NAME: _____

TEACHER: _____

BAULKHAM HILLS HIGH SCHOOL

YEAR 11 HALF YEARLY EXAMINATION

2008

CHEMISTRY

GENERAL INSTRUCTIONS:

- Reading time - 5 minutes.
- Working time - 1½ hours.
- Write using blue or black pen.
- Draw diagrams using pencil.

Total marks - 60

SECTION I – 10 Marks

10 Multiple Choice questions worth one mark each.

SECTION 2 – 50 marks

- All questions are compulsory.
- Answer questions in allocated spaces.

Show all working

SECTION I

10 Multiple Choice Questions
(10 marks)

Contains 10 multiple choice questions work 1 mark each.
Select the best alternative and mark the appropriate space in the Answer Sheet.

1 The list which contains only metallic elements is:

(A) copper, lead, iron, chlorine
(B) aluminium, brass, silver, helium
(C) argon, silicon, magnesium, calcium
(D) sodium, beryllium, cobalt, lithium

2 A group of elements have the following properties:

Substance	Melting Point (°C)	Boiling Point (°C)	Relative Electrical Conductivity	Colour
W	300	1950	good	Silvery – white
X	– 50	400	good	Silvery – white
Y	– 30	60	poor	Red – brown
Z	50	700	fair	Silvery – grey

The element which is a liquid at room temperature is:

(A) W
(B) X
(C) Y
(D) Z

3 Dissolving salt in water is an example of which kind of change?

(A) A reversible physical change.
(B) An irreversible physical change.
(C) A reversible chemical change.
(D) An irreversible chemical change.

4 The decomposition of water into hydrogen and oxygen is an example of which kind of change?

(A) A reversible physical change.
(B) An irreversible physical change.
(C) A reversible chemical change.
(D) An irreversible chemical change.

5 A substance with a very high melting point that can only conduct electrical current in the molten state is most likely:

(A) A network covalent crystal.
(B) A metallic crystal.
(C) An ionic crystal.
(D) A molecular crystal.

6 The number of unshared (non-bonding) electron pairs around the central sulfur atom in the SF_4 molecule is:

(A) O
(B) 1
(C) 2
(D) 3

7 A particular atom has 25 electrons, 25 protons, and 27 neutrons. Its atomic number and mass number, respectively are:

(A) 25 and 52
(B) 25 and 77
(C) 25 and 50
(D) 50 and 77

8 The chemical structure of a metal is best described as:

(A) a network of positive ions and electrons held together by magnetic attractions.
(B) a network of positive ions with delocalised electrons moving through the network.
(C) a network of positive and negative ions held together by electrostatic attractions.
(D) an array of metal atoms loosely bonded together.

9 In which of the following changes to the particles move closer together?

(A) Dissolving sugar in a cup of coffee.
(B) Condensation of stream.
(C) Melting of a block of chocolate.
(D) Evaporation of alcohol.

10 Which of the following is *not* an assumption of the kinetic theory?

(A) Gases consist of tiny particles called molecules.
(B) Gas molecules are composed of at least two atoms.
(C) The molecules of a gas move in rapid, random, straight-line motion.
(D) In gases the particles are widely spaced.

PERIODIC TABLE OF THE ELEMENTS

KEY

Atomic Number	Symbol of element	Name of element
79	Au	Gold
Atomic Weight	197.0	

1 H 1.008 Hydrogen																	2 He 4.003 Helium
3 Li 6.941 Lithium	4 Be 9.012 Beryllium											5 B 10.81 Boron	6 C 12.01 Carbon	7 N 14.01 Nitrogen	8 O 16.00 Oxygen	9 F 19.00 Fluorine	10 Ne 20.18 Neon
11 Na 22.99 Sodium	12 Mg 24.31 Magnesium											13 Al 26.98 Aluminium	14 Si 28.09 Silicon	15 P 30.97 Phosphorus	16 S 32.07 Sulfur	17 Cl 35.45 Chlorine	18 Ar 39.95 Argon
19 K 39.10 Potassium	20 Ca 40.08 Calcium	21 Sc 44.96 Scandium	22 Ti 47.87 Titanium	23 V 50.94 Vanadium	24 Cr 52.00 Chromium	25 Mn 54.94 Manganese	26 Fe 55.85 Iron	27 Co 58.93 Cobalt	28 Ni 58.69 Nickel	29 Cu 63.55 Copper	30 Zn 65.41 Zinc	31 Ga 69.72 Gallium	32 Ge 72.64 Germanium	33 As 74.92 Arsenic	34 Se 78.96 Selenium	35 Br 79.90 Bromine	36 Kr 83.80 Krypton
37 Rb 85.47 Rubidium	38 Sr 87.62 Strontium	39 Y 88.91 Yttrium	40 Zr 91.22 Zirconium	41 Nb 92.91 Niobium	42 Mo 95.94 Molybdenum	43 Tc [97.91] 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 137.3 Barium	57–71 Lanthanoids	72 Hf 178.5 Hafnium	73 Ta 180.9 Tantalum	74 W 183.8 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 [209.0] Polonium	85 At [210.0] Astatine	86 Rn [222.0] Radon
87 Fr [223] Francium	88 Ra [226] Radium	89–103 Actinoids	104 Rf [261] Rutherfordium	105 Db [262] Dubnium	106 Sg [266] Seaborgium	107 Bh [264] Bohrium	108 Hs [277] Hassium	109 Mt [268] Meitnerium	110 Ds [271] Darmstadtium	111 Rg [272] Roentgenium							

