

## **Answers and Marking Scheme**

# **Chemistry**

**Chemical Earth + Metals**

**Theory Test • 2005**

HSCFocus.com

**Part A – 15 marks**

**Attempt Questions 1 – 15**

**Allow about 20 minutes for this part**

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

**Sample:**  $2 + 4 =$  (A) 2 (B) 6 (C) 8 (D) 9  
A ☐ B ☒ C ☐ D ☐

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A ☒ B ☒ C ☐ D ☐

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows.

A ☒ B ☒ C ☐ D ☐  
correct

Answer Box for Questions 1 - 15				
1	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input checked="" type="radio"/>
2	A <input checked="" type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
3	A <input type="radio"/>	B <input checked="" type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
4	A <input type="radio"/>	B <input checked="" type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
5	A <input checked="" type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
6	A <input type="radio"/>	B <input type="radio"/>	C <input checked="" type="radio"/>	D <input type="radio"/>
7	A <input type="radio"/>	B <input type="radio"/>	C <input checked="" type="radio"/>	D <input type="radio"/>
8	A <input checked="" type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
9	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input checked="" type="radio"/>
10	A <input checked="" type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
11	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input checked="" type="radio"/>
12	A <input type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input checked="" type="radio"/>
13	A <input type="radio"/>	B <input checked="" type="radio"/>	C <input type="radio"/>	D <input type="radio"/>
14	A <input type="radio"/>	B <input type="radio"/>	C <input checked="" type="radio"/>	D <input type="radio"/>
15	A <input checked="" type="radio"/>	B <input type="radio"/>	C <input type="radio"/>	D <input type="radio"/>

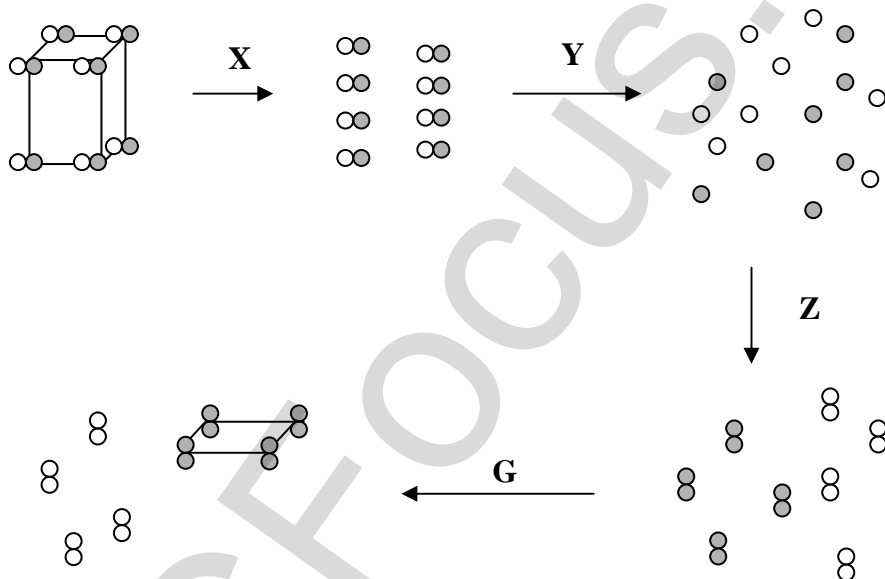
► Mark your answers for Questions 1 – 15 in the Answer Box on page 2.

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1 Which of the following is a property of all ionic solids?

- (A) They are malleable and ductile.
- (B) Their solubility in water is high.
- (C) They are good conductors of electricity.
- (D) Their melting points are above room temperature.**

2 Study the following transformations...



Which of the following gives the correct sequence of chemical or physical changes?

	X	Y	Z	G
<b>(A)</b>	<b>physical change</b>	<b>chemical change</b>	<b>chemical change</b>	<b>physical change</b>
(B)	chemical change	chemical change	chemical change	physical change
(C)	physical change	chemical change	chemical change	chemical change
(D)	chemical change	chemical change	physical change	chemical change

3 Which is the number of neutrons in the  $^{35}\text{Cl}^-$  ion?

- (A) 17
- (B) 18**
- (C) 19
- (D) 35

4 Which property is related to a metal's reactivity?

- (A) electrical conductivity
- (B) first ionisation energy**
- (C) melting point
- (D) density

5 Which of the following ions has an electron arrangement which is the same as an inert gas?

- (A)  $\text{O}^{2-}$**
- (B)  $\text{Li}^{2+}$
- (C)  $\text{Be}^+$
- (D)  $\text{Al}^{2+}$

6 Which of the following changes of energy is observed in these reactions?

	<i>Reaction</i>	<i>Energy absorbed</i>	<i>Energy released</i>
(A)	$\text{H}_2 + \text{O}_2 + \text{spark}$	sound	heat
(B)	$\text{AgBr} + \text{light}$	heat	light + heat
<b>(C)</b>	<b><math>\text{H}_2 + \text{O}_2 + \text{spark}</math></b>	<b>heat</b>	<b>heat + sound</b>
(D)	$\text{AgBr} + \text{light}$	light	heat

7 W, X, Y and Z are elements, each of which has only one possible valency. They form four ionic compounds. The formulae of three of them are...  $\text{X}_2\text{Z}$ ,  $\text{W}_2\text{Z}_3$ , and  $\text{XY}$ .  
What is the formula of the fourth compound?

