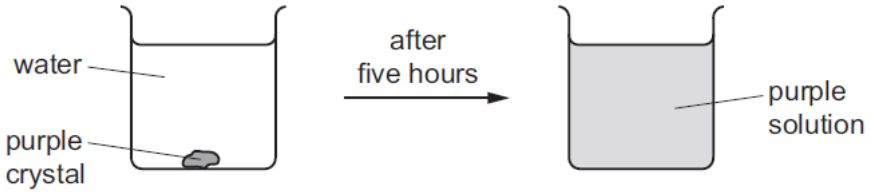
Stoichiometry – 2023 June IGCSE Chemistry 0620

1. June/2023/Paper_ 0620/11/No.8

The diagram shows the result of dropping a purple crystal into water.



Which processes take place in this experiment?

	chemical reaction	diffusing	dissolving
A	✓	✓	✗
B	✓	✗	✗
C	✗	✗	✓
D	✗	✓	✓

2. June/2023/Paper_ 0620/12/No.7

Sodium burns in oxygen to form sodium oxide.

What is the balanced equation for the reaction?

A $4Na + 2O \rightarrow 2Na_2O$

B $4Na + O_2 \rightarrow 2Na_2O$

C $2Na_2 + O_2 \rightarrow 2Na_2O$

D $2Na_2 + 2O \rightarrow 2Na_2O$

3. June/2023/Paper_ 0620/13/No.8

The compound magnesium nitrate has the formula $Mg(NO_3)_2$.

What is the relative formula mass of magnesium nitrate?

A 86 **B** 134 **C** 148 **D** 172

4. June/2023/Paper_ 0620/21/No.8

Heating iron sulfide, FeS_2, in air produces sulfur dioxide.

$$4FeS_2 + 11O_2 \rightarrow 2Fe_2O_3 + 8SO_2$$

What is the maximum mass of sulfur dioxide produced from 120 kg of iron sulfide?

A 64 kg **B** 128 kg **C** 240 kg **D** 512 kg

5. June/2023/Paper_ 0620/22/No.7

Which sample contains the largest number of molecules?

A 16 g of methane, $CH_4(g)$

B 16 g of oxygen, $O_2(g)$

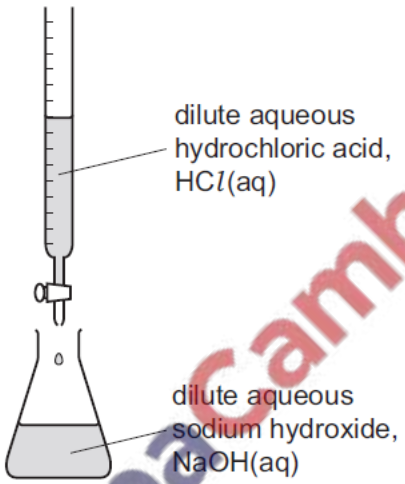
C 16 g of phosphorus, $P_4(s)$

D 16 dm^3 of methane at r.t.p., $CH_4(g)$

6. June/2023/Paper_ 0620/22/No.8

The concentration of a sample of dilute aqueous sodium hydroxide is found by titration.

The apparatus used is shown.



Which information is needed to calculate the concentration of the dilute aqueous sodium hydroxide in mol / dm^3?

	concentration of HCl	volume of HCl used	molar mass of HCl	volume of NaOH used	molar mass of NaOH
A	✓	✓	✓	✓	✓
B	✓	✓	✗	✓	✗
C	✗	✓	✓	✓	✗
D	✓	✗	✗	✗	✓

key

✓ = needed

✗ = not needed

7. June/2023/Paper_ 0620/23/No.9

What is the formula of potassium oxide?

A P_2O **B** PO_2 **C** KO **D** K_2O

8. June/2023/Paper_ 0620/31/No.3(d_ e)

(d) Copper(II) sulfate can be used to test for the presence of water.

$$CuSO_4(s) + 5H_2O(l) \rightleftharpoons CuSO_4 \cdot 5H_2O(s)$$

anhydrous copper(II) sulfate — hydrated copper(II) sulfate

(i) State the meaning of the term hydrated.

..... [1]

(ii) Describe how hydrated copper(II) sulfate is changed to anhydrous copper(II) sulfate.

..... [1]

(e) Complete the symbol equation for the reaction of sodium with water.

$$2Na + ...H_2O \rightarrow 2NaOH + ...$$ [2]

9. June/2023/Paper_ 0620/32/No.3(b_d)

(b) Table 3.1 shows the masses of ions, in mg, present in a 1000 cm^3 sample of polluted water.

