Stoichiometry – 2020 O Level

1. Nov/2021/Paper_11/No.13

Which contains the greatest mass of oxygen?

A 0.2 mol of aluminium nitrate, $Al(NO_3)_3$

B 0.3 mol of potassium sulfate, K_2SO_4

C 0.4 mol of sodium nitrate, $NaNO_3$

D 0.5 mol of magnesium carbonate, $MgCO_3$

2. Nov/2021/Paper_11/No.14

Compound X has a composition by mass of 63.6 % nitrogen and 36.4 % oxygen.

What is the empirical formula of X?

A N_2O **B** NO **C** NO_2 **D** N_2O_4

3. Nov/2021/Paper_11/No.15

The table gives the relative formula mass of four compounds and the mass of each compound present in 1 dm^3 of solution.

Which solution has the highest concentration in mol / dm^3?

	solution	relative formula mass	mass of compound in 1 dm^3 of solution / g
A	HCl	36.5	3.65
B	H_2SO_4	98	9.80
C	KOH	56	2.80
D	$NaOH$	40	6.00

4. Nov/2021/Paper_11/No.16

Which sample contains the most atoms?

A 0.5 mol of water

B 1.0 mol of carbon dioxide

C 1.0 mol of methane

D 2.0 mol of hydrogen chloride

5. Nov/2021/Paper_12/No.7

A sample of a gas occupies a volume of 2.0 dm^3 at room temperature and pressure.

Which changes in the conditions would both decrease the volume occupied by the gas?

	temperature	pressure
A	decreased	decreased
B	increased	decreased
C	decreased	increased
D	increased	increased

6. Nov/2021/Paper_12/No.14

A sample of magnesium hydroxide has a mass of 4.63 g.

How many moles of magnesium hydroxide are present?

A 0.0617 **B** 0.0798 **C** 0.113 **D** 0.154

7. Nov/2021/Paper_12/No.15

Which statement is correct?

A The concentration of a solution is expressed in dm^3 / mol.

B The empirical formula of a compound always gives the actual numbers of each type of atom in one molecule.

C The molecular formula of a compound always contains more atoms than the empirical formula.

D The relative atomic mass of an element is $\frac{\text{the average mass of one atom of the element}}{\frac{1}{12}\text{ the mass of one atom of carbon-12}}$.

8. Nov/2021/Paper_12/No.16

Which sample contains the most atoms?

A 0.5 mol of water

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9. Nov/2021/Paper_12/No.17

The equation shows the production of iron by the reduction of iron(III) oxide.

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

80 tonnes of iron(III) oxide produces 50 tonnes of iron.

What is the percentage yield?

A 45% **B** 63% **C** 68% **D** 89%

10. Nov/2021/Paper_21/No.3e

A 2.25 g sample of an oxide of copper contains 0.250 g of oxygen.

Deduce the empirical formula of this oxide of copper.

[3]

(d) Fluorine reacts with aqueous sodium hydroxide to produce sodium fluoride, NaF, water and oxygen.

$$2F_2 + 4NaOH \rightarrow 4NaF + 2H_2O + O_2$$

Calculate the maximum volume of oxygen produced, in dm^3, at room temperature and pressure, when 0.037 mol of sodium hydroxide react completely with fluorine.

Give your answer to **two** significant figures.

volume of oxygen ..... dm^3 [2]

12. Nov/2021/Paper_21/No.8a

(a) Dilute nitric acid reacts with aqueous barium hydroxide.

$$2HNO_3(aq) + Ba(OH)_2(aq) \rightarrow Ba(NO_3)_2(aq) + 2H_2O(l)$$

(i) A student titrates $25.0\,cm^3$ of dilute nitric acid with $0.0450\,mol/dm^3$ barium hydroxide using methyl orange as an indicator.

A volume of $34.0\,cm^3$ of aqueous barium hydroxide reacts exactly with the dilute nitric acid.