- (A) WY
- (B)  $\text{WY}_2$
- (C)  $\text{WY}_3$**
- (D)  $\text{W}_2\text{Y}_3$

8 Which equation shows the reaction of magnesium metal with oxygen gas?

- (A)  $\text{Mg} + \frac{1}{2}\text{O}_2 \rightarrow \text{MgO}$   
(B)  $2\text{Mg} + \text{O}_2 \rightarrow \text{Mg}_2\text{O}_2$   
(C)  $\text{Mg} + \text{O} \rightarrow \text{MgO}$   
(D)  $\text{Mg}^{2+} + \text{O}^{2-} \rightarrow \text{MgO}$

9 The number of which two subatomic particles can be the same?

- (A) protons in an ion and electrons in the ion  
(B) protons in an atom and electrons in its ion  
(C) electrons in an atom and electrons in its ion  
(D) electrons in an atom and the protons in its ion

10 Which substance contains covalent bonds?

- (A)  $\text{NH}_4\text{Cl}$   
(B)  $\text{BaCl}_2$   
(C)  $\text{InCl}_3$   
(D)  $\text{CsCl}$

11 The melting points of some metal chlorides are given in the table...

<i>Metal chloride</i>	<i>Melting Point (°C)</i>
chromium(II) chloride	815
copper(II) chloride	498

Which bonding force is the strongest among the four compounds?

- (A) Cu – Cl (covalent bond)  
(B) Cu – Cl (ionic bond)  
(C) Cr – Cl (covalent bond)  
(D) Cr – Cl (ionic bond)

- 12** The extraction of aluminium from alumina ( $\text{Al}_2\text{O}_3$ ) requires 50 megajoules per kg of Al produced. What is the explanation for this extremely high energy value?

- (A) The aluminium ion's 3+ charge.  
(B) The hardness of the  $\text{Al}_2\text{O}_3$  crystal lattice.  
(C) Aluminium is very inactive.  
(D) The strong bond between the aluminium and oxygen.

- 13** What is the structure of the given elements?

	<i>Molecules</i>	<i>Covalent lattice (network)</i>
(A)	carbon, nitrogen, hydrogen, chlorine	carbon, boron, lithium
<b>(B)</b>	<b>hydrogen, nitrogen, chlorine</b>	<b>boron, carbon, silicon</b>
(C)	sulfur, phosphorus, oxygen	nitrogen, chlorine, carbon
(D)	sulfur, chlorine, carbon	nitrogen, oxygen, helium

- 14** The diagram shows a portion of the Periodic Table...

[illegible]

Which metal is the most active?

- |     |   |
|-----|---|
| (A) | A |
| (B) | B |
| (C) | C |
| (D) | D |

- 15** The table shows the chronology of metal use through the ages...

<i>Metal</i>	Gold	Copper	Iron	Aluminium
<i>Date of introduction for common use</i>	10000 BC	3000 BC	1000 BC	1930 AD

What is the best explanation for this chronology?

- (A) **metallic activity**  
(B) abundance of metal ore in lithosphere  
(C) malleability  
(D) expensiveness

**Part B – 30 marks**

**Attempt Questions 16 – 24**

**Allow about 50 minutes for this part**

► *Show all relevant working in questions involving calculations.*

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**Question 16 (3 marks)**

- (a) Write the word equation for potassium reacting with water forming an aqueous solution. (1 mark)

**potassium + water → potassium hydroxide + hydrogen**

- (b) Write the balanced formulae equation for (a) including states/phases. (2 marks)



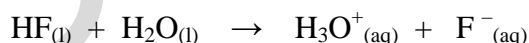
► *One mark for balanced equation + one mark for correct states.*

**Question 17 (4 marks)**

- (a) Draw the Lewis electron dot structure for the compound, hydrogen fluoride, HF. (1 mark)



- (b) Hydrogen fluoride reacts with water according to the following equation...



At room temperature pure hydrogen fluoride exists as a liquid. Explain why pure hydrogen fluoride does not conduct electricity, but it becomes a conductor when dissolved in water. (2 marks)

**HF does not conduct electricity as it does not have mobile ions, it is molecular.  
When HF dissolves in water free ions are produced to carry a charge.**

- (c) Explain why the formula of potassium fluoride (KF) is an empirical formula. (1 mark)

**KF is an ionic lattice structure, and the formula shows the simplest ratio of ions, 1:1.**

**Question 18 (3 marks)**

A student performed a gravimetric analysis of a mixture of sand, salt and water. A beaker that had previously been weighed contained the mixture. The student performed filtration and evaporation in order to separate the mixture. Her results are shown below...