Lanthanoids

57 La 138.9 Lanthanum	58 Ce 140.1 Cerium	59 Pr 140.9 Praseodymium	60 Nd 144.2 Neodymium	61 Pm [145] Promethium	62 Sm 150.4 Samarium	63 Eu 152.0 Europium	64 Gd 157.3 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

Actinoids

89 Ac [227] Actinium	90 Th 232.0 Thorium	91 Pa 231.0 Protactinium	92 U 238.0 Uranium	93 Np [237] Neptunium	94 Pu [244] Plutonium	95 Am [243] Americium	96 Cm [247] Curium	97 Bk [247] Berkelium	98 Cf [251] Californium	99 Es [252] Einsteinium	100 Fm [257] Fermium	101 Md [258] Mendelevium	102 No [259] Nobelium	103 Lr [262] Lawrencium

For elements that have no stable or long-lived nuclides, the mass number of the nuclide with the longest confirmed half-life is listed between square brackets.
The International Union of Pure and Applied Chemistry Periodic Table of the Elements (October 2005 version) is the principal source of data. Some data may have been modified.

Chemistry

DATA SHEET

Avogadro constant, N_A ..... 6.022×10^{23} mol^{-1}

Volume of 1 mole ideal gas: at 100 kPa and

at 0°C (273.15 K) ..... 22.71 L

at 25°C (298.15 K) ..... 24.79 L

Ionisation constant for water at 25°C (298.15 K), K_w ..... 1.0×10^{-14}

Specific heat capacity of water ..... 4.18×10^3 J kg^{-1} K^{-1}

Some useful formulae

$$pH = -\log_{10}[H^+] \qquad \Delta H = -m C \Delta T$$

Some standard potentials

$K^+ + e^-$	$\rightleftharpoons$	$K(s)$	–2.94 V
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	$Ba(s)$	–2.91 V
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	$Ca(s)$	–2.87 V
$Na^+ + e^-$	$\rightleftharpoons$	$Na(s)$	–2.71 V
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	$Mg(s)$	–2.36 V
$Al^{3+} + 3e^-$	$\rightleftharpoons$	$Al(s)$	–1.68 V
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	$Mn(s)$	–1.18 V
$H_2O + e^-$	$\rightleftharpoons$	$\frac{1}{2}H_2(g) + OH^-$	–0.83 V
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	$Zn(s)$	–0.76 V
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	$Fe(s)$	–0.44 V
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	$Ni(s)$	–0.24 V
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	$Sn(s)$	–0.14 V
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	$Pb(s)$	–0.13 V
$H^+ + e^-$	$\rightleftharpoons$	$\frac{1}{2}H_2(g)$	0.00 V
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(aq) + 2H_2O$	0.16 V
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	$Cu(s)$	0.34 V
$\frac{1}{2}O_2(g) + H_2O + 2e^-$	$\rightleftharpoons$	$2OH^-$	0.40 V
$Cu^+ + e^-$	$\rightleftharpoons$	$Cu(s)$	0.52 V
$\frac{1}{2}I_2(s) + e^-$	$\rightleftharpoons$	I^-	0.54 V
$\frac{1}{2}I_2(aq) + e^-$	$\rightleftharpoons$	I^-	0.62 V
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	0.77 V
$Ag^+ + e^-$	$\rightleftharpoons$	$Ag(s)$	0.80 V
$\frac{1}{2}Br_2(l) + e^-$	$\rightleftharpoons$	Br^-	1.08 V
$\frac{1}{2}Br_2(aq) + e^-$	$\rightleftharpoons$	Br^-	1.10 V
$\frac{1}{2}O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O	1.23 V
$\frac{1}{2}Cl_2(g) + e^-$	$\rightleftharpoons$	Cl^-	1.36 V
$\frac{1}{2}Cr_2O_7^{2-} + 7H^+ + 3e^-$	$\rightleftharpoons$	$Cr^{3+} + \frac{7}{2}H_2O$	1.36 V
$\frac{1}{2}Cl_2(aq) + e^-$	$\rightleftharpoons$	Cl^-	1.40 V
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	1.51 V
$\frac{1}{2}F_2(g) + e^-$	$\rightleftharpoons$	F^-	2.89 V

