Question 9

A household cleaning agent contains a weak base of general formula NaX. 1.00 g of this compound was dissolved in deionised water to make 100.0 mL of solution. 20.00 mL samples of this solution were titrated with 0.100 M HCl (aq) and required an average titre of 24.4 mL of the acid for neutralisation.

a.   **i.** Name the instrument used to take the 20.00 ml samples.

_____

ii. Name the instrument which delivers the titre.

_____

<div align="right">1 + 1 = 2 marks</div>

b.   State the Brönsted – Lowry definition of a base.

_____

_____

<div align="right">1 mark</div>

c.   Determine the molar mass of the base.

_____

_____

_____

_____

_____

_____

_____

<div align="right">4 marks</div>

<div align="right">Total 7 marks</div>

<div align="center">

END OF EXAMINATION

</div>

CHEMISTRY

Unit 2

Trial Examination

QUESTION AND ANSWER BOOK

Total writing time: 1 hour 30 minutes

Student name

Structure of book

Section	Number of questions	Number of marks
A	20	20
B	9	50
Total		**70**

- 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 13 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 – 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

In purifying a sample of water, the most appropriate order of the processes involved is

A.   chlorination, filtering, flocculation, settling

B.   flocculation, settling, filtering, chlorination

C.   settling, flocculation, filtering, chlorination

D.   settling, filtering, flocculation, chlorination

Question 2

The pH of unpolluted rainwater is about 6.0. Which one of the following substances makes the biggest contribution to this pH value?

A. CO_2

B. N_2

C. NO_2

D. O_3

Question 3

A group of students produced a red solution by boiling red cabbage leaves in water. When dilute sodium hydroxide was added to the solution, it turned purple. When dilute hydrochloric acid was added to the red solution, no colour change occurred. Which one of the following, when added to the red solution is most likely to cause a colour change?

A.   cleaning solution containing ammonia

B.   concentrated hydrochloric acid

C.   orange juice

D.   vinegar

Question 8

Aqueous solutions of silver nitrate and sodium sulfide are mixed according to the following equation:

$$2\,AgNO_3\,(aq) \; + \; Na_2S\,(aq) \; \rightarrow \; Ag_2S\,(s) \; + \; 2\,NaNO_3\,(aq)$$
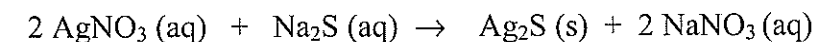
If 100 mL of 0.070 M silver nitrate solution is mixed with 80 mL of 0.075 M sodium sulfide solution:

a.   which reactant is in excess and by what mass, in g?

_____

_____

_____

_____

_____

5 marks

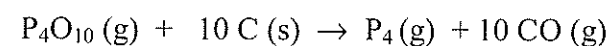b.   what mass, in g, of silver sulfide will precipitate from solution?

_____

_____

_____

3 marks

Total 8 marks

Question 6

In the manufacture of phosphorus, its oxide P_4O_{10} is reacted with carbon according to the equation

$$P_4O_{10}\,(g)\ +\ 10\,C\,(s)\ \rightarrow\ P_4\,(g)\ +10\,CO\,(g)$$

a. Determine the oxidation number of phosphorus in P_4O_{10}.

1 mark

b. What volume of CO at SLC will be produced per gram of phosphorus?

3 marks

Total 4 marks

Question 7

Write balanced half equations for the following conversions (assuming acidic media).

a. $NO_2^-\,(aq)$ $\rightarrow$ $NO_3^-\,(aq)$

2 marks

b. $H_2O_2\,(aq)$ $\rightarrow$ $H_2O\,(l)$

2 marks

c. $(COOH)_2$ $\rightarrow$ $CO_2\,(g)$

2 marks

Total 6 marks

STAV Publishing
2009

CHEMISTRY
Unit 2 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 5

The amount of carbon dioxide in the Earth's atmosphere has risen from 0.03% to 0.04% in recent years. It is believed by many scientists that this increase is causing global warming.

a. Explain, including balanced equations, why carbon dioxide levels have increased markedly in recent years and why they are causing global warming.

