Stoichiometry – 2023 IGCSE Chemistry 0620

1. Nov/2023/Paper_0620/11/No.7

Which equations are balanced?

1 $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

2 $ZnCO_3 + 2HCl \rightarrow ZnCl_2 + CO_2 + 2H_2O$

3 $Mg(NO_3)_2 + NaOH \rightarrow Mg(OH)_2 + 2NaNO_3$

4 $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

2. Nov/2023/Paper_0620/11/No.8

The equation for the combustion of methane is shown.

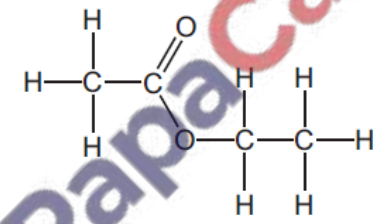
$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Which mass of methane produces 36 g of water?

A 16 g **B** 18 g **C** 32 g **D** 64 g

3. Nov/2023/Paper_0620/12/No.8

The diagram shows the structure of a molecule of ethyl ethanoate.



What is the molecular formula of a molecule of ethyl ethanoate?

A CHO **B** $C_4H_8O_2$ **C** $C_4(H_2)_2(O_2)$ **D** C_2H_4O

4. Nov/2023/Paper_0620/12/No.9

The formula of a compound containing element X is $Na_2X_2O_3$.

The relative formula mass of the compound is 158.

What is the relative atomic mass of X?

A 32 **B** 59.5 **C** 64 **D** 119

5. Nov/2023/Paper_0620/13/No.7

The equation represents the reaction between solid magnesium oxide and dilute hydrochloric acid to form magnesium chloride and water.

$$MgO + 2HCl \rightarrow MgCl_2 + H_2O$$

Which row shows the state symbols for hydrochloric acid, magnesium chloride and water?

	HCl	$MgCl_2$	H_2O
A	(aq)	(aq)	(l)
B	(aq)	(l)	(l)
C	(l)	(aq)	(aq)
D	(l)	(l)	(aq)

6. Nov/2023/Paper_0620/13/No.8

Calcium nitrate has the formula $Ca(NO_3)_2$.

What is the relative formula mass, M_r, of calcium nitrate?

A 102 **B** 150 **C** 164 **D** 204

7. Nov/2023/Paper_0620/13/No.9

What is the equation for the reaction between calcium and chlorine?

A $2Ca + Cl \rightarrow Ca_2Cl$

B $2Ca + Cl_2 \rightarrow Ca_2Cl_2$

C $Ca + Cl \rightarrow CaCl$

D $Ca + Cl_2 \rightarrow CaCl_2$

8. Nov/2023/Paper_0620/21/No.6

Which equations are balanced?

1 $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

2 $ZnCO_3 + 2HCl \rightarrow ZnCl_2 + CO_2 + 2H_2O$

3 $Mg(NO_3)_2 + NaOH \rightarrow Mg(OH)_2 + 2NaNO_3$

4 $CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + H_2O + CO_2$

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

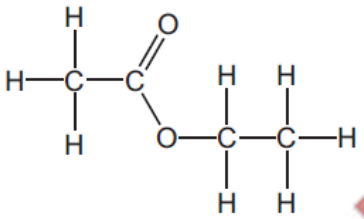
9. Nov/2023/Paper_0620/21/No.7

Which row shows the formulae of sodium carbonate, zinc nitrate and ammonium sulfate?

	sodium carbonate	zinc nitrate	ammonium sulfate
A	Na_2CO_3	$ZnNO_3$	$(NH_4)_2SO_4$
B	Na_2CO_3	$Zn(NO_3)_2$	$(NH_4)_2SO_4$
C	$NaCO_3$	$ZnNO_3$	$(NH_3)_2SO_4$
D	$NaCO_3$	$Zn(NO_3)_2$	$(NH_3)_2SO_4$

10. Nov/2023/Paper_0620/22/No.7

The diagram shows the structure of a molecule of ethyl ethanoate.



What is the molecular formula of a molecule of ethyl ethanoate?

A CHO **B** $C_4H_8O_2$ **C** $C_4(H_2)_2(O_2)$ **D** C_2H_4O

11. Nov/2023/Paper_0620/22/No.8

A hydrocarbon contains 85.7% of carbon by mass.

What is the empirical formula of the hydrocarbon?

A CH_2 **B** CH_4 **C** C_2H_5 **D** C_3H_6

12. Nov/2023/Paper_0620/22/No.9

The formula of a compound containing element X is $Na_2X_2O_3$.

The relative formula mass of the compound is 158.

What is the relative atomic mass of X?

A 32 **B** 59.5 **C** 64 **D** 119

13. Nov/2023/Paper_0620/23/No.7

The equation represents the reaction between solid magnesium oxide and dilute hydrochloric acid to form magnesium chloride and water.

$$MgO + 2HCl \rightarrow MgCl_2 + H_2O$$

Which row shows the state symbols for hydrochloric acid, magnesium chloride and water?

	HCl	$MgCl_2$	H_2O
A	(aq)	(aq)	(l)
B	(aq)	(l)	(l)
C	(l)	(aq)	(aq)
D	(l)	(l)	(aq)

14. Nov/2023/Paper_0620/23/No.9

Which substance is a mixture?

A air

B graphite

C oxygen

D water

15. Nov/2023/Paper_0620/23/No.10

1.0 mol of silver nitrate, $AgNO_3$, contains 1.2×10^{24} ions.

How many ions are there in 0.25 mol of iron(III) oxide, Fe_2O_3?

A 1.5×10^{23} **B** 3.0×10^{23} **C** 7.5×10^{23} **D** 3.0×10^{24}

16. Nov/2023/Paper_0620/31/No.3(a)

(a) Table 3.1 shows the average concentrations, in ng / 1000 cm^3, of air pollutants in four different years.

