STAV PUBLISHING

Student name

CHEMISTRY

Unit 1

Trial Examination

QUESTION AND ANSWER BOOK

Total writing time: 1 hour 30 minutes

Structure of book

Section	Number of questions	Number of marks
A	20	20
B	8	60
	Total	**80**

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers, sharpeners, rulers, an approved 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 11 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.

Published by STAV Publishing. STAV House, 5 Munro Street, Coburg VIC 3058 Australia.
Phone: 61 + 3 9385 3999 • Fax: 61 + 3 9386 6722 • Email: stav@stav.vic.edu.au Website: http://www.sciencevictoria.com.au/stavpublishing

ABN 61 527 110 823

Question 7

When high energy radiation is passed through a sample of sodium vapour, sodium atoms in an excited state are produced. As a consequence the sample then emits yellow light. If this light is passed through a diffraction grating, an emission spectrum is produced consisting of two discrete yellow lines at about 590 nm on a black background.

a. What is meant by 'an excited state'?

1 mark

b. Write a subshell electron configuration for a sodium atom to show an excited state.

1 mark

c. Explain how the lines in the emission spectrum are produced.

3 marks

Total 5 marks

Question 8

A sample of HNO_3 contains twice as many atoms as there are ions in 6.846 g of $Al_2(SO_4)_3$.
Calculate the mass of the HNO_3 in the sample.

6 marks

END OF EXAMINATION

Question 5

Health authorities in many countries support the addition of fluoride ions to water supplies to prevent tooth decay. If the recommended fluoride ion concentration is set at 0.90 mg of fluoride ions per litre of drinking water, calculate

a. i. the amount, in mol, of fluoride ions in 1.0 L of the drinking water.

ii. the number of fluoride ions in 200 mL of the drinking water.

3 marks

b. Sodium fluoride, NaF, is usually the substance added to drinking water to provide the fluoride ions. Determine the mass of sodium fluoride, in grams, that must be in each litre of the water for the concentration of fluoride ions to be 0.90 mg L^{-1}?

3 marks

Total 6 marks

Question 6

Complete the following table.

Name of compound	Formula of compound
calcium nitride	
sodium sulfide	
iron(III) chloride	
	$CH_3CH_2CH_2OH$
	$CH_3CH_2CH(CH_3)CH_3$
	$CH_2CHCH_2CH_3$
3-methylbutanoic acid	semi-structural formula required
	$CH_3CH_2CHClCH_3$

8 marks

STAV Publishing

2009

CHEMISTRY

Unit 1 Trial Examination

MULTIPLE CHOICE ANSWER SHEET

STUDENT NAME:	

INSTRUCTIONS: USE PENCIL ONLY

- Write your name in the space provided above.
- Use a **PENCIL** for **ALL** entries.
- If you make a mistake, **ERASE** it – **DO NOT** cross it out.
- Marks will **NOT** be deducted for incorrect answers.
- **NO MARK** will be given if more than **ONE** answer is completed for any question.
- Mark your answer by **SHADING** the letter of your choice.

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

Question 4

A freshly cut piece of potassium burns in a gas jar containing chlorine gas. A white smoke consisting of potassium chloride is formed and deposited in the gas jar.

a. Write a balanced equation for the reaction between potassium and chlorine.

1 mark

b. With reference to shell electron configuration, explain the changes that occur in both the potassium and chlorine atoms during this reaction.

2 marks

c. The melting point of the potassium chloride formed is much higher than that of chlorine. Use your understanding of structure and bonding of each substance to explain why.

6 marks

Total 9 marks

Question 3

a. Draw a valence diagram (showing all lone electron pairs on the central atom) for each of the following molecules and state the shape of the molecule.

Molecule	Valence diagram	Shape
N_2		
$CHCl_3$		
SF_2		

6 marks

b. For the three molecules indicated, state whether they are polar or non-polar. Briefly justify your response.