Table 3.1

name of ion	formula of ion	mass of ion present in mg / 1000 cm^3 of polluted water
ammonium	NH_4^+	0.5
calcium	Ca^{2+}	1.8
chloride	Cl^-	2.0
copper(II)	Cu^{2+}	0.3
hydrogencarbonate	HCO_3^-	8.0
magnesium	Mg^{2+}	1.6
	NO_3^-	0.6
potassium	K^+	8.3
silicate	SiO_3^{2-}	5.0
sodium	Na^+	5.2
sulfate	SO_4^{2-}	0.2

Answer these questions using information from Table 3.1.

(i) Name the positive ion present in the highest concentration.

..... [1]

(ii) State the name of the NO_3^- ion.

..... [1]

(iii) Calculate the mass of magnesium ions present in 250 cm^3 of polluted water.

mass = ... mg [1]

(c) Water is produced when blue copper(II) sulfate is heated.

$$\underset{\text{blue copper(II) sulfate}}{CuSO_4 \cdot 5H_2O(s)} \rightleftharpoons \underset{\text{white copper(II) sulfate}}{CuSO_4(s)} + 5H_2O(l)$$

(i) Describe how white copper(II) sulfate can be changed to blue copper(II) sulfate.

..... [1]

(ii) Choose a word from the list which best describes white copper(II) sulfate.

Draw a circle around your chosen answer.

anhydrous **aqueous** **hydrated** **oxidised** [1]

(d) Complete the symbol equation for the reaction of calcium with water.

$$Ca + ...H_2O \rightarrow Ca(OH)_2 + ...$$ [2]

10. June/2023/Paper_ 0620/33/No.3(b _ d)

(b) Table 3.1 shows the masses of ions, in mg, present in 1000 cm^3 of polluted water.

Table 3.1

name of ion	formula of ion	mass of ion present in mg / 1000 cm^3 of polluted water
ammonium	NH_4^+	1.2
calcium	Ca^{2+}	2.2
chloride	Cl^-	2.5
hydrogencarbonate	HCO_3^-	13.0
magnesium	Mg^{2+}	1.0
nickel(II)	Ni^{2+}	0.2
nitrate	NO_3^-	0.4
potassium	K^+	6.3
silicate	SiO_3^{2-}	8.0
sodium	Na^+	12.2
	SO_4^{2-}	0.1

Answer these questions using information from Table 3.1.

(i) Name the positive ion present in the lowest concentration.

..... [1]

(ii) State the name of the ion SO_4^{2-}.

..... [1]

(iii) Calculate the mass of calcium ions present in 250 cm^3 of polluted water.

mass = ... mg [1]

(c) Cobalt(II) chloride can be used to test for the presence of water.

$$CoCl_2(s) + 6H_2O(l) \rightleftharpoons CoCl_2 \cdot 6H_2O(s)$$

blue cobalt(II) chloride — pink cobalt(II) chloride

(i) Describe how pink cobalt(II) chloride can be changed to blue cobalt(II) chloride.

..... [1]

(ii) Choose a word from the list which best describes pink cobalt(II) chloride.

Draw a circle around your chosen answer.

anhydrous **hydrated** **liquid** **reduced** [1]

(d) Iron reacts with steam to form Fe_3O_4 and a gas which pops with a lighted splint.

Complete the symbol equation for this reaction.

$$3Fe + ...H_2O \rightarrow Fe_3O_4 + 4.....$$ [2]

11. June/2023/Paper_ 0620/41/No.4(d)

Oxygen is produced by the decomposition of aqueous hydrogen peroxide. Manganese(IV) oxide, MnO_2, is a catalyst for this reaction.

(d) The equation for the decomposition of aqueous hydrogen peroxide, $H_2O_2(aq)$, is shown.

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

$50.0\,cm^3$ of a $0.200\,mol/dm^3$ solution of $H_2O_2(aq)$ is used.

Calculate the mass of O_2 that forms.
Use the following steps.

- Calculate the number of moles of H_2O_2 used.

..... mol

- Determine the number of moles of O_2 produced.

..... mol

- Calculate the mass of O_2 produced.

..... g
[3]

12. June/2023/Paper_ 0620/42/No.4(g)

(g) In a titration, 25.0 cm^3 of 0.0800 mol/dm^3 aqueous potassium hydroxide, KOH(aq), is neutralised by 20.0 cm^3 of dilute sulfuric acid, $H_2SO_4(aq)$.

$$2KOH(aq) + H_2SO_4(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$$

Calculate the concentration of H_2SO_4, in g/dm^3 using the following steps.

- Calculate the number of moles of KOH used.

..... mol

- Determine the number of moles of H_2SO_4 which react with the KOH.

..... mol

- Calculate the concentration of H_2SO_4 in mol/dm^3.

..... mol/dm^3

- Calculate the concentration of H_2SO_4 in g/dm^3.

..... g/dm^3

[5]

13. June/2023/Paper_ 0620/43/No.4(c, d)

(c) The equation for the reaction is shown.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$$

25.0 cm^3 of 2.00 mol/dm^3 $H_2SO_4(aq)$ is added to excess zinc.