Table 3.1

year	concentration of air pollutant in ng / 1000 cm^3				
	ammonia	hydrocarbons	oxides of nitrogen	particulates	sulfur dioxide
2019	10.6	12.0	15.3	30.1	20.5
2020	11.2	13.0	21.6	28.2	20.0
2021	14.3	15.2	23.5	26.5	25.0
2022	15.5	9.0	14.0	25.2	18.2

(i) Name the pollutant that has the lowest concentration in 2019.

..... [1]

(ii) Name the pollutant that shows a continuous decrease in concentration from 2019 to 2022.

..... [1]

(iii) Calculate the average mass, in ng, of sulfur dioxide in a 250 cm^3 sample of polluted air in 2020.

mass = ... ng [1]

17. Nov/2023/Paper_0620/32/No.3(a)

(a) Table 3.1 shows the average concentrations, in ng / 1000 cm^3, of air pollutants in four different years.

Table 3.1

year	concentration of air pollutant in ng / 1000 cm^3				
	carbon monoxide	hydrocarbons	oxides of nitrogen	particulates	sulfur dioxide
2019	2.5	12.0	19.6	28.0	30.0
2020	2.0	13.5	21.8	30.1	21.7
2021	1.8	14.8	18.5	27.5	23.8
2022	1.6	16.0	22.7	26.2	25.0

(i) Name the oxide pollutant that has the highest concentration in 2021.

..... [1]

(ii) Name the pollutant that shows a continuous decrease in concentration from 2019 to 2022.

..... [1]

(iii) Calculate the average mass, in ng, of particulates in a 250 cm^3 sample of polluted air in 2019.

mass = ... ng [1]

18. Nov/2023/Paper_0620/33/No.3(a)

(a) Table 3.1 shows the average concentrations, in ng / 1000 cm^3, of air pollutants in four different years.

Table 3.1

year	concentration of air pollutant in ng / 1000 cm^3				
	carbon monoxide	hydrocarbons	oxides of nitrogen	particulates	sulfur dioxide
2019	5.3	22.0	15.6	19.0	20.0
2020	4.1	13.5	14.8	20.1	18.2
2021	5.8	14.8	22.7	23.5	16.2
2022	2.6	18.0	10.9	26.2	14.0

(i) Name the pollutant which has the highest concentration in 2019.

..... [1]

(ii) Name the pollutant that shows a continuous decrease in concentration from 2019 to 2022.

..... [1]

(iii) Calculate the average mass, in ng, of hydrocarbons in a 200 cm^3 sample of polluted air in 2019.

mass = ... ng [1]

19. Nov/2023/Paper_0620/41/No.2(b)

Boron and aluminium are Group III elements.

(b) The relative atomic mass of boron to one decimal place is 10.8.

(i) Determine the relative abundance of ^{10}B present in boron. Give your answer as a percentage.

..... % [1]

(ii) Use the relative atomic mass of boron to calculate the number of atoms in 0.540 g of boron. Give your answer in standard form.

number of atoms = ... [2]

20. Nov/2023/Paper_0620/41/No.4(c, d)

Aqueous hydrogen peroxide, H_2O_2, slowly forms water and oxygen at room temperature and pressure, r.t.p. This reaction is catalysed by manganese(IV) oxide.

The equation is shown.

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

(c) Manganese(IV) oxide is added to 20 cm^3 of aqueous hydrogen peroxide. The total volume of oxygen gas produced is 72 cm^3 at r.t.p.

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

Calculate the concentration of the aqueous hydrogen peroxide in g/dm^3 using the following steps.

- Calculate the number of moles of oxygen gas produced.

..... mol

- Determine the number of moles of hydrogen peroxide which reacts.

..... mol

- Calculate the concentration of aqueous hydrogen peroxide in mol/dm^3.

..... mol/dm^3

- Calculate the concentration of aqueous hydrogen peroxide in g/dm^3.

..... g/dm^3
[5]

(d) Suggest the identity of one **other** metal oxide which also catalyses this reaction.

..... [1]

21. Nov/2023/Paper_0620/43/No.4(c)

This question is about sulfuric acid and salts that are made from sulfuric acid.

(c) Nickel(II) sulfate crystals contain water of crystallisation.

When nickel(II) sulfate crystals, $NiSO_4 \cdot xH_2O$, are heated, they give off water.

$$NiSO_4 \cdot xH_2O(s) \rightarrow NiSO_4(s) + xH_2O(g)$$

A student carries out an experiment to determine the value of **x** in $NiSO_4 \cdot xH_2O$.

step 1 Nickel(II) sulfate crystals are weighed.

step 2 Nickel(II) sulfate crystals are heated.

step 3 The remaining solid is allowed to cool and is then weighed.

step 4 The remaining solid is heated again, allowed to cool and is then weighed.

step 5 Step 4 is repeated until there is no change in mass.

(i) State the term used to describe crystals that contain water of crystallisation.

..... [1]

(ii) State why **step 4** is repeated until there is no change in mass.

..... [1]

(iii) In an experiment, 0.454 g of nickel(II) sulfate crystals, $NiSO_4 \cdot xH_2O$, is used. The mass of anhydrous nickel(II) sulfate, $NiSO_4$, remaining is 0.310 g.

[M_r: $NiSO_4$, 155; H_2O, 18]

Determine the value of **x** in $NiSO_4 \cdot xH_2O$.

Use the following steps.

- Calculate the number of moles of $NiSO_4$ remaining.

moles of $NiSO_4$ = ...

- Calculate the mass of H_2O given off.

mass of H_2O = ... g

- Calculate the number of moles of H_2O given off.

moles of H_2O = ...

- Calculate the value of **x**.

x = ...
[4]