Victorian Certificate of Education

CHEMISTRY 2026 Unit 1

SAC 1 AOS 1 Outcome 1

Reading time: 5 minutes

Writing time: 70 minutes

Directions to students

Student's Name: _____

Teacher: _____

Structure of booklet

Section	Question to be answered	Total marks
Multiple choice	20	20
Short answer	5	50
	Total	70

Materials

- Students are permitted to bring into the examination room: pencils, highlighters, erasers, sharpeners, rulers, and an approved scientific calculator.

- Students are NOT permitted to bring into the examination room:
white out liquid/tape, phones or electronic devices, including smart watches.

- Students are provided with the following: Question and answer book of 16 pages and VCAA Data booklet.

The task

- Please ensure that you write your name and teacher's name on this booklet. This paper consists of short answer questions and 20 multiple choice questions.

- There are a total of 70 marks available.

- Be sure to include states with all chemical equations.

- All numerical answers need to be quoted to the correct number of significant figures.

- All working out must be shown in the space provided.

Multiple choice answer sheet. Circle one correct response

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

1. Which element has the highest first ionization energy?
   a) Sulfur
   b) Phosphorus
   c) Chlorine
   d) Argon

2. Using electrostatic repulsion, which species would be expected to have the largest radius?
   a) Na
   b) Na^+
   c) Cl
   d) Cl^-

3. Which species has the smallest electronegativity difference with hydrogen?
   a) Fluorine
   b) Chlorine
   c) Oxygen
   d) Nitrogen

4. Which option below has the elements in order of increasing reactivity from left to right, where left is the lowest and right has the highest reactivity.

   a) Be, Mg, Sr, Ra
   b) Cs, Rb, Na, Li
   c) Ra, Ba, Ca, Be
   d) K, Ca, Mg, Be

5. Consider the subshell electronic configurations of the neutral elements shown below?
   i. $1s^2,\ 2s^2,\ 2p^6,\ 3s^2,\ 3p^6,\ 3d^5, 4s^1$
   ii. $1s^2,\ 2s^2,\ 2p^6,\ 3s^2,\ 3p^6, 3d^{10}, 4s^1$
   iii. $1s^2, 2s^2,\ 2p^6,\ 3s^1,\ 3p^2$
   iv. $1s^2,\ 2s^2,\ 2p^6,\ 3s^2,\ 3p^6, 3d^6, 4s^2$
   v. $1s^2,\ 2s^2,\ 2p^6,\ 3s^2,\ 3p^6, 3d^6, 4s^1, 4p^1$

   Which of the above are in an excited state not at ground state?
   a) i, ii and iv only
   b) i, ii, iii, iv and v
   c) i, ii and v only
   d) v and iii only

6. Below are the electronic configurations of 4 ions.
   i. $1s^2,\ 2s^2,\ 2p^6,\ 3s^2,\ 3p^6$
   ii. $1s^2,\ 2s^2,\ 2p^6$
   iii. $1s^2,\ 2s^2,\ 2p^6,\ 3s^2,\ 3p^6$
   iv. $1s^2,\ 2s^2,\ 2p^6,\ 3s^2,\ 3p^6,\ 3d^9$

   Which option below best relates the ion to the electronic configuration.

   a) i belongs to Ar^{2+}
   b) ii. belongs to Al^{2+}
   c) iii. belongs to Mg^{+}
   d) iv. belongs to Cu^{2+}

The information below relates to questions 7 - 9
Consider the four molecular substances listed below.
CH_3NH_2, NH_3, CO_2, HCl

7. Which compound has the lowest boiling temperature

   a) CH_3NH_2
   b) CO_2
   c) NH_3
   d) HCl

8. Which are symmetrical molecules?

   a) CH_3NH_2 and NH_3 only
   b) CO_2 only
   c) NH_3 and CO_2 only
   d) HCl and CO_2 only

9. Liquid propane ($CH_3CH_2CH_3$) can dissolve fully in:
   a) $CH_3NH_2(l)$
   b) $CO_2(l)$
   c) $NH_3(l)$
   d) HCl(l)

