

Student name

CHEMISTRY

Unit 1

Trial Examination

QUESTION AND ANSWER BOOK

Total writing time: 1 hour 30 minutes

Structure of book

Area	Number of questions	Number of questions to be answered	Number of marks	Suggested times (minutes)
A	20	20	20	20
B	9	9	70	70
Total			90	90

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, an approved graphics calculator (memory cleared) and/or one scientific calculator.
- Students are NOT permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.

Materials supplied

- Question and answer book of 17 pages, with a detachable data sheet in the centrefold and a detachable answer sheet for multiple-choice questions inside the front cover.

Instructions

- Detach the data sheet from the centre of this book and the answer sheet for multiple-choice questions during reading time.
- Write your **name** in the space provided above on this page and on the answer sheet for multiple-choice questions.
- All written responses should be in English.

At the end of the examination

- Place the answer sheet for multiple-choice questions inside the front cover of this book.

SECTION A

Specific instructions for Section A

Section A consists of 20 multiple choice questions. Section A is worth approximately 22 per cent of the marks available. You should spend approximately 20 minutes on Section A.

Choose the response that is **correct** or **best answers the question**, and mark your choice on the multiple choice answer sheet according to the instructions on that sheet.

A correct answer is worth 1 mark, an incorrect answer is worth no marks. No mark will be given if more than one answer is shown for any question. Marks will **not** be deducted for incorrect answers. You should attempt every question.

Question 1

When compared to the particles in a gas, the particles in a solid are likely to be

- A. further apart and moving more rapidly in a random fashion.
- B. further apart and moving more slowly about fixed positions.
- C. closer together and moving more rapidly in a random fashion.
- D. closer together and moving more slowly about fixed positions.

Question 2

Which of the alternatives contains a pair of isotopes?

- A. diamond and graphite
- B. ^{18}O and ^{18}F
- C. ^{14}N and ^{31}P
- D. ^3He and ^4He

Question 3

The two species that contain the same number of electrons are

- A. F and Cl
- B. Fe^{2+} and Co^{3+}
- C. Ne and Ar
- D. F^- and K^+

Question 4

The pair of species that has the greatest similarities in chemical properties is

- A. ^{23}Na and $^{23}\text{Na}^+$
- B. ^{39}K and ^{23}Na
- C. ^{23}Na and ^{22}Na
- D. ^{23}Na and ^{23}Mg

Question 5

Silicon has been the element at the forefront of microchip technology. In the periodic table, silicon is located in

- A. Period 3 Group IV
- B. Period 3 Group VI
- C. Period 4 Group IV
- D. Period 4 Group VI

Question 6

An element towards the bottom left hand corner of the periodic table will tend to have:

- A. metallic character and a high electronegativity.
- B. metallic character and a low electronegativity.
- C. non-metallic character and a high electronegativity.
- D. non-metallic character and a low electronegativity.

Question 7

Element X has three valence electrons and element Y has six valence electrons. The likely formula of the ionic substance formed from X and Y is:

- A. XY
- B. XY₂
- C. X₂Y
- D. X₂Y₃

Question 8

Dispersion forces exist in all substances. The other types of chemical bonding present in an aqueous **solution** of sodium chloride are

- A. ionic and covalent only.
- B. ionic and hydrogen bonding only.
- C. ion-dipole, covalent and hydrogen bonding only.
- D. ion-dipole, ionic, hydrogen bonding and covalent only.

Question 9

The process whereby an ionic substance dissolves in water is known as

- A. precipitation.
- B. hydrolysis.
- C. ionisation.
- D. dissociation.

Question 10

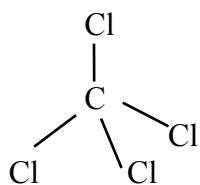
The pair of species listed that does **not** contain the same number of electrons is

- A. CO_3^{2-} and SO_2
- B. NH_4^+ and O^{2-}
- C. CH_4 and SiH_4
- D. H_2S and PH_3

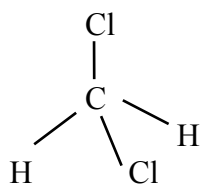
Question 11

Which of the following structural formulae represents a polar molecule?

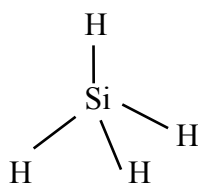
A



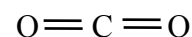
B



C



D

**Question 12**

The fourth member of the **alkene** homologous series has the molecular formula:

- A. C_4H_8
- B. C_4H_{10}
- C. C_5H_{10}
- D. C_5H_{12}

Question 13

Hydrocarbons may be used as fuels. Incomplete combustion of hydrocarbons leads to the formation of black smoke. The higher the ratio of carbon atoms to hydrogen atoms in a hydrocarbon, the greater amount of smoke that forms when it is burned. Equal amounts of each of the hydrocarbons below is burnt.