Calculate the concentration of the dilute nitric acid.

concentration of nitric acid ..... mol/dm^3 [3]

(ii) Describe how to prepare pure dry crystals of barium nitrate from aqueous barium nitrate.

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..... [3]

13. Nov/2021/Paper_22/No.2e

A 36.3 g sample of a compound contains 14.4 g carbon, 0.600 g hydrogen and 21.3 g chlorine.

(i) Calculate the empirical formula of this compound.

[2]

(ii) The relative molecular mass of this compound is 181.5.

Deduce the molecular formula of this compound.

[1]

(d) Water and oxygen are formed when aqueous hydrogen peroxide decomposes.

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

Calculate the maximum volume of oxygen, at room temperature and pressure, which is produced by the complete decomposition of a solution containing 16.0 g of hydrogen peroxide.

Give your answer to **three** significant figures.

volume of oxygen ..... dm^3 [3]

15. Nov/2021/Paper_22/No.8a

(a) Dilute sulfuric acid reacts with aqueous sodium hydroxide as shown.

$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

(i) A student titrates 25.0 cm^3 of dilute sulfuric acid with sodium hydroxide of concentration 0.0150 mol/dm^3, using litmus as an indicator.

A volume of 24.0 cm^3 of aqueous sodium hydroxide reacts exactly with the dilute sulfuric acid.

Calculate the concentration of the dilute sulfuric acid.

concentration of dilute sulfuric acid ..... mol/dm^3

[3]

(ii) Describe how to prepare pure dry crystals of sodium sulfate from aqueous sodium sulfate.

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16. Jun/2020/Paper_11/No.13

A chicken egg has a mass of 60 g. The egg shell is 10% of the total mass. The egg shell is made of calcium carbonate.

What is the mass of calcium in the egg shell?

A 0.24 g **B** 0.40 g **C** 2.4 g **D** 4.0 g

17. Jun/2020/Paper_11/No.14

Ethanol can be made by the reaction shown.

$$C_2H_5Br + NaOH \rightarrow C_2H_5OH + NaBr$$

If 5.00 g of C_2H_5Br produces 1.59 g of ethanol, what is the **molar** percentage yield of ethanol?
[M_r: C_2H_5Br, 109; C_2H_5OH, 46]

A 13% **B** 32% **C** 42% **D** 75%

18. Jun/2020/Paper_12/No.14

The expression shown for the value of A_r for fluorine is incomplete.

$$A_r \text{ (fluorine)} = \frac{\text{average mass of one .....1..... of fluorine}}{\text{.....2..... of the mass of one atom of } {}^{12}_{6}\text{C}}$$

How should the gaps in the expression be correctly completed?

	gap 1	gap 2
A	atom	$\frac{1}{6}$
B	atom	$\frac{1}{12}$
C	molecule	$\frac{1}{6}$
D	molecule	$\frac{1}{12}$

19. Jun/2020/Paper_12/No.15

A mixture of 5 cm^3 of CH_4 and 100 cm^3 of air is exploded. Assume air is 80% N_2 by volume and 20% O_2 by volume. The resulting mixture is cooled. All volumes are measured at room temperature and pressure.

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

What is the composition of the resulting gas?

	5 cm^3 of CO_2	10 cm^3 of O_2	80 cm^3 of N_2	10 cm^3 of steam
A	✓	✓	✓	✓
B	✓	✓	✓	✗
C	✓	✗	✓	✓
D	✓	✗	✓	✗

20. Jun/2020/Paper_21/No.5

Hydrochloric acid, HCl, reacts with barium hydroxide, $Ba(OH)_2$, as shown.

$$2HCl(aq) + Ba(OH)_2(aq) \rightarrow BaCl_2(aq) + 2H_2O(l)$$

A sample of $25.0\,cm^3$ of $0.0500\,mol/dm^3$ $Ba(OH)_2$ is placed in a beaker.

Dilute HCl is added slowly, from a burette, to the $Ba(OH)_2(aq)$ in the beaker.

A pH probe is used to measure the pH of the solution in the beaker until a total of $40.0\,cm^3$ of dilute HCl is added.

