YEAR 12 TERM ONE END EXAMINATION 2021

CHEMISTRY

Time Allowed: 3 hours

(An extra 10 minutes is allowed for reading this paper.)

INSTRUCTIONS

1. Write your Name on the front page of the Answer Booklet.

2. Write all your answers in the Answer Booklet provided.

3. If you use extra sheets of paper, be sure to show clearly the question number(s) being answered and to tie each sheet in your Answer Booklet at the appropriate places. Ensure that your Name is written on the extra sheets.

4. Answer all the questions with a blue or black ballpoint pen or ink pen. Do not use red ink. You may use a pencil only for drawing.

5. You may use a calculator, provided it is silent, battery-operated and non-programmable.

SUMMARY OF QUESTIONS

	Strand	Multiple choice	Short Answer	Total	Suggested Time
1	General chemistry All the questions are compulsory	4	16	20	36 minutes
2	Investigating matter All the questions are compulsory	6	24	30	54 minutes
3	Reactions All the questions are compulsory	10	40	50	90 minutes
	TOTAL	**20**	**80**	**100**	**180 minutes**

INSTRUCTIONS

Please read these instructions carefully before answering the questions.

Multiple Choice Questions

Circle the letter that represents the best answer in the grid provided in each strand in the Answer Booklet. Each question is worth 1 mark.

1. In your Answer Booklet, circle the letter of the best answer. If you change your mind, put a line through your first choice and circle the letter of your next choice.

   For example:

12	A	Ⓑ	Ⓒ	D

2. If you change your mind again and like your first answer better, put a line through your second circle and tick ( ) your first answer.

   For example:

12	A	Ⓑ√	Ⓒ	D

3. No mark will be given if you circle more than one letter for a question.

Short Answer Questions

Write your answers in the spaces provided in the Answer Booklet.

STRAND 1 GENERAL CHEMISTRY   (20 MARKS)

There are four multiple choice questions and seven short answer questions. All are compulsory.

Multiple Choice

1. The exponential base unit for the prefix giga is denoted by _____.

   A. 10^{-9}

   B. 10^3

   C. 10^6

   D. 10^9

2. In an experiment, it must always be ensured that measurements recorded are of

   A. low accuracy and low precision.

   B. high accuracy and low precision.

   C. low accuracy and high precision.

   D. high accuracy and high precision.

3. Having knowledge of dimensional analysis helps an experimenter to

A. reduce error in measurement.

B. increase accuracy of the measured value.

C. increase precision of the measured value.

D. determine the correct units of a calculation problem.

4. Which of the following is an example of a random error?

A. A top pan balance showing a reading without any mass.

B. A stopwatch showing 10 seconds for an actual time of 9 seconds.

C. A voltmeter showing a reading of 0.55 volts even when disconnected.

D. Having eye slightly above the level of liquid while recording burette reading.
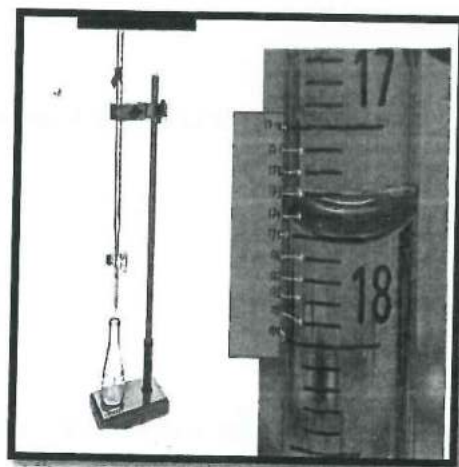
Short Answer

5. Distinguish between precision and accuracy in measurements.   **(2 marks)**

6. Distinguish between systematic and random error and describe its effect on precision and accuracy in measurements.   **(2 marks)**

