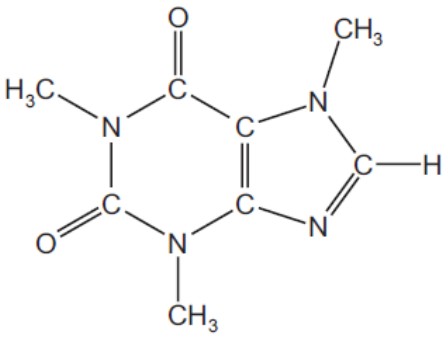
Stoichiometry – 2022 Nov IGCSE Chemistry 0620

1. Nov/2022/Paper_11/No.8

Caffeine is a stimulant found in coffee.



caffeine

Which formula represents caffeine?

A $C_7H_{10}N_4O_2$ **B** $C_8H_{10}N_3O_2$ **C** $C_8H_{10}N_4O_2$ **D** $C_8H_{11}N_4O_2$

2. Nov/2022/Paper_11/No.9

The fuel ethane, C_2H_6, burns in air to form carbon dioxide and water.

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

Which statement about burning ethane is correct?

A When one molecule of ethane burns, one molecule of water is formed.

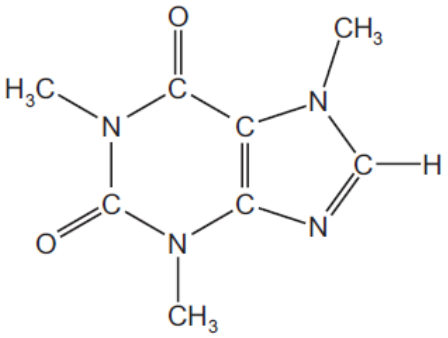
B The number of atoms at the end of the reaction is the same as at the start.

C During the reaction there is a decrease in the number of molecules.

D The reaction is endothermic.

3. Nov/2022/Paper_12/No.8

Caffeine is a stimulant found in coffee.



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4. Nov/2022/Paper_12/No.9

What is the relative formula mass of ammonium sulfate, $(NH_4)_2SO_4$?

A 63 **B** 114 **C** 118 **D** 132

5. Nov/2022/Paper_13,21,22,28/No.8

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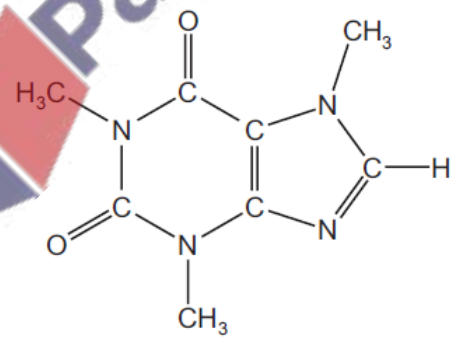

caffeine

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6. Nov/2022/Paper_13/No.9

Iron reacts with sulfuric acid to form iron(II) sulfate.

What is the equation for this reaction?

A $Fe + H_2SO_4 \rightarrow FeSO_4 + 2H$

B $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$

C $Fe + 2H_2SO_4 \rightarrow FeSO_4 + 2H_2O + SO_2$

D $2Fe + H_2SO_4 \rightarrow Fe_2SO_4 + H_2$

7. Nov/2022/Paper_21/No.9

4.55 g of zinc is reacted with 50 cm^3 of 2.25 mol / dm^3 dilute hydrochloric acid.

The equation for the reaction is shown.

$$Zn + 2HCl \rightarrow ZnCl_2 + H_2$$

Which volume of hydrogen gas, at room temperature and pressure, is produced in the reaction?

A 1.35 dm^3 **B** 1.67 dm^3 **C** 2.70 dm^3 **D** 3.34 dm^3

8. Nov/2022/Paper_22/No.9

Which sample does **not** contain a number of atoms equal to the Avogadro constant?

A 14 g of nitrogen, N_2

B 6 g of water, H_2O

C 4 g of helium, He

D 28 g of carbon monoxide, CO

9. Nov/2022/Paper_23/No.9

The equation for the reaction between hydrogen sulfide, H_2S, and oxygen is shown.

$$2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O$$

Which mass of oxygen is required to react with 5.1 g of hydrogen sulfide?

A 2.4 g **B** 4.8 g **C** 7.2 g **D** 14.4 g

10. Nov/2022/Paper_23/No.26

12.4 g of copper(II) carbonate is heated in a test-tube. Only 50% is decomposed.

[M_r: $CuCO_3$, 124; CuO, 80]

What will be the final mass of the substances in the test-tube?

A 9.4 g **B** 9.8 g **C** 10.2 g **D** 10.6 g

11. Nov/2022/Paper_31/No.2(a)

(a) The table compares the percentage by mass of the elements in the whole Earth and in the Earth's crust.

element	percentage by mass in the whole Earth	percentage by mass in the Earth's crust
aluminium	1.20	8.20
calcium	1.10	3.60
iron	34.60	5.00
magnesium	12.70	2.00
oxygen	29.50	46.60
silicon	15.20	29.50
sodium	0.60	2.80
titanium	0.10	0.55
other elements		1.75
total	100.00	100.00

Answer these questions using only the information in the table.