The table shows how the pH of the solution in the beaker changes.

volume of dilute HCl added / cm^3	pH of the solution in the beaker
0.0	13.0
5.0	12.9
10.0	12.5
15.0	11.6
20.0	7.0
25.0	3.0
30.0	1.6
35.0	1.1
40.0	0.9

(a) Explain, in terms of the ions present, why the pH of the solution in the beaker changes from 13.0 to 0.9.

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..... [2]

(b) Use the data in the table to state the volume of dilute HCl that just neutralises all of the sample of $Ba(OH)_2(aq)$.

volume of dilute HCl ..... cm^3 [1]

(c) Use your answer to **(b)** to calculate the concentration, in mol/dm^3, of the dilute HC*l*.

concentration of dilute HC*l* ..... mol/dm^3 [3]

[Total: 6]

21. Jun/2020/Paper_22/No.5

Sulfuric acid, H_2SO_4, reacts with sodium hydroxide, NaOH, as shown.

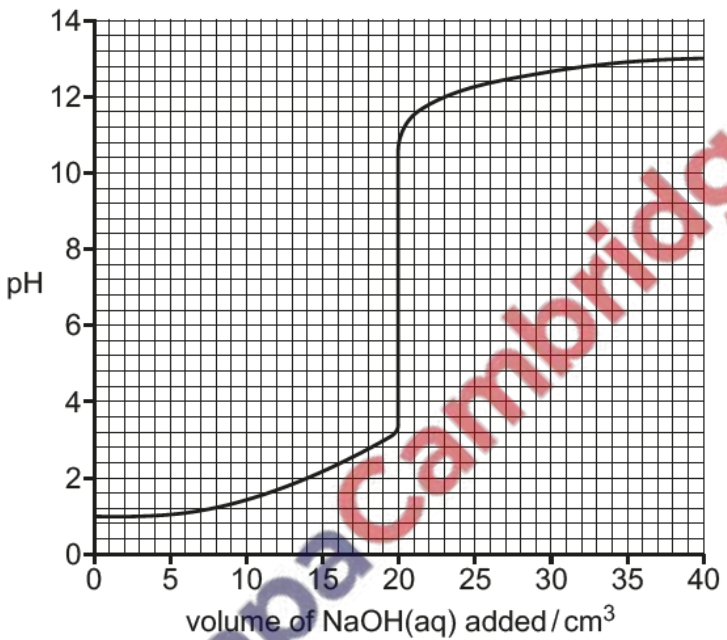
$$H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$$

A sample of 25.0 cm^3 of 0.0500 mol/dm^3 H_2SO_4 is placed in a beaker.

NaOH(aq) is added slowly, from a burette, to the H_2SO_4 in the beaker.

A pH probe is used to measure the pH of the solution in the beaker until a total of 40.0 cm^3 of NaOH(aq) is added.

The graph shows how the pH of the solution in the beaker changes.



(a) Explain, in terms of the ions present, why the pH of the solution in the beaker changes from 1.0 to 13.0.

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..... [2]

(b) Use the graph to state the volume of NaOH(aq) that just neutralises all of the H_2SO_4.

volume of NaOH(aq) ..... cm^3 [1]

(c) Use your answer to **(b)** to calculate the concentration, in mol/dm^3, of the NaOH(aq).

concentration of NaOH(aq) ..... mol/dm^3 [3]

[Total: 6]

22. Jun/2020/Paper_22/No.7c,d

(c) An oxide of phosphorus contains 43.7% by mass of phosphorus.

(i) Show that the empirical formula for this oxide is P_2O_5.

[2]

(ii) A sample of this oxide has a mass of 2.56 g.

The sample contains 0.00901 mol of the oxide.

Calculate the relative molecular mass and hence the molecular formula for this oxide of phosphorus.

relative molecular mass .....

molecular formula .....

[2]

(d) State the structure and bonding in silicon dioxide, SiO_2.

..... [1]