7. Give the reading (in mL) of the following measuring apparatus with the correct uncertainty

   i.   ii.
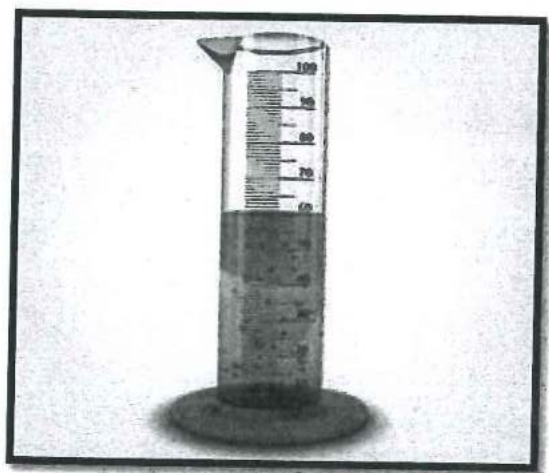
          (2 marks)

8. What is the mass in kg of a 2 L liquid which has a density of 13.6 g/mL? **(2 marks)**

9. Convert a density of 3.16 g/mL to its equivalent in g/L.   **(2 marks)**

10. A sample of sea water contains 7.28 g of sodium chloride per litre of solution. How many milligrams of sodium chloride would be contained in 25.0 mL of this solution?

          (2 marks)

11. Consider the following measurements in the table below. The values were recorded during a lab investigation in which the final mass value of the sample created should have been 26.30 grams.

Student	Trial 1	Trial 2	Trial 3
Megan	26.30 g	26.29 g	26.30 g
Heather	38.12 g	26.30 g	12.43 g
Luis	36.39 g	36.40 g	36.40 g
Adam	24 g	24 g	24 g
George	26.28 g	26.31 g	26.32 g

List the students' names whose measurements were:

a) accurate AND precise _____

b) precise but NOT accurate _____

c) NEITHER precise NOR accurate_____

d) accurate but not precise _____   **(4 marks)**

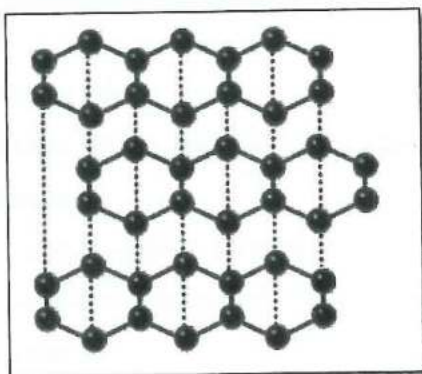**STRAND 2 INVESTIGATING MATTER**   **(30 MARKS)**

There are six multiple choice questions and seven short answer questions. All are compulsory.

Multiple Choice

1. The molecule that has a trigonal pyramid shape is _____.

    A. Cl_2

    B. BF_3

    C. NH_3

    D. CCl_4

2. Figure 1 shows the structure of an element.

What is the name of this element?

   A. Chloride

   B. Diamond

   C. Graphite

   D. Silicon dioxide

3. Why does the element in figure 1 conduct electricity?

   A. It has delocalized electrons

   B. It contains hexagonal rings

   C. It has weak forces between the layers

   D. It has ionic bond

4. The table shows some boiling point data.

Substance	Boiling point
Water	100°C
Methane	-162°C

Which statement explains the data in the table?

   A. Methane has a lower boiling point than water

   B. The intermolecular forces between the molecules in methane are weaker than the intermolecular forces between the molecules in water

   C. The covalent bonds between the atoms in a water molecule are stronger than the covalent bonds between the atoms in a methane molecule

   D. The covalent bonds between the atoms in a water molecule are weaker than the covalent bonds between the atoms in a methane molecule

5. Which of the following is the correct definition for electronegativity?

   A. The amount of energy required to remove an electron

   B. The amount of energy to attract or bond electrons

   C. Half the distance between the nucleic of two bonded atoms

   D. All of the above correctly explain electronegativity.

6. Which of the following Group I element is least electronegative?

   A. Hydrogen (H)

   B. Lithium (Li)

   C. Sodium (Na)

   D. Potassium (K)

SHORT ANSWERS

7. Use the following terms to fill in the blanks.

   Covalent, strong, large, delocalized, ionic, small

   Metals are good conductors of electricity because they contain electrons that are
   _____(i)_____. Metals have high melting points because their bonding is
   _____(ii)_____. Polymers have ___(iii)___ molecules. The atoms in the polymer molecules are
   joined together by strong ___(iv)___ bonds. **(2 marks)**