The following information shown in fig. 1 relates to questions 10 – 13

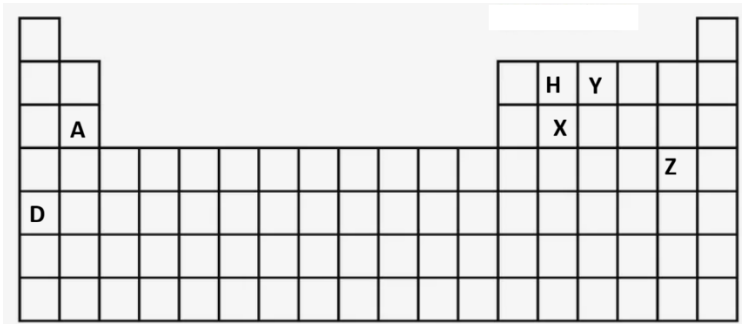


Figure 1 – Periodic table showing the position of 6 elements

10. A new substance is formed from the reaction between elements Y and Z. Which one of the following options is true?
    a) The substance has the formula YZ_4 and has weak dispersion forces as the only intermolecular force present.
    b) The substance has the formula ZY_3 and has weak dispersion forces as well as dipole-dipole interactions.
    intermolecular forces present.
    c) The substance has the formula ZY and forms a strong 3-dimenional network lattice of positive and negative ions.
    d) The substance has the formula YZ_4 with weak dipole-dipole interactions .

11. A new substance is formed from the reaction between elements A and Z. Which one of the following options is true?
    a) The substance will be brittle and conduct electricity in the solid state.
    b) The substance will be a gas at room temperature .
    c) The substance will be malleable and conduct electricity in the solid state.
    d) The substance will be brittle and conduct electricity in the aqueous state.

12. Which one of the following options is true about element H?
    a) Element H has a crystal lattice composed of covalent bonds only.
    b) Element H has a crystal lattice composed of positive and negative ions.
    c) Element H is most likely a gas at room temperature.
    d) Element H has a crystal lattice composed of positive ions and delocalized electrons.

13. The following unknown element has three isotopes. The isotopic mass and the percentage abundance are given below.

Isotope	Isotopic mass (amu)	Percentage abundance
X	45	20
Z	47	65
Y	53	15

The average atomic mass is

a) 49.6 amu
b) 51.5 amu
c) 47.5 amu
d) 52.3 amu

14. Consider the crystal structure of compound Z as shown in fig. 2 on the right.
Which one of the following statements is true regarding the compound.

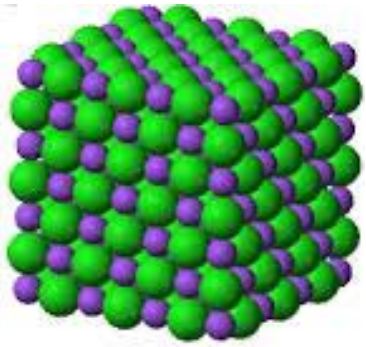


Figure 2 – shows the crystal structure of compound Z

a) It will conduct electricity, in the solid state only, as it is composed of ions.
b) It will have a low melting point as ions will move such that similar charged ions will repel each other.
c) It will be malleable in the solid state and able to be hammered into different shapes.
d) Compound Z exists as a liquid only at relatively high temperatures due to strong electrostatic forces of attraction that exist between particles in the lattice.

The information below is relevant to questions 15-16

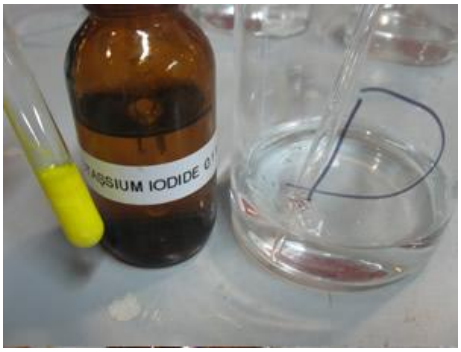


Figure 3 – A yellow precipitate is formed between potassium iodide and a clear solution.