_____

_____

_____

_____

_____

_____

3 marks

b.   **i.** Describe the test used in the laboratory to determine the presence of carbon dioxide.

_____

_____

     ii. Write a balanced equation (including states) to explain what is occurring for a positive test in **b. i.** above.

_____

$1 + 1 = 2$ marks

c. Carbon dioxide can be a useful substance in some situations. Name two unrelated uses of carbon dioxide.

_____

_____

2 marks

Total 7 marks

Question 3

A sodium ethanoate, CH_3COONa solution has a pH of 8, while an ammonium chloride, NH_4Cl solution has a pH of 5. Write **ionic** equations to show why:

a.　a solution of CH_3COONa has a pH higher than 7

_____

1 mark

b.　solution of NH_4Cl has a pH lower than 7

_____

1 mark

Total 2 marks

Question 4

A solution contains 2.0 g of NaCl dissolved in 250 mL. Give the concentration of the solution in

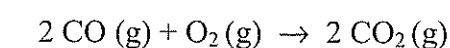**a.**　$mg\ L^{-1}$

_____

1 mark

b.　% (m / v)

_____

1 mark

c.　$mol\ L^{-1}$

_____

2 marks

Total 4 marks

Question 4

Carbon monoxide can be oxidised to carbon dioxide as shown below.

$$2\ CO\,(g) + O_2\,(g)\ \rightarrow\ 2\ CO_2\,(g)$$

3 mol of CO and 2 mol of O_2 are mixed. When the reaction is complete, there will be

A.　4 mol of CO_2 produced

B.　2 mol of CO_2 produced

C.　1 mol of CO unreacted

D.　0.5 mol of O_2 unreacted

Question 5

The burning of sulfur can be represented by the following equation:　$S\,(s)\ +\ O_2\,(g)\ \rightarrow SO_2\,(g)$

Which of the following is closest to the volume, in L, of sulfur dioxide gas that will be released at 25°C and 101.3 kPa when 8.00 g of sulfur is burnt?

A.　3.06

B.　6.11

C.　12.2

D.　24.5

Question 6

Chlorine is used to treat local water supplies in order to

A.　make water suitable for swimming.

B.　kill micro-organisms living in the water.

C.　promote sedimentation of finely suspended solids.

D.　precipitate heavy metal ions such as lead and mercury.

Question 7

50 mL of a 0.200 $mol\ L^{-1}$ solution of sodium hydroxide is diluted to 2.0 L with de-ionised water. What is the pH of the diluted solution?

A.　11.7

B.　12.3

C.　12.7

D.　13.3

Question 8

The mass, in g, of solute required to prepare 1.50 L of 0.080 M $CuSO_4.5H_2O$ will be closest to

A. 3.0

B. 5.0

C. 30

D. 50

Question 9

32 g of oxygen gas contains

A. 6.0×10^{23} atoms

B. 2.0 mol of oxygen molecules

C. 1.2×10^{24} mol of atoms

D. 6.0×10^{23} oxygen molecules

Question 10

If 2.0 mol of $FeCl_3$ dissolves to form an aqueous solution, the total **number** of ions would be

A. 4.0

B. 8.0

C. $4.0 \times 6.02 \times 10^{23}$

D. $8.0 \times 6.02 \times 10^{23}$

Question 11

The pH of an aqueous solution of 0.10 M Na_2HPO_4 was found to be 9.5. The best explanation of this is

