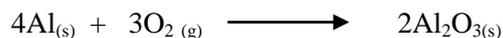# Metals
Topic Test

Part 1: Multiple Choice
Choose the **best** alternative and indicate your response on the answer sheet

1. The chemical equation for the reaction between aluminium and oxygen is:

$$4Al_{(s)} + 3O_{2\,(g)} \longrightarrow 2Al_2O_{3(s)}$$

The number of moles of aluminium oxide produced from one mole of aluminium is:

   a) 0.5
   b) 1
   c) 2
   d) 4

2. Which one of the following factors could be important in determining whether a mineral deposit is an economic ore body?

   a) geographical location of the mineral deposit
   b) concentration of metal in the mineral deposit
   c) selling price of the metal
   d) all of the above

3. A metal can often be isolated by heating a mixture of the metal oxide with carbon. In a particular experiment, samples of oxides of copper, sodium, iron and aluminium were mixed with powdered carbon and heated in an oven. As the temperature of the mixture increased, the first metal to appear would be

   a) copper.
   b) sodium.
   c) iron.
   d) aluminium.

4. Which of the following molecular formulas has the same empirical formula

   a) CH_4 and C_2H_6
   b) CO_2 and CO
   c) C_2H_2 and C_6H_6
   d) $C_6H_{12}O_6$ and C_2H_6O

5. A 'period' in the periodic table is

   a) a row of the periodic table.
   b) a column of the periodic table.
   c) elements with the same electro-negativity.
   d) elements with different numbers of valence electrons.

6. Elements in different groups of the periodic table (for example, sodium and chlorine) generally have different chemical properties because:

   a) they have different numbers of valence electrons.
   b) they have different shells as their outer shell.
   c) they have atoms that are different in size.
   d) they have different mass numbers.

7.   In the reaction $CuO(s) + H_2(g) \rightarrow Cu(s) + H_2O(g)$, the reducing agent is

        a) $H_2(g)$.
        b)   C u in $CuO(s)$.
        c)   O in $CuO(s)$.
        d)   H in $H_2O(g)$.

8.   The number of moles of chlorine molecules (Cl_2) that could be obtained from 3.85 g of $FeCl_3$ is closest to

        a)   0.024
        b)   0.036
        c)   0.072
        d)   0.108

9.   An electron transfer reaction occurs when magnesium is added to dilute sulphuric acid. Which species are spectators?

        a) Mg
        b) Mg^{2+}
        c) SO_4^-
        d) H^+

10.   In one mole of water the total number of atoms is:

        a) 6.022×10^{23}
        b) 1.2044×10^{24}
        c) 1.8066×10^{24}
        d) 2.4088×10^{24}

Part 2: Short Response
Answer the questions in the spaces provided

13.   Magnetite (Fe_3O_4) is a type of iron ore. The extraction of iron from this ore can be represented by the following equation:

$Fe_3O_{4(s)} + 4C_{(s)} \rightarrow 3Fe_{(s)} + 4CO_{(g)}$
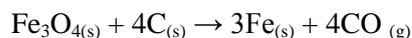
Calculate the mass of iron that can be extracted from 5.00×10^3 g of ore if it contains 90.0% $Fe_3O_4.$
(3 marks)

_____
_____
_____
_____
_____

14.   Copper metal reacts with concentrated nitric acid to produce nitric oxide (nitrogen (II) oxide) gas according to the equation:

$3Cu(s) + 8HNO_{3(aq)} \rightarrow 3Cu(NO_3)_{2(aq)} + 2NO_{(g)} + 4H_2O_{(l)}$
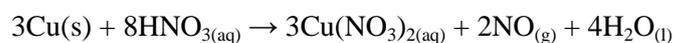
a) **Calculate** the mass of copper (II) nitrate that would be produced if exactly 2.50 g of copper reacted completely according to the above equation. **(2 marks)**

_____
_____
_____
_____
_____

b) **Explain** why this reaction is an oxidation–reduction reaction. (1 mark)

_____
_____
_____

15.   The first ionisation energies (kJ mol–1) of representative elements are shown in the table below.

H							He
1318							2380
Li	Be	B	C	N	O	F	Ne
527	904	807	1090	1410	1320	1690	2090
Na	Mg	Al	Si	P	S	Cl	Ar
502	745	586	791	1020	1000	1260	1530

From the data, several general trends have been proposed. One of them is that the first ionisation energies increase across a period.

a) Taking the third period (Na → Ar) as an example, **discuss** the general trend in first ionisation energies in terms of atomic radii. (2 marks)

b) **Identify** the trend in ionisation energies down a group. (1 mark)

16.   Most metals found in the Earth's crust are combined with other elements in naturally occurring compounds called minerals. Depending on the reactivity of the metal, different techniques are used to extract these metals from their ores. Some information about the extraction of three different metals is shown below.

Metal	Formula of main mineral	Method of extraction
Iron	Fe_2O_3	Reduction with carbon or carbon monoxide
Aluminium	$Al_2O_3.3H_2O$	Electrolysis
Copper	Cu_2S	Roasting in air

a) **Arrange** these metals in order of increasing reactivity. **Justify** your choice with reference to the method of extraction. (1 mark)

b) **Explain** why the order of reactivity given in **a)** is also the same order in which these metals were initially used by humans. (1 mark)

c) **Account** for the fact that aluminium metal is more expensive than iron (1 mark)

17.   Consider the reaction when magnesium is added to dilute sulfuric acid. (4 marks)

a)   write the balance chemical equation for this reaction
b)   write the oxidation – reduction half equations

18.   Compound X has a percentage composition of 85.7% carbon and 14.3% hydrogen. The molar mass of compound X is 84 grams. Calculate the empirical and molecular formulas of compound X. (4 marks)