8. Briefly explain why Oxygen is more electronegative than lithium. **(2 marks)**

9. Explain the basic principles of the VSEPR theory for predicting the shapes of
   molecules and ions. **(2 marks)**

10. Study the diagram of the ammonia molecule below and answer the questions that
    follow:
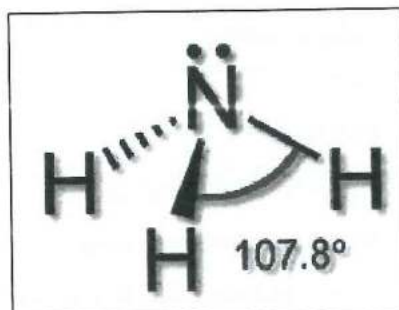
    (i)   State the number of electron groups present in the ammonia molecule.
          (1 mark)

    (ii) Describe the electron group geometry of the ammonia molecule. **(1 mark)**

    (iii) Describe the molecular geometry (shape) of the ammonia molecule. **(1 mark)**

11. Account for the following:

    i.   Although both NH_3 and CH_4 have tetrahedral electron group geometry, the
          shape of NH_3 is trigonal pyramid and that of CH_4 is tetrahedral. **(2 marks)**

    ii.   The C-Cl bond in a carbon tetrachloride molecule (CCl_4) is polar but the overall
          molecule is non-polar. **(2 marks)**

    iii. Metals are lustrous. **(1 mark)**

    iv.   Diamond and graphite have a high melting and boiling point. **(1 mark)**

    v.   Silicon dioxide is hard and has high melting and boiling point. **(1 mark)**

12. Briefly explain why ionic compounds cannot conduct electricity in solid state but
    can conduct electricity in liquid state (in molten and solution). **(2 marks)**

13. Using a suitable diagram, explain why sodium chloride (NaCl) is able to dissolve in water. What is this process known as? **(2 marks)**

14. A group of Year 12 students wanted to carry out an experiment to determine the polarity of water molecules.

    (i)   Describe the experimental procedure students would use to determine the polarity of water molecules. (Note: The experimental procedure should include the use of a burette and a charged plastic ruler.) **(2 marks)**

    (ii)   State an observation from this experiment. **(1 mark)**

    (iii) Provide a reason for the observation stated in part (ii) above. **(1 mark)**

STRAND 3 REACTIONS   **(50 MARKS)**

There are ten multiple choice questions and short answer questions. All are compulsory.

Multiple Choice

1. Which of the following is not the property of Oxidant
    A. Substance that loses oxygen or gains hydrogen
    B. Substance that gains electron or an electron acceptor
    C. Substance whose oxidation number has decreased
    D. Substance whose oxidation number has increased

2. A molecular formula shows the _____ of atoms of different elements in a molecule.
    A. mass
    B. ratio
    C. number
    D. arrangement

3. A primary standard should
    A. be insoluble in water.
    B. have a low molecular mass.
    C. not be available in pure form.
    D. be stable at room temperature.

4. The glassware that can be used to transfer 20 mL of a liquid most accurately is a
    A. beaker.
    B. pipette.

C. conical flask.

D. measuring cylinder.

5. In a reaction, reduction occurs when

    A. hydrogen is lost.

    B. oxygen is gained.

    C electron is gained.

    D. oxidation number is increased.

6. An oxidation reaction can be defined as the

    A. loss of oxygen.

    B. gain of hydrogen.

    C gain of electrons.

    D. increase in the oxidation number.

7. Which of the following is a source from which aluminium can be extracted?

    A. Azurite

    B. Bauxite

    C. Malachite

    D. Chalcocite

8. A student wished to find the concentration of some dilute hydrochloric acid (HCl) by titration. He pipetted 20 mL portions of 0.01 mol L-1 sodium hydroxide into conical flasks and titrated each of them with dilute HCl using a suitable indicator. Which of the following procedures is most likely to result in an incorrect value for the concentration of the acid?

