

Periodic Table [S]

1. The Periodic Table was originally developed as a list of atoms arranged in terms of their mass and chemical reactivity. We now think of it as a list of elements.
 - a. What order are the elements listed? **[2]**

 - b. State the name and symbol of the element in Period 5, Group 4: **[2]**

 - c. Elements can be classified as metals or non-metals.
 - i. State two properties of metals: **[2]**

 - ii. An element was combusted in oxygen and the product of the reaction dissolved in water to form a solution with pH 3. What type of element was it?
[1]

 - d. Explain why, in terms of the arrangement of electrons, two elements in the same Group undergo similar chemical reactions: **[2]**

 - e. State the name and symbol of an element that you would expect to have very small atoms and be chemically inert: **[2]**

2. Group 1 metals all highly reactive.

a. Sodium reacts violently with water to produce an alkaline solution.

i. Write a balanced equation, including state symbols, for the reaction of sodium with water: **[3]**

ii. State three observations you would make during this reaction: **[3]**

iii. Would you expect rubidium to react more or less violently than sodium? **[1]**

iv. Explain your answer to part iii: **[4]**

b. Potassium is so reactive that it tarnishes when exposed to air within seconds.

i. Write a balanced equation for the formation of potassium oxide: **[2]**

ii. State and explain the colour universal indicator would turn if added to a solution of potassium oxide in water: **[2]**

3. The Group 7 elements (the Halogens) are a series of reactive non-metals.
- a. The halogens each have distinctive physical properties. State the difference between bromine and iodine in terms of:
- State at room temperature and pressure: **[2]**
 - Colour: **[2]**
- b. Hydrogen chloride is a colourless gas that dissolves in water.
- Write a balanced equation, with state symbols, for the formation of hydrogen chloride: **[3]**
 - State the colour change you would observe during the reaction in part i: **[2]**
 - Explain why hydrogen chloride dissolved in water turns blue litmus paper red but hydrogen chloride dissolved in methylbenzene does not: **[4]**
- c. Fluorine is a yellow gas at room temperature and pressure.
- State whether it is more or less reactive than iodine: **[1]**

ii. Explain your answer to part i: **[4]**

d. You are provided with bottles of the following solutions. Explain how, using the word *oxidise*, you could show that iodine is less reactive than bromine: **[5]**

KCl(aq), KBr(aq), KI(aq)

Cl₂(aq), Br₂(aq), I₂(aq)

4. Oxygen is a reactive gas at room temperature and pressure.

a. It can be produced by the decomposition of hydrogen peroxide (H₂O₂):

i. Write a balanced equation for this reaction: **[2]**

ii. State a suitable catalyst for this reaction: **[1]**

b. State the percentage of oxygen in air at atmospheric pressure: **[1]**

- c. Other elements can combust in oxygen.
- i. Write a balanced equation for the combustion of sulphur: **[2]**
 - ii. This reaction occurs as a side-reaction in various industrial processes. Explain how it contributes towards acid rain: **[2]**
- d. Write a balanced equation for the combustion of hydrogen: **[2]**
- e. Carbon also combusts in plentiful oxygen to form carbon dioxide.
- i. State two uses for carbon dioxide: **[2]**
 - ii. Describe one other way, including a balanced equation, to produce carbon dioxide: **[3]**
 - iii. Describe the test for carbon dioxide: **[2]**

Periodic Table [S]

1. The Periodic Table was originally developed as a list of atoms arranged in terms of their mass and chemical reactivity. We now think of it as a list of elements.

a. What order are the elements listed? [2]

increasing... [1] ... atomic number [1]

b. State the name and symbol of the element in Period 5, Group 4: [2]

Sn [1], tin [1]

c. Elements can be classified as metals or non-metals.

i. State two properties of metals: [2]

conduct electricity, malleable, ductile, alkaline/basic oxide, dense

[1] each, maximum [2]

ii. An element was combusted in oxygen and the product of the reaction

dissolved in water to form a solution with pH 3. What type of element was it?