15. Which of the following contaminants is most likely present in the clear solution?
    a) Iron(II) nitrate
    b) Sodium phosphate
    c) Potassium nitrate
    d) Lead(II) nitrate

16. A student suggested that silver nitrate may be present in the clear solution. Which option represents the reaction taking place if silver nitrate was present?
    a) $Ag(NO_3)(aq) + KI((s) \rightarrow AgI(aq) + KNO_3(aq)$
    b) $AgNO_3(aq) + KI((s) \rightarrow AgI(aq) + KNO_3(aq)$
    c) $AgNO_3(aq) + KI((aq) \rightarrow AgI(s) + KNO_3(aq)$
    d) $AgNO_3(aq) + KI((s) \rightarrow AgI(aq) + KNO_3(aq)$

17. Magnesium nitrate solution is mixed with a solution of sodium phosphate. Which option below represents the net ionic equation for this reaction?
    a) $3Mg^{2+}(aq) + 2PO_4^{3-}(aq) \rightarrow Mg_3(PO_4)_2(s)$
    b) $Mg^{2+}(aq) + PO_4^{2-}(aq) \rightarrow MgPO_4(s)$
    c) $2Mg^{2+}(aq) + PO_4^{-}(aq) \rightarrow Mg_2PO_4\ (s)$
    d) $3Mg^{2+}(aq) + 2PO_4^{3-}(s) \rightarrow Mg_3(PO_4)_2(s)$

18. Consider the density toy shown on the right in fig. 4. Which two liquids can be used for this toy to work as it does?

a) C_6H_{14} and H_2O
b) C_9H_{20} and C_8H_{18}
c) NH_3 and H_2O
d) HCl and H_2O

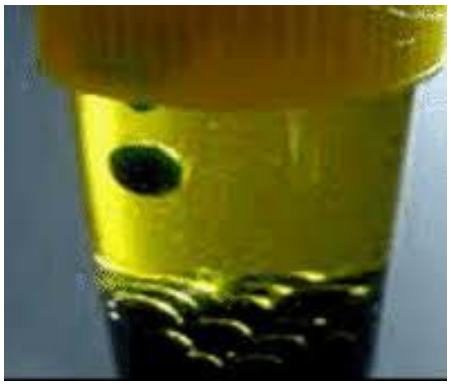


Figure 4 – A density toy

19. Consider the table of reactive metals shown in fig. 5. Which one of the following options is a practical metal to use as a sacrificial anode to protect an iron nail from rusting when placed in water?

a) Zn
b) Fe
c) Tin
d) Na

Figure 5 – Table of reactive metals.

20. Consider the chromatogram shown in fig. 6 of a mixture of dyes. The chromatogram was developed using water as a solvent. What does the chromatogram reveal about the molecules of each dye?

a) The molecules of the blue dye do not dissolve in water
b) The red dye has the most polar molecules
c) The red dye has the most non-polar molecules
d) The green dye has the most polar molecule

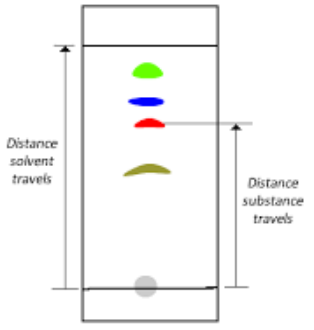


Figure 6 – A chromatogram of a mixture of dyes.

Section B

1. Consider the four molecules SO_3, NH_3, CH_4 and C_2H_6 .
   a. Place the molecules in order of increasing boiling temperature(BP) and give an explanation as to why SO_3 is placed at the top of the list with the highest BP.
   Low _____ , _____ , _____ , _____SO_3 _____High

_____

_____

_____

_____

_____

_____

_____ *3 marks*

   b. Complete the table below by circling the correct response *4 marks*

	SO_3	CH_4	NH_3	O_2
Intermolecular forces	Dispersion forces Dipole-dipole interactions Hydrogen bonding	Dispersion forces Dipole-dipole interactions Hydrogen bonding	Dispersion forces Dipole-dipole interactions Hydrogen bonding	Dispersion forces Dipole-dipole interactions Hydrogen bonding
Intramolecular bonding	Polar covalent Non-polar covalent Ionic	Polar covalent Non-polar covalent Ionic	Polar covalent Non-polar covalent Ionic	Polar covalent Non-polar covalent Ionic

c. Using the molecules HCl and Cl_2, explain how polar and non-polar covalent bonds form and include diagrams of each molecule.

_____

_____

_____

_____

_____

_____ *3 marks*

HCl	Cl_2

d. In the box below clearly draw a labelled diagram of the structure of a Cu metal lattice and use the diagram to explain three properties of metals, malleability, high melting temperatures and heat conductivity.