A. the Na^+ ions form NaOH in solution.

B. Na_2HPO_4 is an ampholyte.

C. the HPO_4^{2-} preferentially donate protons to water molecules.

D. the HPO_4^{2-} ions preferentially accept protons from water molecules.

1 + 2 = 3 marks

Question 2

Aqueous solutions of barium hydroxide and sulfuric acid are mixed and a reaction occurs.
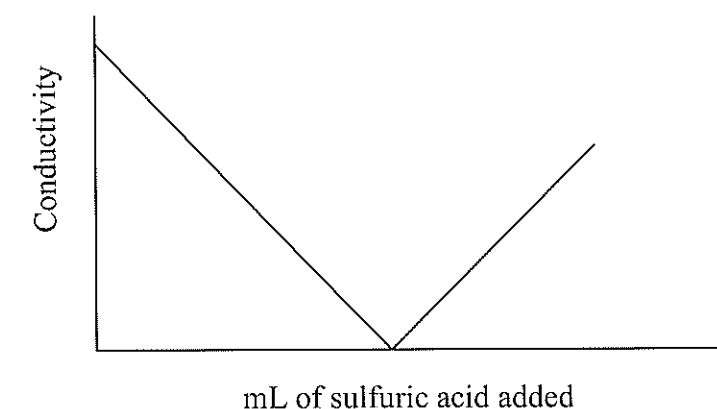
a. Write a balanced overall equation to represent this reaction.

_____

2 marks

b. Name this type of chemical reaction.

_____

1 mark

c. A 20.0 mL sample of barium hydroxide was titrated with 0.12 mol L^{-1} sulfuric acid. The conductivity of the solution was measured throughout the titration and the graph shown below was obtained.

mL of sulfuric acid added

i. What causes the conductivity?

_____

ii. Explain the changes in conductivity shown by the graph.

_____

_____

_____

_____

1 + 2 = 3 marks

Total 6 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 0.10 mol L^{-1} solution of hydrochloric acid has a pH of 1.0, whereas a 0.10 mol L^{-1} solution of citric acid (shown below) has a pH of 1.6.

$$\begin{array}{c} CH_2COOH \\ | \\ HO{-\!\!-}CCOOH \\ | \\ CH_2COOH \end{array}$$
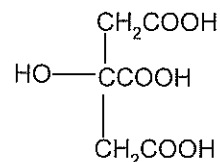
a.   Calculate the concentration of hydronium ions in **each** of the solutions.

_____

_____

_____

2 marks

b.   Explain why the two solutions have different pH values.

_____

_____

_____

_____

_____

_____

4 marks

Total 6 marks

Question 12

When the temperature of 1 L of gas in a syringe is raised from 200°C to 400 °C, and at the same time the pressure is increased from 200 kPa to 400 kPa, the volume will then be

A.   still 1 L.

B.   less than 1 L.

C.   greater than 1 L.

D.   unable to be determined unless more information is given.

Question 13

Under which of the following set of conditions does a real gas behave least ideally?

A.   low pressure and low temperature

B.   low pressure and high temperature

C.   high pressure and low temperature

D.   high pressure and high temperature

Question 14

When zinc powder is added to an aqueous solution of copper(II) sulfate, the powder quickly becomes coated with copper metal. This is because

A.   zinc metal is an oxidant and Cu^{2+} (aq) is a reductant.

B.   zinc metal is a stronger oxidant than Cu^{2+} (aq).

C.   zinc metal is a reductant and Cu^{2+} (aq) is an oxidant.

D.   zinc metal is reduced and Cu^{2+} (aq) is oxidised.

Question 15

When the following pairs of substances are mixed, which will react spontaneously?

A. Sn^{2+} (aq) and Fe^{2+} (aq)

B. Ni^{2+} (aq) and Sn^{2+} (aq)

C. Zn^{2+} (aq) and Fe^{2+} (aq)

D.   Ni (s) and Sn^{2+} (aq)

Question 16

The oxidation number of the Cr atoms in $Na_2Cr_2O_7$ is

A.   - 4

B.   - 6

C.   +4

D.   +6

Question 17

Given the equation $CaCO_3 (s) + 2 HCl (aq) \rightarrow CaCl_2 (aq) + CO_2 (aq) + H_2O (l)$

The minimum volume, in mL, of 2.0 M HCl(aq) that is required to dissolve 10 g of calcium carbonate is closest to

A.   50

B.   100

C.   150

D.   200

Question 18

Gaseous hydrogen chloride consists of molecules. The best evidence that an aqueous solution of hydrogen chloride is not composed of the same particles as the gas is

A.   the dissolving of HCl in water is accompanied by a substantial temperature rise.

B.   HCl (aq) is a good conductor of electricity whereas water is a poor conductor.

C.   HCl (aq) turns blue litmus paper red whereas neither dry hydrogen chloride nor water has any effect on blue litmus paper.