[1]

non-metal [1]

d. Explain why, in terms of the arrangement of electrons, two elements in the same Group undergo similar chemical reactions: [2]

chemical reactions depend on outer-shell electrons [1]

two elements in the same group have the same number of outer-shell electrons [1]

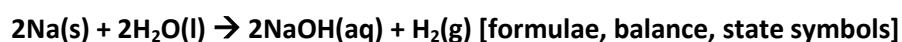
e. State the name and symbol of an element that you would expect to have very small atoms and be chemically inert: [2]

He [1], helium [1] (allow Ne, neon although clearly He is smaller)

2. Group 1 metals all highly reactive.

a. Sodium reacts violently with water to produce an alkaline solution.

i. Write a balanced equation, including state symbols, for the reaction of sodium with water: **[3]**



ii. State three observations you would make during this reaction: **[3]**

fizzing, Na floats, Na moves around, Na disappears, heat given off

[1] each, maximum [3]

iii. Would you expect rubidium to react more or less violently than sodium? **[1]**

more violently [1]

iv. Explain your answer to part iii: **[4]**

rubidium has more electron shells [1]

so its outer electron is further from the nucleus [1]

which means it is held there less strongly [1]

and is therefore more easily lost [1]

b. Potassium is so reactive that it tarnishes when exposed to air within seconds.

i. Write a balanced equation for the formation of potassium oxide: **[2]**



ii. State and explain the colour universal indicator would turn if added to a solution of potassium oxide in water: **[2]**

purple/blue [1], because solution is alkaline [1]

3. The Group 7 elements (the Halogens) are a series of reactive non-metals.
- a. The halogens each have distinctive physical properties. State the difference between bromine and iodine in terms of:
- State at room temperature and pressure: **[2]**
bromine is liquid [1], iodine is solid [1]
 - Colour: **[2]**
bromine is red/brown [1], iodine is grey (NOT purple) [1]
- b. Hydrogen chloride is a colourless gas that dissolves in water.
- Write a balanced equation, with state symbols, for the formation of hydrogen chloride: **[3]**
 $\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{HCl}(\text{g})$ [formulae, balance, state symbols]
 - State the colour change you would observe during the reaction in part i: **[2]**
green [1] to colourless [1]
 - Explain why hydrogen chloride dissolved in water turns blue litmus paper red but hydrogen chloride dissolved in methylbenzene does not: **[4]**
HCl dissociates to give H^+ in water [1]
so it is acidic and turns blue litmus to red [1]
HCl does not dissociate in methylbenzene so there's no H^+ [1]
so it is not acidic and blue litmus remains the same colour [1]
- c. Fluorine is a yellow gas at room temperature and pressure.
- State whether it is more or less reactive than iodine: **[1]**
more reactive [1]

ii. Explain your answer to part i: [4]

fluorine has less shells [1]

so the incoming electron is closer to the nucleus [1]

so its attraction to the nucleus is greater [1]

so it is more readily added to the atom [1]

d. You are provided with bottles of the following solutions. Explain how, using the word *oxidise*, you could show that iodine is less reactive than bromine: [5]

KCl(aq), KBr(aq), KI(aq)

Cl₂(aq), Br₂(aq), I₂(aq)

add Br₂(aq) to KI(aq) [1]

the colour changes from orange [1] to brown (NOT purple) [1]

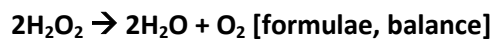
this shows that iodine has been oxidised by bromine [1]

so iodine must be less reactive than bromine [1]

4. Oxygen is a reactive gas at room temperature and pressure.

a. It can be produced by the decomposition of hydrogen peroxide (H₂O₂):

i. Write a balanced equation for this reaction: [2]



ii. State a suitable catalyst for this reaction: [1]

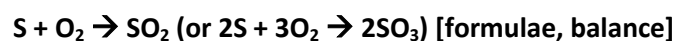
iron oxide, manganese oxide, copper oxide [1 for any]

b. State the percentage of oxygen in air at atmospheric pressure: [1]

21%

c. Other elements can combust in oxygen.

i. Write a balanced equation for the combustion of sulphur: **[2]**



ii. This reaction occurs as a side-reaction in various industrial processes. Explain how it contributes towards acid rain: **[2]**

SO_2 (or SO_3) dissolves in rainwater [1]

to form an acidic solution [1]

d. Write a balanced equation for the combustion of hydrogen: **[2]**



e. Carbon also combusts in plentiful oxygen to form carbon dioxide.

i. State two uses for carbon dioxide: **[2]**

carbonated drinks [1]

fire extinguishers [1]

ii. Describe one other way, including a balanced equation, to produce carbon dioxide: **[3]**

heat a metal carbonate [1] OR add an acid to a metal carbonate [1]

collect the gas that forms [1]

under water [1] OR by displacement of water [1]

iii. Describe the test for carbon dioxide: **[2]**

Bubble through limewater [1], which goes cloudy [1]