_____

_____

_____

_____

_____

_____ *4 marks*

e. Aluminium oxide melts at 2072 °C whilst NaCl melts at 801 °C. Explain the difference in melting temperatures between the two compounds.

_____

_____

_____ *2 marks*

f. CO_2 is a small molecule that turns from a solid to a gas (sublimes) at around -75 °C, whilst SiO_2 melts at 1713 °C. Explain why?

_____

_____

_____

_____

_____ *3 marks*

g. Graphite and diamond are made of carbon atoms covalently bonded to each other. Both substances occur naturally. Diamond is extremely strong, used to drill through hard rock whilst graphite is a lubricant for heavy machinery and unlike diamond conducts electricity in the solid state. Explain the difference in properties. Use a diagram in the box provided to assist your explanation.

_____

_____

_____

_____

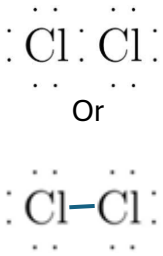
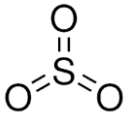
_____

_____

_____ *4 marks*

Diamond	Graphite

2. In the table below, correctly fill the remaining cells. *6 marks*

Formula	Lewis dot diagram	Structural formula	Shape	Symmetry
Cl_2	 Or		*Linear*	Symmetrical Asymmetrical
SO_3				Symmetrical Asymmetrical
NCl_3				Symmetrical Asymmetrical
SO_2				Symmetrical Asymmetrical
CH_4				Symmetrical Asymmetrical

3. Two solutions are mixed as per fig. 8. A red precipitate is formed.

Figure 8 – The precipitate formed when silver nitrate is mixed with sodium dichromate

a. Name the precipitate that is shown in fig.8.

_____ *1 mark*

b. Give the chemical formula of the precipitate.

_____ *1 mark*

c. Give the overall chemical equation for this reaction. States included

_____*3 marks*

d. Give the net ionic equation for the reaction taking place.

_____ *2 marks*

e. In another experiment, two solutions, potassium phosphate and aluminium nitrate are mixed.

i. With reference to your 2026 data booklet suggest why a precipitate is likely to form.

_____

_____ *1 mark*

ii. Give the name and formula of the precipitate

Name _____ *1 mark*

Formula _____ *2 marks*

iii. Identify the spectator ions

_____ *1 mark*

4. Consider the results of a metal displacement experiment conducted in class, shown in fig. 9. It involves metals A, X, B and Y.

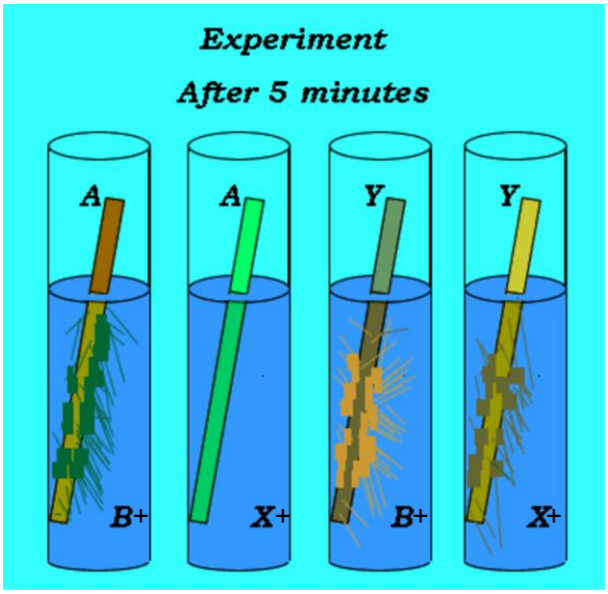


Figure 9 – metal displacement experiment

a. Place the metals in order of increasing reactivity. *1 mark*

Low _____, _____, _____, _____, High

b. A bridge is made of metal X. The bolts holding the beams together are made of metal X. Overtime, the bridge is in need of repair. Explain how the bolts will be impacted and give an explanation based on the experimental results shown in fig. 9.

_____

_____

_____

_____

_____ *3 marks*

5. Consider the two chromatograms shown below in fig. 10. Water was used as the mobile phase. Chromatogram A and B were made from two different brands of black texta.