(i) Deduce the percentage by mass of the other elements in the whole Earth.

..... [1]

(ii) State which element is present in the whole Earth in the greatest percentage by mass.

..... [1]

(iii) Give **two** major differences in the composition of the whole Earth and the Earth's crust.

1 .....

.....

2 .....

.....

[2]

12. Nov/2022/Paper_32/No.2(a)

(a) The table compares the percentage by mass of the elements in the Earth's crust and in the Moon's crust.

element	percentage by mass in the Earth's crust	percentage by mass in the Moon's crust
aluminium	8.20	7.50
calcium	3.60	7.50
iron	5.00	13.50
magnesium	2.00	5.50
oxygen	46.60	40.00
silicon	29.50	19.50
titanium	0.55	3.00
other elements	4.55	
total	100.00	100.00

Answer these questions using only the information in the table.

(i) Deduce the percentage by mass of the other elements in the Moon's crust.

..... [1]

(ii) State which element is present in the Earth's crust in the greatest percentage by mass.

..... [1]

(iii) Give **two** major differences in the composition of the Earth's crust and in the Moon's crust.

1 .....

.....

2 .....

.....

[2]

13. Nov/2022/Paper_33/No.2(a)

(a) The table compares the percentage by mass of the elements in the whole Earth and in the oceans.

element	percentage by mass in the whole Earth	percentage by mass in the oceans
calcium	1.1	0.1
chlorine	less than 0.01	1.0
hydrogen	less than 0.01	11.0
iron	34.6	0.0
magnesium	12.7	1.0
oxygen	29.5	85.0
silicon	15.2	0.0
sodium	0.6	1.0
other elements	6.3	
total	100.00	100.00

Answer these questions using only the information in the table.

(i) Deduce the percentage by mass of the other elements in the oceans.

..... [1]

(ii) State which non-metallic element is present in the whole Earth in the greatest percentage by mass.

..... [1]

(iii) Give **two** major differences in the composition of the whole Earth and of the oceans.

1 .....

.....

2 .....

.....

[2]

14. Nov/2022/Paper_41/No.2(c)

(c) When potassium is added to water, it reacts vigorously and a coloured flame is seen. The equation for the reaction is shown.

$$2K(s) + 2H_2O(l) \rightarrow 2KOH(aq) + H_2(g)$$

(i) State the colour of the flame seen.

..... [1]

(ii) The solution formed is potassium hydroxide, a strong alkali.

State the formula of the ion responsible for alkalinity in a solution.

..... [1]

(iii) State the colour of litmus in a strong alkali.

..... [1]

(iv) Calculate the volume, in cm^3, of hydrogen gas formed when 2.34 g of potassium is added to excess water at room temperature and pressure.

Use the following steps.

- Calculate the number of moles of potassium added.

= ..... mol

- Determine the number of moles of hydrogen gas formed.

= ..... mol

- Calculate the volume of hydrogen gas formed.

volume = ... cm^3
[3]

15. Nov/2022/Paper_41/No.4(e, f)

(e) Magnesium sulfate crystals have the formula, $MgSO_4 \cdot xH_2O$, where x is a whole number of molecules of water.

The student heats the crystals to remove the molecules of water.

$$MgSO_4 \cdot xH_2O(s) \rightarrow MgSO_4(s) + xH_2O(g)$$

(i) Name the term given to crystals containing molecules of water.

..... [1]

(ii) The student heats a sample of $MgSO_4 \cdot xH_2O$ and finds it has lost 0.140 moles of H_2O and has 2.40 g of $MgSO_4$ remaining.

Determine the value of x. Use the following steps.

- Calculate the M_r of $MgSO_4$.

M_r = ...

- Determine the number of moles of $MgSO_4$ formed.

moles of $MgSO_4$ formed = ...

- Determine the value of x in $MgSO_4 \cdot xH_2O$.

x = ...
[3]

(f) If the student uses dilute nitric acid instead of dilute sulfuric acid, the salt formed is magnesium nitrate, $Mg(NO_3)_2$.

Write the chemical equation for the reaction when solid magnesium nitrate is heated.

..... [2]

16. Nov/2022/Paper_42/No.2(c)

(c) Sodium reacts vigorously with water to form aqueous sodium hydroxide, NaOH, which is a strong base.

(i) Explain in terms of proton transfer what is meant by a base.

..... [1]

(ii) State a pH number that indicates the presence of a strong alkali.

..... [1]

(iii) State the colour of methyl orange in aqueous sodium hydroxide.

..... [1]

(iv) The equation for the reaction is shown.

$$2Na(s) + 2H_2O(l) \rightarrow 2NaOH(aq) + H_2(g)$$

Calculate the concentration of NaOH(aq) formed, in g/dm^3, when 0.345 g of sodium is added to 50.0 cm^3 of distilled water. Assume there is no change in volume.

Use the following steps.