    A. Rinsing the conical flasks with distilled water but not drying them before use.

    B. Rinsing the burette with only distilled water but not drying it before use.

    C. Rinsing the pipette with the sodium hydroxide solution before use.

    D. Rinsing the burette with distilled water and then with hydrochloric acid before use.

9. A technique in which a solution of known concentration is used to determine the unknown concentration of another solution is known as

    A. standard solution

    B. titration

    C. endpoint

    D. concentration

10. Which of the following is an example of hydrated salt

    A. $CuSO_4$

    B. $CuSO_4.2H_2O$

    C. H_2O

    D. $MgSO_4$

Short Answer

11. A sample of hydrated calcium sulphate, $CaSO_4.xH_2O$, has a relative formula mass of 172. What is the value of x? **(2 marks)**

12. Find the number of hydrogen atoms in 3 moles of water (H_2O). **(1 mark)**

13. What is the concentration in $molL^{-1}$ of 250 mL of magnesium chloride solution containing 8.4 g of the salt? **(2 marks)**

14. A chemist was required to prepare 0.20 mol L^{-1} of glucose solution. What volume of this solution can be made if he has 50.0 mL of 0.50 mol L^{-1} glucose solution in his pharmacy? **(2 marks)**

15. A compound with the following composition has a molar mass of 60.10g/mol: 39.97% carbon; 13.41% hydrogen; 46.62% nitrogen. Find the molecular formula.

    (2 marks)

16. An organic compound is found to contain 64.80 % carbon, 13.62 % hydrogen and 21.58 % oxygen. The molecular mass of this compound is 74 g mol^{-1}.

    (i) Calculate the empirical formula of the compound. **(2 marks)**

    (ii) Determine the molecular formula of the compound. **(1 mark)**

17. Find the molar mass of CH_3Br. **(2 marks)**

18. 10.00 mL samples of 0.05 mol L^{-1} aliquot of a standard potassium carbonate (K_2CO_3) solution was pipetted into a conical flask. This sample was titrated with hydrochloric acid (HCl) solution of unknown concentration. The indicator, methyl orange showed that the end-point had been reached after an average titre of 25.00 mL of HCl was added.

    (a) What is the function of the indicator? **(1 mark)**

(b) Determine the moles of potassium carbonate in the 10.00 mL sample. **(1 mark)**

(c) Write a balanced equation for the reaction between hydrochloric acid and potassium carbonate. **(2 marks)**

(d) How many moles of HCl are there in the 25.00 mL titre? **(2 marks)**

(e) Determine the concentration of HCl used in this titration. **(1 mark)**

19. Define reduction in terms of electron transfer. **(1 mark)**

20. All reactions in which electron transfer take place are redox reactions. This diagram shows the electron transfer during one redox reaction.
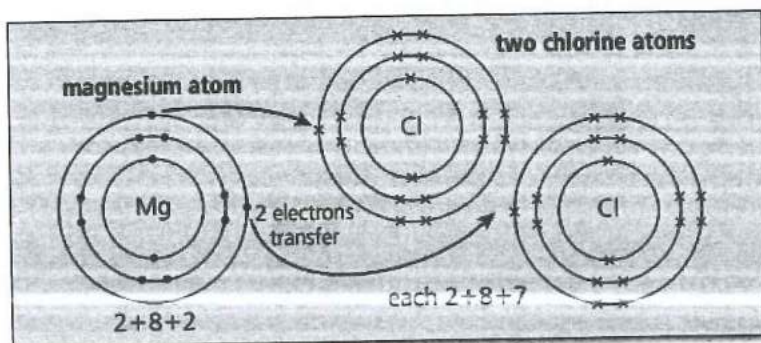
a. What is the product of this reaction? **(1 mark)**