Aylward and Findlay, *SI Chemical Data* (5th Edition) is the principal source of data for this examination paper. Some data may have been modified for examination purposes.

NAME: _____

TEACHER: _____

BAULKHAM HILLS HIGH SCHOOL

YEAR 11 HALF YEARLY EXAMINATION

2008

CHEMISTRY

MULTIPLE CHOICE ANSWER SHEET

SECTION I

Place a cross **(X)** in the box that corresponds to the best answer.

QUESTION	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Marks	
Section 1	/10
Section 2	/50
Total	**/60**

SECTION 2
(50 marks)

Contains 12 questions of variable length.
Write your answers in the spaces provided.

QUESTION 11 (4 marks)

Marks

Draw a diagram to show the electronic structure of:

(a) a fluorine atom **1**

(b) a fluoride ion **1**

(c) Give the name and formula of any ionic compound containing oxygen. **1**

_____

_____

(d) Give the name and formula of any covalent compound containing oxygen. **1**

_____

_____

QUESTION 12 (2 marks)

Explain why some elements have atoms with more than one mass number. **2**

_____

_____

QUESTION 13 (2 marks)

Draw the Lewis dot structure for:

(a) calcium chloride $CaCl_2$. **1**

(b) ammonia NH_3. **1**

QUESTION 14 (3 marks)

Describe examples of chemical reactions for each of the following:

(a) a chemical reaction in which light is absorbed. **1**

_____

_____

(b) a chemical reaction that produces heat. **1**

_____

_____

QUESTION 14 (Continued)

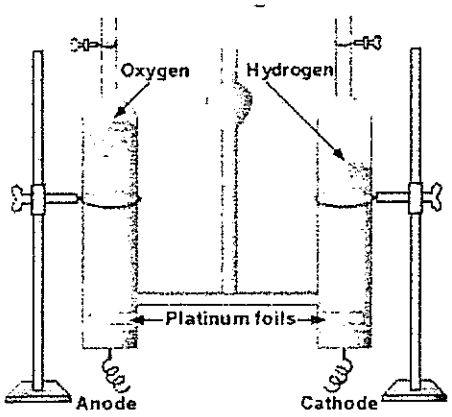
Marks

(c) a chemical reaction caused by electricity. **1**

_____

_____

QUESTION 15 (4 marks)



(a) Write a word and symbol equation for the reaction represented in the above diagram. **2**

Word equation _____

Symbol equation _____

(b) What name is given to the process causing decomposition? **1**

_____

(c) Account for the differences in volumes of hydrogen and oxygen gas produced. **1**

_____

_____

_____

QUESTION 16 (6 marks)

Marks

(a) Draw and label the equipment that was used in the school laboratory to decompose a metal carbonate.

2

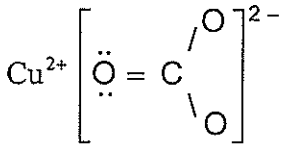
(b) In the above experiment, limewater was used to show when carbon dioxide gas was produced. The word equation for the reaction is:

limewater + carbon dioxide → calcium carbonate + water

Complete the symbol equation for the reaction. **1**

$Ca(OH)_2$ + _____ → _____ + _____

(c) A Lewis structure for copper carbonate is shown below:



Describe the chemical bonding in copper carbonate. **2**

_____

_____

QUESTION 17 (6 marks)

Marks

The element molybdenum (Mo) has the following properties:

Melting Point	2610°C
Boiling Point	5560°C
Density	10.2 g mL^{-1}
Electrical Conductivity	Good
Flexibility	Both Malleable and Ductile

Using this information, answer the following questions.

