germanium	**33 As** 74.92 arsenic	**34 Se** 78.96 selenium	**35 Br** 79.90 bromine	**36 Kr** 83.80 krypton
37 Rb 85.47 rubidium	**38 Sr** 87.61 strontium	**39 Y** 88.91 yttrium	**40 Zr** 91.22 zirconium	**41 Nb** 92.91 niobium	**42 Mo** 95.96 molybdenum	**43 Tc** technetium	**44 Ru** 101.1 ruthenium	**45 Rh** 102.9 rhodium	**46 Pd** 106.4 palladium	**47 Ag** 107.9 silver	**48 Cd** 112.4 cadmium	**49 In** 114.8 indium	**50 Sn** 118.7 tin	**51 Sb** 121.8 antimony	**52 Te** 127.6 tellurium	**53 I** 126.9 iodine	**54 Xe** 131.3 xenon
55 Cs 132.9 caesium	**56 Ba** 137.3 barium	**57–71** lanthanoids	**72 Hf** 178.5 hafnium	**73 Ta** 180.9 tantalum	**74 W** 183.9 tungsten	**75 Re** 186.2 rhenium	**76 Os** 190.2 osmium	**77 Ir** 192.2 iridium	**78 Pt** 195.1 platinum	**79 Au** 197.0 gold	**80 Hg** 200.6 mercury	**81 Tl** 204.4 thallium	**82 Pb** 207.2 lead	**83 Bi** 209.0 bismuth	**84 Po** polonium	**85 At** astatine	**86 Rn** radon
87 Fr francium	**88 Ra** radium	**89–103** actinoids	**104 Rf** rutherfordium	**105 Db** dubnium	**106 Sg** seaborgium	**107 Bh** bohrium	**108 Hs** hassium	**109 Mt** meitnerium	**110 Ds** darmstadtium	**111 Rg** roentgenium	**112 Cn** copernicium	**113 Nh** nihonium	**114 Fl** flerovium	**115 Mc** moscovium	**116 Lv** livermorium	**117 Ts** tennessine	**118 Og** oganesson

Lanthanoids

57 La 138.9 lanthanum	**58 Ce** 140.1 cerium	**59 Pr** 140.9 praseodymium	**60 Nd** 144.2 neodymium	**61 Pm** promethium	**62 Sm** 150.4 samarium	**63 Eu** 152.0 europium	**64 Gd** 157.3 gadolinium	**65 Tb** 158.9 terbium	**66 Dy** 162.5 dysprosium	**67 Ho** 164.9 holmium	**68 Er** 167.3 erbium	**69 Tm** 168.9 thulium	**70 Yb** 173.1 ytterbium	**71 Lu** 175.0 lutetium

Actinoids

89 Ac actinium	**90 Th** 232.0 thorium	**91 Pa** 231.0 protactinium	**92 U** 238.0 uranium	**93 Np** neptunium	**94 Pu** plutonium	**95 Am** americium	**96 Cm** curium	**97 Bk** berkelium	**98 Cf** californium	**99 Es** einsteinium	**100 Fm** fermium	**101 Md** mendelevium	**102 No** nobelium	**103 Lr** lawrencium

Standard atomic weights are abridged to four significant figures.
Elements with no reported values in the table have no stable nuclides.
Information on elements with atomic numbers 113 and above is sourced from the International Union of Pure and Applied Chemistry Periodic Table of the Elements (November 2016 version).
The International Union of Pure and Applied Chemistry Periodic Table of the Elements (February 2010 version) is the principal source of all other data. Some data may have been modified.

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Trial Examination 2021

HSC Year 12 Chemistry

DIRECTIONS:

Write your name in the space provided.
Write your student number in the boxes provided below. Then, in the columns of digits below each box, fill in the oval which has the same number as you have written in the box. Fill in **one** oval only in each column.
Read each question and its suggested answers. Select the alternative A, B, C, or D that best answers the question. Fill in the response oval completely, using blue or black pen. Mark only **one oval** per question.

A ○ B ● C ○ D ○

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ● B ⊗ C ○ D ○

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and draw an arrow as follows.

correct ↓

A ⊗ B ⊗ C ○ D ○

STUDENT NAME: _____

STUDENT NUMBER:

1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9
0	0	0	0	0	0	0	0	0

SECTION I
MULTIPLE-CHOICE ANSWER SHEET

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

STUDENTS SHOULD NOW CONTINUE WITH SECTION II

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