N_2 _____

_____

$CHCl_3$ _____

_____

SF_2 _____

_____

3 marks

Total 9 marks

SECTION A – Multiple-choice questions

Instructions for Section A
Answer all questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** or that **best answers** the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No mark will be given if more than one answer is completed for any question.

Question 1

Glen Seaborg contribution to the elements in the periodic table is considerable. He is best known for the

A. discovery of the noble gases
B. discovery of element 106, Sg
C. identification of many trans-uranium elements
D. synthesis of element 51, Sb

Question 2

Which of the following atoms has the greatest number of neutrons?

A. ^{56}Mn
B. ^{56}Ni
C. ^{57}Co
D. ^{58}Fe

Question 3

The electronic configuration of the Mg^{2+} ion is

A. $1s^2 2s^2 2p^6 3s^2$
B. $1s^2 2s^2 2p^6 3s^2 3p^2$
C. $1s^2 2s^2 2p^4$
D. $1s^2 2s^2 2p^6$

Question 4

Nickel is a valuable metal. The number of electrons that are in the outer most occupied subshell of a nickel atom is

A. 2
B. 8
C. 10
D. 18

Question 5

Which of the following ionic compounds would be expected to have the highest melting point?

A. sodium fluoride
B. sodium oxide
C. magnesium chloride
D. magnesium oxide

Question 6

Which of the following molecules is v-shaped (angular)?

A. H_2S
B. PCl_3
C. C_2H_6
D. HCl

Question 7

Which of the following molecules is non-polar?

A. H_2S
B. PCl_3
C. C_2H_6
D. HCl

Question 8

A substance melts at high temperature, is insoluble in water, and does not conduct electricity in both the solid and liquid states. This substance is most likely to be

A. Al
B. O_2
C. CH_4
D. SiO_2

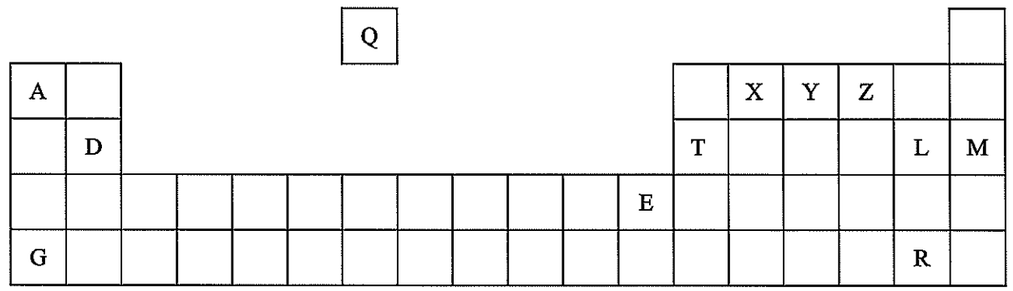
Question 9

When going down Group I, which one of the following occurs?

A. the elements become less reactive
B. the first ionisation energy decreases
C. the atomic radius decreases
D. the attraction between the nucleus and valence electron increases.

Question 2

The diagram below represents the Periodic Table with a selection of elements represented by letters.
Note: these letters are not the actual symbols of these elements.



a. Selecting only from the elements labelled on the Periodic Table above write the letter (A, D, E, G, L, M, Q, R, T, X, Y or Z) corresponding to the element that:

i. is a non-metal with five electrons in its outershell _____

ii. is in Group 13 _____

iii. is a transition element with three fully occupied shells _____

iv. has the highest electronegativity of the elements shown _____

v. is in Period 2 and has a total of three electrons _____

vi. forms an ionic compound with chlorine where the ion of the element has a +2 charge _____

vii. forms molecules containing one atom of the element to three atoms of element Q _____

7 marks

b. Atoms of two elements react to form a compound. Give the chemical formula of the compound formed

i. using the elements A and L. _____

ii. using the elements Z and T. _____

2 marks

c. Give the electron shell arrangement for

i. an atom of element X _____

ii. the cation formed from element D _____

2 marks

Total 11 marks

SECTION B – Short answer questions

Instructions for Section B

Answer **all** questions in the spaces provided.