- Calculate the number of moles of Na added.

= ..... mol

- Determine the number of moles of NaOH formed.

= ..... mol

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

concentration of NaOH = ... mol/dm^3

- Determine the M_r of NaOH and calculate the concentration of NaOH in g/dm^3.

concentration of NaOH = ... g/dm^3

[5]

(e) Magnesium sulfate crystals have the formula, $MgSO_4 \cdot xH_2O$, where x is a whole number of molecules of water.

The student heats the crystals to remove the molecules of water.

$$MgSO_4 \cdot xH_2O(s) \rightarrow MgSO_4(s) + xH_2O(g)$$

(i) Name the term given to crystals containing molecules of water.

..... [1]

(ii) The student heats a sample of $MgSO_4 \cdot xH_2O$ and finds it has lost 0.140 moles of H_2O and has 2.40 g of $MgSO_4$ remaining.

Determine the value of x. Use the following steps.

- Calculate the M_r of $MgSO_4$.

M_r = ...

- Determine the number of moles of $MgSO_4$ formed.

moles of $MgSO_4$ formed = ...

- Determine the value of x in $MgSO_4 \cdot xH_2O$.

x = ...
[3]

(f) If the student uses dilute nitric acid instead of dilute sulfuric acid, the salt formed is magnesium nitrate, $Mg(NO_3)_2$.

Write the chemical equation for the reaction when solid magnesium nitrate is heated.

..... [2]

18. Nov/2022/Paper_43/No.4(c_ e)

(c) Phosphorus oxychloride has the formula $POCl_3$.

Phosphorus oxychloride is the only product of the reaction between phosphorus(V) chloride, PCl_5, and phosphorus(V) oxide, P_4O_{10}.

Write a chemical equation for the reaction between phosphorus(V) chloride and phosphorus(V) oxide.

..... [2]

(d) Compound **X** has the following composition by mass.

H, 3.66%; P, 37.80%; O, 58.54%

Calculate the empirical formula of compound **X**.

empirical formula = ... [2]

(e) Compound **Y** has the empirical formula H_3PO_4 and a relative molecular mass of 98.

Deduce the molecular formula of compound **Y**.

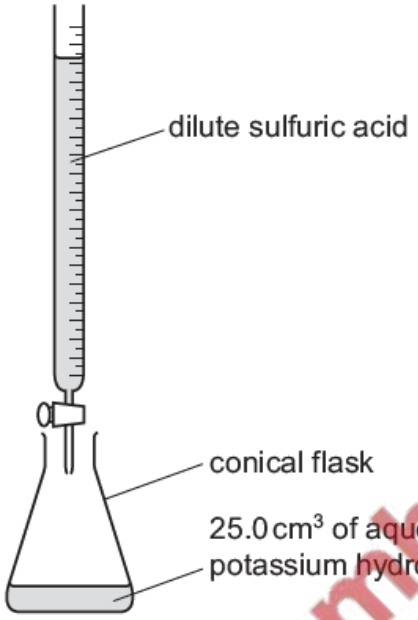
molecular formula = ... [1]

19. Nov/2022/Paper_43/No.5(c_ e)

(c) Dilute sulfuric acid and aqueous potassium hydroxide are used to make aqueous potassium sulfate.

$$H_2SO_4 + 2KOH \rightarrow K_2SO_4 + 2H_2O$$

The method includes use of the following apparatus.



(i) Calculate the volume of 0.0625 mol/dm³ dilute sulfuric acid, H_2SO_4, that completely reacts with 25.0 cm³ of 0.100 mol/dm³ potassium hydroxide, KOH, to produce aqueous potassium sulfate.

Use the following steps.

- Calculate the number of moles of KOH in 25.0 cm³ of 0.100 mol/dm³ KOH.

= ..... mol

- Deduce the number of moles of H_2SO_4 that react with KOH.

= ..... mol

- Calculate the volume of H_2SO_4 required.

volume = ... cm^3
[3]

(ii) The experiment is repeated using the same volume and concentration of potassium hydroxide and the same concentration of dilute sulfuric acid. In this second experiment, the product is aqueous potassium hydrogensulfate, $KHSO_4$.

$$H_2SO_4 + KOH \rightarrow KHSO_4 + H_2O$$

Use your answer to **(c)(i)** and the equation to deduce the volume of H_2SO_4 required.

volume = ... cm^3 [1]

(d) Aqueous potassium hydrogensulfate, $KHSO_4(aq)$, contains the ions $K^+(aq)$, $H^+(aq)$ and $SO_4^{2-}(aq)$.

Describe the observations in the following tests.

(i) A flame test is carried out on aqueous potassium hydrogensulfate.

..... [1]

(ii) Solid copper(II) carbonate is added to aqueous potassium hydrogensulfate.

.....

..... [2]

(iii) An acidic solution containing aqueous barium ions, $Ba^{2+}(aq)$, is added to aqueous potassium hydrogensulfate.

..... [1]

(e) Write the ionic equation for the reaction in **(d)(iii)**.

Include state symbols.

..... [3]