b. Write a balanced equation for the full reaction. **(2 marks)**

c. i Which element is being oxidised? **(1 mark)**

   ii Write a half-equation for the oxidation. **(1 mark)**

d. i Which element is being reduced? **(1 mark)**

   ii Write a half-equation for the reduction of this element. **(1 mark)**

21. Give the oxidation state of the underlined atom in each formula below:

   i. aluminium oxide, $\underline{Al}_2O_3$ **(1 mark)**

   ii. ammonia, $\underline{N}H_3$ **(1 mark)**

   iii. $H_2\underline{C}O_3$ (aq), carbonic acid **(1 mark)**

   iv. phosphorus trichloride, $\underline{P}Cl_3$ **(1 mark)**

22. Balance the equation shown below which shows sulphur dioxide reacting with acidified dichromate ions. $SO_2 + Cr_2O_7^{2-} \rightarrow SO_4^{2-} + Cr^{3+}$ **(2 marks)**

23. Consider the ion-electron equation shown below.

   $MnO_4^- + xH^+ + ye^- \rightarrow Mn^{2+} + zH_2O$ Determine the numerical values of x, y and z. **(3 marks)**

24. Draw a diagram of the electrodeposition of copper and label the following components: Blistered copper, pure copper metal, acidified copper(II) sulphate solution, anode, cathode, cell **(2 marks)**

PERIODIC TABLE OF THE ELEMENTS

Group I	II		III	IV	V	VI	VII	VIII

Row 1

| 1 H 1 | | | | | | | | 2 He 4 |

| 3 Li 7 | 4 Be 9 | | 5 B 11 | 6 C 12 | 7 N 14 | 8 O 16 | 9 F 19 | 10 Ne 20 |

| 11 Na 23 | 12 Mg 24 | | 13 Al 27 | 14 Si 28 | 15 P 31 | 16 S 32 | 17 Cl 35.5 | 18 Ar 40 |

Transition elements:

| 19 K 39 | 20 Ca 40 | 21 Sc 45 | 22 Ti 48 | 23 V 51 | 24 Cr 52 | 25 Mn 55 | 26 Fe 56 | 27 Co 59 | 28 Ni 59 | 29 Cu 64 | 30 Zn 65 | 31 Ga 70 | 32 Ge 73 | 33 As 75 | 34 Se 79 | 35 Br 80 | 36 Kr 84 |

| 37 Rb 85 | 38 Sr 88 | 39 Y 89 | 40 Zr 91 | 41 Nb 93 | 42 Mo 96 | 43 Tc (98) | 44 Ru 101 | 45 Rh 101 | 46 Pd 106 | 47 Ag 108 | 48 Cd 112 | 49 In 115 | 50 Sn 119 | 51 Sb 122 | 52 Te 128 | 53 I 127 | 54 Xe 131 |

| 55 Cs 133 | 56 Ba 137 | 57* La 139 | 72 Hf 178 | 73 Ta 181 | 74 W 184 | 75 Re 186 | 76 Os 190 | 77 Ir 192 | 78 Pt 195 | 79 Au 197 | 80 Hg 201 | 81 Tl 204 | 82 Pb 207 | 83 Bi 209 | 84 Po (209) | 85 At (210) | 86 Rn (222) |

| 87 Fr (223) | 88 Ra 226 | 89+ Ac 227 | 104 Ku 260 |

* Lanthanide Series

| 58* Ce 140 | 59 Pr 141 | 60 Nd 144 | 61 Pm (145) | 62 Sm 150 | 63 Eu 152 | 64 Gd 157 | 65 Tb 159 | 66 Dy 162 | 67 Ho 165 | 68 Er 167 | 69 Tm 169 | 70 Yb 173 | 71 Lu 175 |

+ Actinide Series

| 90 Th 232 | 91 Pa 231 | 92 U 238 | 93 Np 237 | 94 Pu (244) | 95 Am (243) | 96 Cm (247) | 97 Bk (247) | 98 Cf (252) | 99 Es (254) | 100 Fm (257) | 101 Md (258) | 102 No (259) | 103 Lr (260) |

( ) mass number of most stable isotope.

Key:

$^z_A X$

z — Atomic number
x — symbol of element
A — Relative atomic mass