To obtain full marks for your responses 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 chemical equations are balanced and that the formulas for individual substances include an indication of state; for example, $H_2(g)$; NaCl(s)

Question 1

A sample of the element lithium ($A_r = 6.9$) has two naturally occurring isotopes as shown in the Table below.

Identity of isotope	Relative isotopic mass
Lithium-6	6.015
Lithium-7	7.016

a. Name the instrument used to determine relative isotopic mass.

_____

1 mark

b. What does the term 'relative' refer to?

_____

_____

1 mark

c. Calculate the percentage of Lithium-7 in the above sample.

_____

_____

_____

3 marks

d. Write the full isotopic symbol (nuclide representation) for a Lithium-7 atom. _____

1 mark

Total 6 marks

Question 10

Which of the following would have the largest radius?

A. a sodium atom
B. a sodium ion
C. a potassium atom
D. a potassium ion

Question 11

Some students set out to determine the empirical formula of black copper oxide. They started with 2.65 g of black copper oxide which was then converted in a series of reactions to metallic copper. The mass of dry copper obtained was 2.12 g. The empirical formula of the oxide is

A. CuO
B. Cu_2O
C. Cu_3O_4
D. CuO_2

Question 12

The amount of substance, in mol, of **sodium ions** in 1.64 g of sodium phosphate, Na_3PO_4, (M = 164 g mol^{-1}) is closest to

A. 0.0100
B. 0.0300
C. 1.00
D. 3.00

Question 13

The number of hydrogen atoms present in 2.0 g of CH_4 is

A. 7.5×10^{22}
B. 3.0×10^{23}
C. 1.2×10^{24}
D. 4.8×10^{24}

Question 14

The mass in grams of 0.150 mol of butanoic acid is

A. 9.00
B. 11.1
C. 11.4
D. 13.2

Question 15

All alkenes have

A. only single covalent bonds
B. one or more C/C double covalent bonds
C. similar size and shape molecules
D. no more than one double bond

Question 16

The number of hydrogen atoms present in a molecule of butan-1-ol is

A. 8
B. 9
C. 10
D. 11

Question 17

Which one of the following substances is **not** able to form an addition polymer?

A. $CH_3(CH_2)_5CHCCl_2$
B. $C_2H_2Cl_2$
C. C_2H_3Cl
D. $CH_3CHClCH_2Cl$

Question 18

The number of different structural isomers represented by the formula C_5H_{12} is

A. 2
B. 3
C. 4
D. 5

Question 19

The list below contains **molecular** formulae of three organic compounds.

I. $C_2H_4O_2$
II. C_2H_6O
III. $C_2H_6O_2$

The listed formulae that could represent carboxylic (alkanoic) acids are

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

Question 20

Which of the following substances is expected to have the **highest** boiling point?

A. CH_4
B. C_2H_6
C. CCl_4
D. C_2Cl_6

END OF SECTION A

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CHEMISTRY
Unit 1 Trial Examination

DATA SHEET

Directions to students

Detach this data sheet during reading time.
This data sheet is provided for your reference.

Table of some selected ions

1+		2+		3+	
Silver	Ag^+	Zinc	Zn^{2+}	Iron(III)	Fe^{3+}
Copper(I)	Cu^+	Copper(II)	Cu^{2+}	Chromium(III)	Cr^{3+}
Ammonium	NH_4^+	Mercury(II)	Hg^{2+}		
		Iron(II)	Fe^{2+}		
1-		**2-**		**3-**	
Hydroxide	OH^-	Carbonate	CO_3^{2-}	Phosphate	PO_4^{3-}
Nitrate	NO_3^-	Sulfate	SO_4^{2-}		
Nitrite	NO_2^-	Sulfite	SO_3^{2-}		
Ethanoate	CH_3COO^-	Dichromate	$Cr_2O_7^{2-}$		
Permanganate	MnO_4^-	Hydrogenphosphate	HPO_4^{2-}		
Hydrogencarbonate	HCO_3^-				
Hydrogensulfate	HSO_4^-				