Which would produce the most black smoke when burnt?

- A. ethane
- B. pentene
- C. butane
- D. hexane

Question 14

Which one of the following groups contains substances that are all members of the same homologous series?

- A. $\text{CH}_3\text{CH}_2\text{CH}=\text{CH}_2$, $\text{CH}_3\text{CH}=\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$
 B. $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$, $\text{CH}_3\text{CH}_2\text{CHCl}_2$, $\text{CH}_3\text{CH}_2\text{CCl}_3$
 C. $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, $\text{CH}_3\text{CH}_2\text{COOH}$, $\text{CH}_3\text{CH}_2\text{OCH}_3$
 D. $\text{CH}_3\text{CH}_2\text{CH}_3$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$

Question 15

In an investigation of precipitation reactions, a student mixed sets of three solutions and observed whether precipitates formed. The results are shown in the table below.

Test	Solutions mixed	Precipitate formed
1	Calcium bromide Copper(II) nitrate Sodium iodide	No
2	Calcium iodide Copper(II) sulfate Sodium nitrate	Yes

The ionic equation for the formation of the precipitate in the second test is

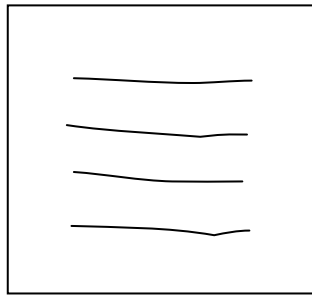
- A. $\text{Cu}^{2+}_{(\text{aq})} + 2\text{I}^{-}_{(\text{aq})} \rightarrow \text{CuI}_{2(\text{s})}$
 B. $2\text{Na}^{+}_{(\text{aq})} + \text{SO}_4^{2-}_{(\text{aq})} \rightarrow \text{Na}_2\text{SO}_{4(\text{s})}$
 C. $\text{Ca}^{2+}_{(\text{aq})} + \text{SO}_4^{2-}_{(\text{aq})} \rightarrow \text{CaSO}_{4(\text{s})}$
 D. $\text{Cu}^{2+}_{(\text{aq})} + 2\text{NO}_3^{-}_{(\text{aq})} \rightarrow \text{Cu}(\text{NO}_3)_{2(\text{s})}$

Question 16

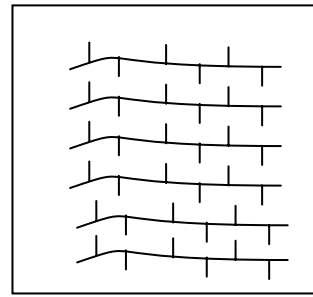
A variety of 'light' beer contains 2.70 % *m/v* alcohol. If a person were to drink **two** 375 mL bottles, the mass of alcohol consumed would be closest to

- A. 5.40 g.
 B. 10.1 g.
 C. 10.8 g.
 D. 20.3 g.

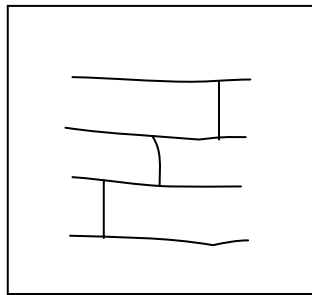
Questions 17 and 18 refer to the representations of the four plastics A to D.



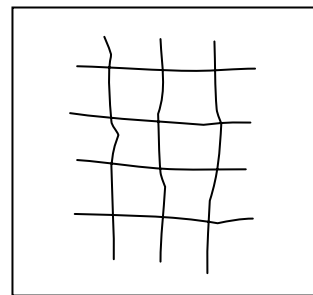
Plastic A



Plastic B



Plastic C



Plastic D

Question 17

The plastic material most likely to be a thermosetting plastic is

- A. Plastic A.
- B. Plastic B.
- C. Plastic C.
- D. Plastic D.

Question 18

The plastic material most likely to exhibit the greatest elasticity is

- A. Plastic A.
- B. Plastic B.
- C. Plastic C.
- D. Plastic D.

Question 19

Water wets clean glass because

- A. glass has a relatively low surface energy and is hydrophobic.
- B. glass has a relatively low surface energy and is hydrophilic.
- C. glass has a relatively high surface energy and is hydrophobic.
- D. glass has a relatively high surface energy and is hydrophilic.