(a) In what physical state would molybdenum exist at room temperature? **1**

_____

(b) Would the element be classed as a metal or a non-metal? **1**

_____

(c) Would molybdenum float on water? Explain. **2**

_____

_____

(d) Would molybdenum melt in a candle flame? **1**

_____

(e) Molybdenum has been used as a filament material in electronic tubes and light bulbs. What properties make it very suitable for this? **1**

_____

_____

QUESTION 18 (4 marks)

Marks

You are provided with a beaker containing a mixture of sand and salt water.

(a) Describe, with experimental details, a method you would use to separate the sand from the salt water. **2**

(b) A gravimetric analysis of the mixture was carried out, and the following results were obtained.

mass of sand + salt water + beaker = 180.4 g
mass of beaker = 120.2 g
mass of dried sand = 30.6 g
mass of dried salt = 4.1 g

Calculate the % of sand and salt in the mixture. **2**

QUESTION 19 (4 marks)

Complete the following table for four elements of your choice:

Element	A use of this element	Physical properties related to this use

QUESTION 20 (6 marks)

Marks

Six solid substances Q, R, S T, U and V (not their chemical symbols) were subjected to a series of physical tests. These are some of the results.

Solids	Electrical Conductivity (solid state)	Solubility in water	Heating in candle flame	Heating in hottest Bunsen Flame
Q	does not conduct	insoluble	melts	(not tested)
R	does not conduct	soluble	does not melt	does not melt
S	yes	insoluble	does not melt	melts
T	does not conduct	insoluble	does not melt	does not melt
U	does not conduct	soluble	melts	(not tested)
V	does not conduct	insoluble	does not melt	does not melt

- Melted Q did not conduct electricity.
- R and U are both soluble in water and do not conduct in the solid state. However, the solution of R conducted electricity and the solution of U did not.
- When a specially hot flame was used both T and V melted. Molten T did not conduct electricity but molten V did.

On the basis of the above information, classify each substance as metallic, ionic, covalent molecular or covalent lattice structures. **6**

Solid	Structure
Q	
R	
S	
T	
U	
V	

QUESTION 21 (5 marks)

Some covalent compounds are molecular, others form covalent lattices.

(a) Give an example of each, and draw 2 dimensional diagrams which show the bonding in each of the substances you named. (Use at least 12 atoms in each diagram.) **3**

(b) What are the limitations of these models? **2**

_____

_____

_____

QUESTION 22 (5 marks)

The solubilities at 25° C of three white barium salts, in grams per 100 mL of water are:

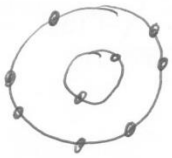
barium sulfate	0.00025
barium nitrate	10.1
barium iodide	220

15 g of a white powder was prepared by missing 5.0 g of each of these three barium salts. Your task is to obtain a sample of pure barium sulphate and a sample of virtually pure barium nitrate.

Write the method for the separation process. Explain at each stage what happens to the mixture. **5**

Year 11 ½ yearly Chemistry 2008
Answers

1. D 2. (B or C) 3.A 4.C 5.C 6.B 7.A 8. B 9.B 10.B

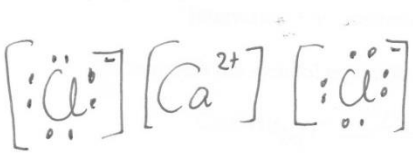
Q11. a)  b) 

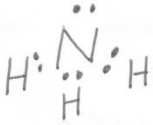
c) both name and formula required for one mark.
d) both the name and formula required for one mark.

12.

mark	criteria
2	* reference to isotopes (varying numbers of neutrons) * mass number is the total number of protons plus neutrons in the nucleus.
1	One of the above.

13. a) (1 mk) b) (1 mk)





14. a) eg photosynthesis, decomposition of AgBr etc. (1 mk)

b) explosion, burning of candle wax etc. (1 mk)

c) electrolysis of water etc. (1 mk)

15. a)

mark	criteria
2	* water → hydrogen + oxygen * $2H_2O \rightarrow 2H_2 + O_2$ (states not required)
1	One of the above.