Some electronegativity values

											H 2.1
Li	1.0	Be	1.6	B	2.0	C	2.5	N	3.0	O	3.5	F	4.0
Na	0.9	Mg	1.3	Al	1.6	Si	1.9	P	2.2	S	2.6	Cl	3.2

Approximate Surface energies of some common substances

Substance	Surface energy(in mJ m^{-2})
Copper	1370
Magnesium oxide	1200
Diamond	9820
Paraffin wax	50
Polyethene	32
Teflon	16
Mercury	476
Water	72
Ethanol	22
Heptane	20
Petrol (octane)	20

Periodic table of the elements

Key to table

79 Au 197.0 Gold

– Atomic number
– Symbol of element
– Relative atomic mass
– Name of element

1 H 1.0 Hydrogen																	**2** He 4.0 Helium
3 Li 6.9 Lithium	**4** Be 9.0 Beryllium											**5** B 10.8 Boron	**6** C 12.0 Carbon	**7** N 14.0 Nitrogen	**8** O 16.0 Oxygen	**9** F 19.0 Fluorine	**10** Ne 20.1 Neon
11 Na 23.0 Sodium	**12** Mg 24.3 Magnesium											**13** Al 27.0 Aluminium	**14** Si 28.1 Silicon	**15** P 31.0 Phosphorus	**16** S 32.1 Sulfur	**17** Cl 35.5 Chlorine	**18** Ar 39.9 Argon
19 K 39.1 Potassium	**20** Ca 40.1 Calcium	**21** Sc 44.9 Scandium	**22** Ti 47.9 Titanium	**23** V 50.9 Vanadium	**24** Cr 52.0 Chromium	**25** Mn 54.9 Manganese	**26** Fe 55.9 Iron	**27** Co 58.9 Cobalt	**28** Ni 58.7 Nickel	**29** Cu 63.6 Copper	**30** Zn 65.4 Zinc	**31** Ga 69.7 Gallium	**32** Ge 72.6 Germanium	**33** As 74.9 Arsenic	**34** Se 79.0 Selenium	**35** Br 79.9 Bromine	**36** Kr 83.8 Krypton
37 Rb 85.5 Rubidium	**38** Sr 87.6 Strontium	**39** Y 88.9 Yttrium	**40** Zr 91.2 Zirconium	**41** Nb 92.9 Niobium	**42** Mo 95.9 Molybdenum	**43** Tc 98.1 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 137.4 Barium	**57** La 138.9 Lanthanum	**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 (209) Polonium	**85** At (210) Astatine	**86** Rn (222) Radon
87 Fr (223) Francium	**88** Ra (226) Radium	**89** Ac (227) Actinium	**104** Rf (261) Rutherfordium	**105** Db (262) Dubnium	**106** Sg (263) Seaborgium	**107** Bh (264) Bohrium	**108** Hs (265) Hassium	**109** Mt (268) Meitnerium	**110** Ds (271) Darmstadtium	**111** Rg (272) Roentgenium	**112** Uub	**114** Uuq		**116** Uuh			**118** Uuo

58 Ce 140.1 Cerium	**59** Pr 140.9 Praseodymium	**60** Nd 144.2 Neodymium	**61** Pm (145) Promethium	**62** Sm 150.3 Samarium	**63** Eu 152.0 Europium	**64** Gd 157.2 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 173.0 Ytterbium	**71** Lu 175.0 Lutetium
90 Th 232.0 Thorium	**91** Pa 231.0 Protactinium	**92** U 238.0 Uranium	**93** Np 237.1 Neptunium	**94** Pu (244) Plutonium	**95** Am (243) Americium	**96** Cm (247) Curium	**97** Bk (247) Berkelium	**98** Cf (251) Californium	**99** Es (254) Einsteinium	**100** Fm (257) Fermium	**101** Md (258) Mendelevium	**102** No (255) Nobelium	**103** Lr (260) Lawrencium