Question 20

Which one of the following would be most useful as a surfactant?

- A. CH_3COONa
- B. $\text{CH}_3\text{CH}_2\text{COOK}$
- C. $\text{CH}_3(\text{CH}_2)_{16}\text{COONa}$
- D. $\text{C}_6\text{H}_5\text{SO}_3\text{Na}$

END OF SECTION A

SECTION B**Specific instructions for Section B**

Section B consists of nine short answer questions numbered 1 to 9; you must answer all of these questions. This section is worth 70 marks which is approximately 78 per cent of the total. You should spend approximately 70 minutes on this section.

The marks allotted to each question and the suggested times are shown at the end of each question.

Questions must be answered in the spaces provided in this book.

To obtain full marks for your response you should

- give simplified answers with an appropriate number of significant figures for all numerical questions; unsimplified answers will not be given full marks.
- show all working in your answers to numerical questions. No credit will be given for an incorrect answer unless it is accompanied by details of the working.
- make sure all chemical equations are balanced and that the formulas for individual substances include an indication of state (for example, $\text{H}_2(\text{g})$; $\text{NaCl}(\text{s})$).

Question 1

During your studies of Chemistry this semester, you should have encountered the following types of bonding – ionic, metallic, covalent molecular, covalent network lattice and covalent layer lattice.

The following table contains information about four different materials. Use this data to identify the type of bonding that exists in each of the materials. Write your answer in the appropriate space.

Material	Properties	Type of bonding
A	This material melts at 1410 °C and boils at 2680 °C, is insoluble in water and does not conduct electricity as a solid or a liquid.	
B	This material does not conduct electricity in any state and has a melting point of -101 °C.	
C	This material melts at 455 °C, is insoluble in water, will conduct electricity in the molten state but not its solid state.	
D	This material melts at a temperature of 64 °C and conducts electricity in the solid and molten state.	

(4 marks)
(Suggested time: 4 minutes)

(c) Give the electron shell arrangement for

(i) element G _____

(ii) the ion D^{2+} _____

(iii) the **anion** formed from element L _____

(7 + 1 + 3 = 11 marks)
(Suggested time: 11 minutes)

Question 3

The chemical represented by molecular formula, $C_4H_8O_2$, is present in rancid butter.

(a) There are several isomers with the molecular formula $C_4H_8O_2$. What is meant by the term **isomers**?

(b) Given that the chemical in the rancid butter is also a straight chain carboxylic acid, write the semi-structural formula of the chemical.

(c) Draw the full structure (showing bonds) of another carboxylic acid with formula $C_4H_8O_2$

(1 + 2 + 1 = 4 marks)
(Suggested time: 4 minutes)

Question 4 Complete the following table.

Name of compound	Formula of compound
magnesium sulfide	
	$\text{Fe}_2(\text{Cr}_2\text{O}_7)_3$
copper(II) nitrate	
	$\text{Al}_2(\text{SO}_3)_3$
2-chloropropane	semi-structural formula only required
	C_6H_{12}
	$\text{C}_3\text{H}_7\text{OH}$
pentanoic acid	semi-structural formula only required
	$\text{ClCH}_2\text{CHCHCH}_2\text{CH}_3$

(9 marks)
(Suggested time: 9 minutes)

Question 5

Magnesium is a metallic element whereas fluorine, is a non-metallic element. When the elements react together magnesium fluoride is formed.

- (a) Give the electron shell arrangement of a magnesium atom.

- (b) Describe

- (i) the structure of magnesium.

- (ii) the bonding found in magnesium.

- (c) List two physical properties you would expect magnesium to show.

- (i)

- (ii)

- (d) Explain each of these properties in terms of the structure and/or bonding found in magnesium.

- (e) Give the electron shell arrangement of fluorine.

(f) (i) Describe the structure of fluorine gas.

(ii) Describe the bonding type(s) that exists in fluorine if it were in the liquid state.

(g) (i) In terms of the electron arrangements, describe what happens when magnesium and fluorine react.

(ii) Write down the formula for the substance formed.

(h) Name the bonding present in magnesium fluoride.

(1 + 2 + 2 + 2 + 1 + 3 + 3 + 1 = 15 marks)
(Suggested time: 15 minutes)

Question 6

(a) Draw a structural formula (showing all lone pairs on the central atom) for each of the following molecules and name the shape of the molecule.