Calculate the volume of H_2 formed at room temperature and pressure (r.t.p.). The volume of one mole of any gas is 24 dm^3 at r.t.p.
Use the following steps.

- Calculate the number of moles of H_2SO_4 used.

..... mol

- Deduce the number of moles of H_2 produced.

..... mol

- Calculate the volume of H_2 formed at r.t.p.

..... dm^3
[3]

(d) Hydrogen can also be produced by the reaction of zinc with dilute hydrochloric acid.

(i) Write a symbol equation for this reaction.

..... [2]

(ii) State the test for hydrogen gas.

test .....

positive result .....
[1]

14. March/2023/Paper_ 0620/12/No.8

Methane, CH_4, burns in air to form carbon dioxide and water.

What is the balanced equation for this reaction?

A $CH_4(g) + O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

B $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

C $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + H_2O(g)$

D $CH_4(g) + 3O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

15. March/2023/Paper_ 0620/12/No.9

Magnesium reacts with steam.

$$Mg + H_2O \rightarrow MgO + H_2$$

When 2.43 g of magnesium reacts with an excess of steam, the products are 4.03 g of magnesium oxide and 0.20 g of hydrogen.

What is produced when 7.29 g of magnesium reacts with an excess of steam?

A 1.34 g of magnesium oxide and 0.07 g of hydrogen

B 4.03 g of magnesium oxide and 0.20 g of hydrogen

C 8.06 g of magnesium oxide and 0.40 g of hydrogen

D 12.09 g of magnesium oxide and 0.60 g of hydrogen

16. March/2023/Paper_ 0620/22/No.8

Methane, CH_4, burns in air to form carbon dioxide and water.

What is the balanced equation for this reaction?

A $CH_4(g) + O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

B $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

C $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + H_2O(g)$

D $CH_4(g) + 3O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

17. March/2023/Paper_ 0620/22/No.9

The equation for the thermal decomposition of sodium hydrogencarbonate is shown.

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

The M_r of sodium hydrogencarbonate, $NaHCO_3$, is 84.

The M_r of sodium carbonate, Na_2CO_3, is 106.

In an experiment, 2.1 g of sodium hydrogencarbonate is heated but not all of it decomposes. All of the carbon dioxide is collected and measured at room temperature and pressure. The total volume of carbon dioxide produced is 0.21 dm^3.

The volume of 1 mole of a gas at room temperature and pressure is 24 dm^3.

Which statement is correct?

A The mass of sodium carbonate produced is 0.93 g.

B The mass of sodium carbonate produced is 1.33 g.

C The percentage yield of carbon dioxide is 10%.

D The percentage yield of carbon dioxide is 35%.

18. March/2023/Paper_ 0620/32/No.2(b)

(b) Table 2.1 shows the masses of some of the ions in 1000 cm^3 of the solution obtained by filtering a sample of soil with distilled water.

Table 2.1

name of ion	formula of ion	mass of ion in 1000 cm^3 of solution / mg
ammonium	NH_4^+	25.0
calcium	Ca^{2+}	0.4
chloride	Cl^-	0.5
iron(II)	Fe^{2+}	27.0
magnesium	Mg^{2+}	4.0
nitrate	NO_3^-	23.0
phosphate	PO_4^{3-}	15.5
potassium	K^+	29.0
sodium	Na^+	2.0
	SO_4^{2-}	6.0

Answer these questions using the information in Table 2.1.

(i) Name the negative ion that has the lowest concentration.

..... [1]

(ii) State the name of the SO_4^{2-} ion.

..... [1]

(iii) Calculate the mass of phosphate ions in 200 cm^3 of the solution.

mass = ... mg [1]

(d) Hydrated copper(II) sulfate is a coloured compound. It exists as hydrated crystals which contain water molecules.

(i) State the term given to water molecules present in hydrated crystals.

..... [1]

(ii) State the colour of hydrated copper(II) sulfate crystals.

..... [1]

(iii) Write the formula of hydrated copper(II) sulfate.

..... [2]

(e) Copper(II) oxide is formed when copper(II) nitrate, $Cu(NO_3)_2$, is heated.

$$2Cu(NO_3)_2(s) \rightarrow 2CuO(s) + 4NO_2(g) + O_2(g)$$

(i) State the class of oxide to which copper(II) oxide belongs.

..... [1]

(ii) State the meaning of the Roman numeral (II) in the name copper(II) oxide.

..... [1]

(iii) 0.0200 moles of $Cu(NO_3)_2$ is heated.

Calculate the mass of 0.0200 moles of $Cu(NO_3)_2$.

mass = ... g [2]

(iv) Calculate the **total** volume of gas, in dm^3 at r.t.p., produced when 0.0200 moles of $Cu(NO_3)_2$ is heated.

volume = ... dm^3 [2]

(v) Powdered aluminium reduces copper(II) oxide.

Write the symbol equation for this reaction.

..... [2]