Mass of beaker	200.00g
Mass of filter paper	0.75g
Mass of evaporating dish	105.47g
Mass of beaker and mixture	286.47g
Mass of dried filter paper and dried sand	30.25g
Mass of evaporating dish and salt	110.62g

Determine the percentage by mass of each component in the mixture. Show all working.

$$\text{Mass of sand} = 30.25 - 0.75\text{g} = 29.50\text{g}$$

$$\text{Mass of salt} = 110.62 - 105.47\text{g} = 5.15\text{g}$$

$$\text{Mass of water} = 286.47 - 200.00 - 29.5 - 5.15\text{g} = 51.82\text{g}$$

$$\% \text{ Mass of sand} = 29.5 \div 86.47 \times 100 = 34.12\%$$

$$\% \text{ Mass of salt} = 5.15 \div 86.47 \times 100 = 5.96\%$$

$$\% \text{ Mass of water} = 51.82 \div 86.47 \times 100 = 59.93\%$$



### Question 19 (4 marks)

MX is a white solid that melts at 730°C. MX does not conduct electricity in the solid state but conducts when molten. YZ melts at – 230°C and boils at 76°C. YZ does not conduct electricity in either the solid or liquid state.

- (a) Identify the type of bonding present in MX. (1 mark)

**Ionic**

- (b) Identify the type of structure of YZ. (1 mark)

**Covalent molecular or covalent molecular lattice**

- (c) Account for the electrical non-conductivity of MX in the solid phase and its conductivity in the liquid phase. (2 marks)

**There are no mobile charged species in MX. The ions in the solid phase are rigidly held in place in the crystal lattice. (1 mark)**

**In the liquid phase, the ions are free to move, hence, is able to conduct electricity. (1 mark)**

### Question 20 (2 marks)

Describe a model for the structure of metals. Discuss one limitation of the use of models with respect to metallic lattices.

**Metals consist of a lattice of cations surrounded by a “sea of delocalised electrons”. (1 mark)**

**This model, however, is not able to account for differences in the melting and boiling point of metals. For example, why does Hg have such a low melting point? (1 mark)**

### Question 21 (4 marks)

- (a) Write the balanced formulae equation for the decomposition of copper(II) carbonate. (1 mark)



- (b) In class, you observed the electrolysis of water.
- (i) List two observations which allowed you to conclude that water is a compound. (2 marks)

**Observations to support that water is a compound...**

- ▶ Two different substances (oxygen gas & hydrogen gas) were tested to be present during electrolysis. This shows that water is made up of more than one type of atom. (1 mark)
- ▶ The two substances obtained were in definite ratio of 2:1 as shown by the 2:1 ratio of the gas volumes. (1 mark)

- (ii) State another observation that shows that electrolysis is a chemical change. (1 mark)

A chemical change has occurred as shown by the difference in the properties of reactant (water) and the products (oxygen and hydrogen, both gases) or any suitable answer. (1 mark)

**Question 22 (4 marks)**

The table shows the atomic radii of Period 2 elements...

Element	Li	Be	B	C	N	O	F	Ne
Atomic radius (nm)	0.152	0.112	0.085	0.077	0.075	0.073	0.072	0.071

- (a) Predict the **relative** size for sodium's atomic radius and give a reason for your prediction. (2 marks)
- ▶ A numerical value is not required.

The predicted atomic radius of sodium would be greater than lithium's value of 0.152 nm (1 mark)

Since sodium has three electron shells it would be larger than lithium with two electron shells. (1 mark)

- (b) Which Period 2 element has the highest first ionisation energy?  
Give a reason for your choice. (2 marks)

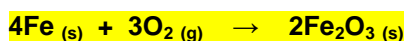
Neon (1 mark) has the highest first ionisation energy value because its outer electrons would be held firmly due to its small size. (1 mark)

### Question 23 (4 marks)

- (a) A party sparkler produces bright sparks when fine iron powder reacts with oxygen...



Write the balanced formulae equation for this reaction. (1 mark)



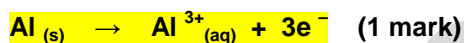
► The formation of FeO also acceptable.

- (b) Aluminium reacts slowly with dilute hydrochloric acid and a transfer of electrons occurs.

- (i) Write a balanced formulae equation for this reaction. (1 mark)



- (i) Write two ionic half-equations which show this electron transfer process. (2 marks)



### Question 24 (2 marks)

The table outlines the uses of common alloys related to their properties...

Alloy	Common Use	Property related to use
Brass	Keys	Excellent machinability
Steel	Steel tools, fasteners, fencing wire (1 mark on any)	High tensile strength
Solder	Joining electrical wires and connections in electronic circuits	Low melting point Adhesiveness to copper (1 mark for any)

Complete the blank cells in the table giving an appropriate use and/or property for steel and solder.