Molecule	Structural formula	Name of Shape
PH_3		
SiCl_4		
SF_2		

- (b) For the three molecules indicated, state whether the molecule is polar or non-polar and briefly justify your choice.

PH_3

SiCl_4

SF_2

(6 + 3 = 9 marks)
(Suggested time: 9 minutes)

Question 7

In a ski lodge, a student notices that there is an instruction over the sink that reads

“Leave water tap dripping over the winter period to prevent pipes from freezing.”

- (a) What would be the problem if the pipes froze?

- (b) Explain why this problem would occur based on your knowledge of the properties and structures of water.

Another problem that lodges in the snowfields face is that at the low temperatures that occur over winter, ionic compounds become less soluble and can precipitate out, eventually clogging pipes. In one of these situations, zinc nitrate solution (dissolved off the galvanised iron roof) mixes with sodium carbonate solution (which is in the ground water) in a drainpipe.

- (c) (i) Write a balanced overall equation for the precipitation reaction which occurs.

- (ii) Write an ionic equation for this precipitation reaction.

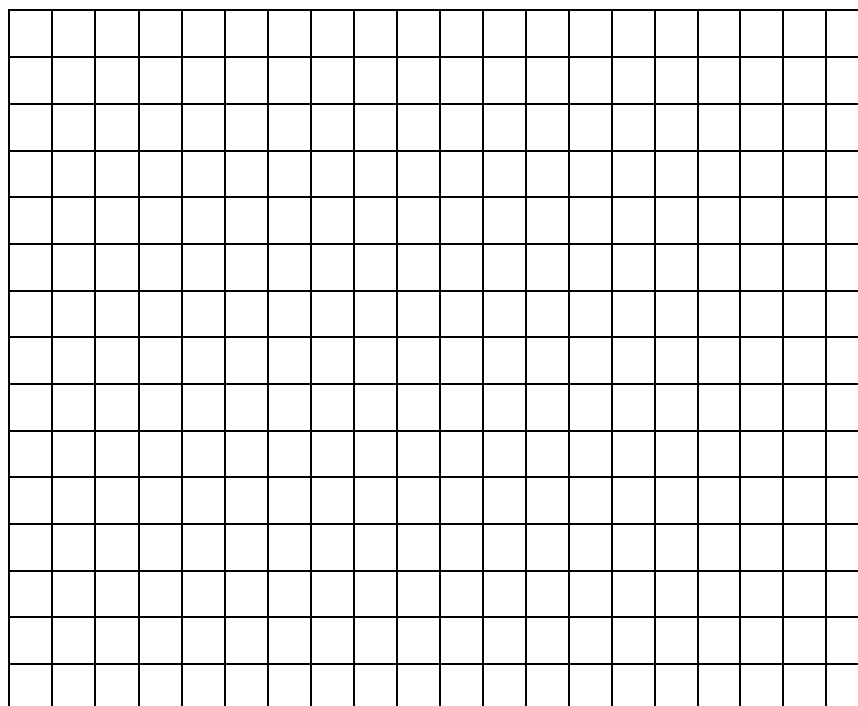
(1 + 2 + 4 = 7 marks)
(Suggested time: 7 minutes)

Question 8

- (a) A group of students were attempting to construct the solubility curve (grams of solid dissolved per 100 g of solvent versus temperature) for sodium nitrate. To achieve this they placed various masses of solid sodium nitrate into test tubes and then added 20.0 g of water. The mixtures were slowly heated with stirring and the temperature recorded when all of the solid was dissolved. This data is shown in the table below.

m(NaNO₃)(g)	Temperature (°C)	g(solute)/100g solvent
14.0	24	
16.2	36	
21.0	48	
24.0	58	
25.0	66	
28.0	75	
30.0	81	

- (i) Using the data provided, complete the third column of the table and draw the solubility curve for sodium nitrate on the grid below. Clearly label both axes.



- (ii) From the solubility curve determine the minimum mass of solid sodium nitrate required to produce 500 g of a saturated solution at 60°C.

- (b) A laboratory technician diluted 400 mL of a 5.0 % m/v solution of hydrogen peroxide with distilled water until the final volume of the solution was 8.0 L.

What is the new concentration, expressed as a percentage m/v, of the hydrogen peroxide?

(4 + 2 = 6 marks)
(Suggested time: 6 minutes)

Question 9

Write balanced chemical equations for each of the following.

- (a) Pentane vapour burns in a plentiful supply of air.

- (b) Chromium metal burns in oxygen gas to produce chromium(III) oxide.

(5 marks)
(Suggested time: 5 minutes)

END OF EXAMINATION