D.   HCl is evolved when concentrated hydrochloric acid is boiled.

Question 19

Which one of the following processes does **not** involve reduction?

A.   photosynthesis

B.   respiration

C.   magnesium reacting with chlorine

D.   ozone being converted to oxygen gas

Question 20

Each of the following represents a redox reaction. In which of the following is the bolded substance acting as a reducing agent?

A. $ZnO (s) + \textbf{CO} (g) \rightarrow Zn (s) + CO_2 (g)$

B. $Cu (s) + \textbf{N}_2\textbf{O} (g) \rightarrow CuO (s) + N_2 (g)$

C. $3Cu (s) + \textbf{N}_2 (g) \rightarrow 3 H_2O (g) + CuO (s) + 2 NH_3 (g)$

D. $H_2S (g) + \textbf{Cl}_2 (aq) \rightarrow 2H^+ (aq) + 2Cl^- (aq) + S (s)$

END OF SECTION A

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																	2
H 1.0 Hydrogen																	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 Uub	114 Uuq Uuq		116 Uuh Uuh			118 Uuo 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

CHEMISTRY
Unit 2 Trial Examination

DATA SHEET

Directions to students

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

Data

Physical constants

Avogadro's Constant, N_A = 6.0×10^{23} mol^{-1}

Gas Molar Volume at SLC, V_m = 24.5 L mol^{-1}

Gas Molar Volume at STP, V_m = 22.4 L mol^{-1}

Gas constant, R = 8.31 J K^{-1} mol^{-1}

1 atm = 101 325 Pa = 760 mm Hg

0°C = 273 K

Ionic product of water, K_w = 1.00×10^{-14} M^2 (at 25°C)

Ideal gas equation

$pV = nRT$

Some Solubility Data

Level of Solubility	Ionic compounds containing	Exceptions
Generally soluble	Na^+, K^+, NH_4^+, NO_3^-, CH_3COO^-	None
	Cl^-, Br^-, I^-	Ag^+ compounds
	SO_4^{2-}	Pb^{2+}, Ba^{2+}, Ag^+ and Ca^{2+} compounds
Low solubility	CO_3^{2-}, PO_4^{3-}, S^{2-}	Na^+, K^+, and NH_4^+ compounds
	OH^-	Na^+, K^+, NH_4^+, Ba^{2+} and Sr^{2+} compounds

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

An abridged Electrochemical Series

$Au^+(aq) + e^- \rightleftharpoons Au (s)$

$Ag^+(aq) + e^- \rightleftharpoons Ag (s)$

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

$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu (s)$

$2H^+(aq) + 2e^- \rightleftharpoons H_2 (g)$

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

$Sn^{2+}(aq) + 2e^- \rightleftharpoons Sn (s)$

$Ni^{2+}(aq) + 2e^- \rightleftharpoons Ni (s)$

$Co^{2+}(aq) + 2e^- \rightleftharpoons Co (s)$

$Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe (s)$

$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn (s)$

$Cr^{2+}(aq) + 2e^- \rightleftharpoons Cr (s)$

$Al^{3+}(aq) + 3e^- \rightleftharpoons Al (s)$

$Mg^{2+}(aq) + 2e^- \rightleftharpoons Mg (s)$

$Na^+(aq) + e^- \rightleftharpoons Na (s)$

$Ca^{2+}(aq) + 2e^- \rightleftharpoons Ca (s)$

$K^+(aq) + e^- \rightleftharpoons K (s)$