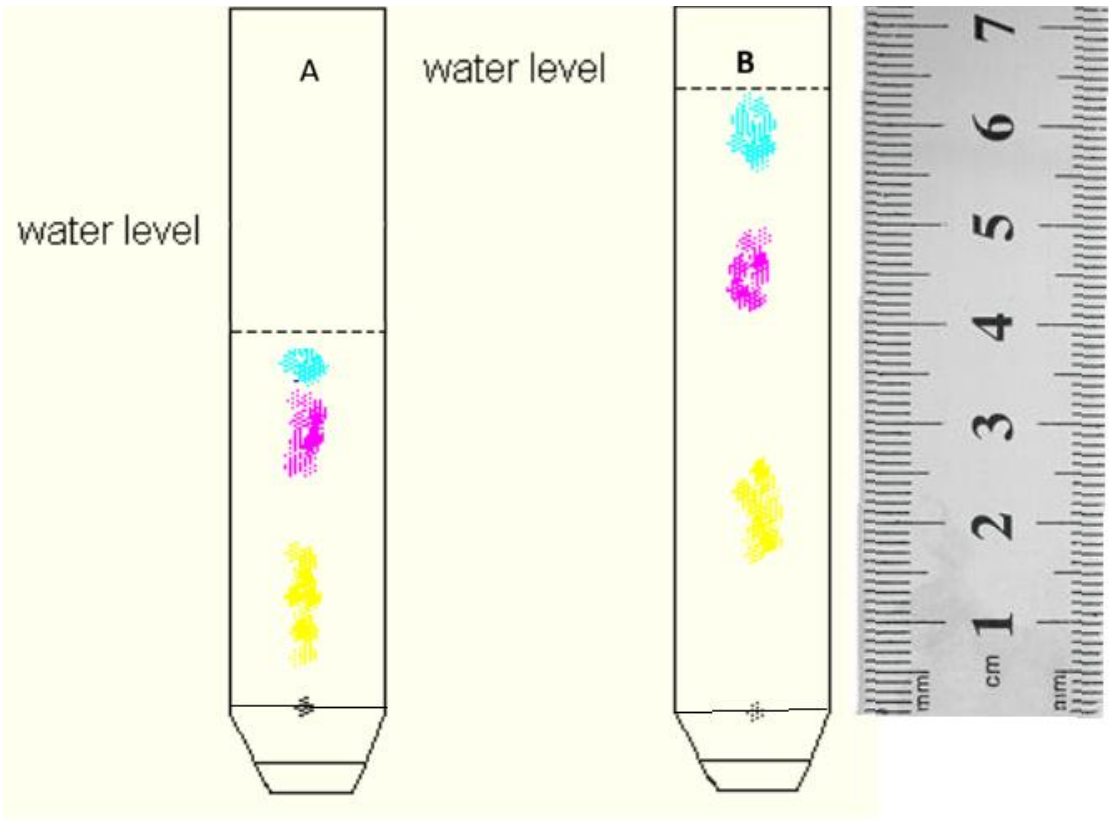


Figure 10 – chromatograms of two different brands of black texta, produced under identical conditions

a) Which colour, if any, appears to be used in both brands of texta. Justify your answer.

_____

_____

_____

_____

_____

_____

_____ *3 marks*

b)

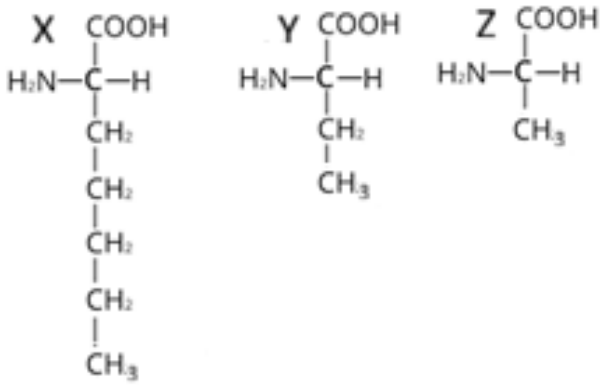


Figure 11 – three molecules that were in the ink that produced chromatogram A.

Associate each molecule in fig. 11 to a colour and justify your answer.

_____

_____

_____

_____

_____

_____

_____ *3 marks*

End of assessment.