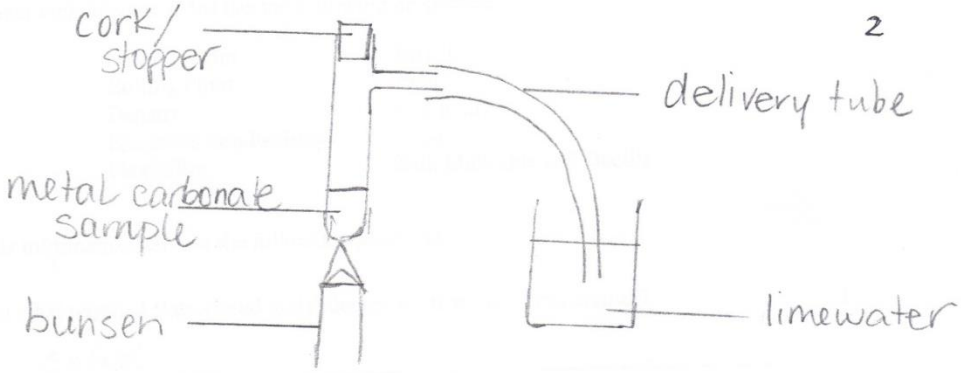
15b) electrolysis (1mk)
15c) during decomposition, for every one molecule of O_2, two molecules of H_2 are released.(1mk)

5

QUESTION 16 (6 marks)

Marks

(a) Draw and label the equipment that was used in the school laboratory to decompose a metal carbonate. **2**



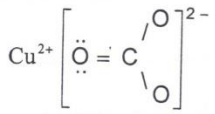
(b) In the above experiment, limewater was used to show when carbon dioxide gas was produced. The word equation for the reaction is:

limewater + carbon dioxide → calcium carbonate + water

Complete the symbol equation for the reaction. **1**

$Ca(OH)_{2(aq)} + \underline{CO_2(g)} \rightarrow \underline{CaCO_3(s)} + \underline{H_2O(l)}$

(c) A Lewis structure for copper carbonate is shown below:



Describe the chemical bonding in copper carbonate. **2**

Between Cu^{2+} and CO_3^{2-} ions exists ionic bonding but within the CO_3^{2-} ion there is covalent bonding.

QUESTION 17 (6 marks) **Marks**

The element molybdenum (Mo) has the following properties:

Melting Point	2610°C
Boiling Point	5560°C
Density	10.2 g mL^{-1}
Electrical Conductivity	Good
Flexibility	Both Malleable and Ductile

Using this information, answer the following questions.

(a) In what physical state would molybdenum exist at room temperature? **1**

solid

(b) Would the element be classed as a metal or a non-metal? **1**

metal

(c) Would molybdenum float on water? Explain. **2**

no, as its density is greater than that of water, at 1.0 g/mL.

(d) Would molybdenum melt in a candle flame? **1**

no.

(e) Molybdenum has been used as a filament material in electronic tubes and light bulbs. What properties make it very suitable for this? **1**

ductile (drawn into filament), good electrical conductivity, high melting point.

Q 18.a)

mark	criteria
2	* equipment – filter funnel, filter paper * sand is the residue on the filter paper * wash with tap water / distilled water
1	2 of the above

18.b) mass (sand + salt) = 60.2g

% sand = 30.6/ 60.2 x 100 = 50.8% (1 mk)
% salt = 4.1/60.2 x 100 = 6.8% (1 mk)

19. For each element, the use had to relate to the properties.
Two properties were required for one mark.

(Chemical properties were accepted if they applied to the use eg: chlorine has antibacterial operties.)

20.

solid	structure
Q	Covalent molecular
R	Ionic
S	Metallic
T	Network/ covalent lattice
U	Covalent molecular
V	ionic

1 mark each = 6mks.

Question 21

Correct examples of each + correct structure + correct description of bonding in each example Covalent molecular: Br_2, H_2O, HCl, Covalent Lattice : SiO_2, SiC, C(diamond) Correct structure showing the bonds Correct description of covalent bonds and inter-molecular forces in each	3 marks
Correct example of each + correct structure of each OR Correct example of each + correct indication of bonding in each OR Correct structure of each + correct indication of bonding in each OR One correct example + structure + bonding	2 marks
Correct example of either one OR correct structure of either one OR correct indication of bonding in either one	1mark

Question 22

* Add 100ml of water (or more than 55ml) * barium sulphate is insoluble (most of it) and nitrate and iodide dissolve completely * Filter to separate pure barium sulphate * boil to reduce the volume of water to less than 50ml *Barium nitrate will stay dissolved but barium iodide will crystallise out. *Filter to separate barium iodide and evaporate the filtrate to obtain almost pure salt.	5 marks
*Use 50ml of water (or do not specify the volume of water) to dissolve the salts initially and the rest of the procedure is correct OR *Any one of the above steps omitted	4 marks
*Four of the above steps correctly stated	3 marks
* Three steps correctly stated	2 marks
*Two steps correctly stated	1 mark
*If students mentioned alternative methods, they had to be correct with the volume of water added to the salts because the question asks for pure barium sulphate and almost pure barium iodide.	