Chemistry

Cambridge University Examinations

General Certificate of Education Ordinary Level
O – LEVEL 5070. Notes, P1, P2 and P4

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Chapter

FORMULAE and EQUATIONS

Work Sheet
Paper *1*

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1 A compound containing only the elements carbon and hydrogen has 80.0% by mass of carbon.

What is its empirical formula?

A C_3H **B** CH_3 **C** CH_4 **D** C_2H_6

2 Which fertiliser contains the greatest percentage by mass of nitrogen?

A $(NH_4)_2HPO_4$ $M_r = 132$

B $(NH_4)_2SO_4$ $M_r = 132$

C NH_4NO_3 $M_r = 80$

D $CO(NH_2)_2$ $M_r = 60$

3 Analysis of a sample of an oxide of nitrogen gave the following data.

- percentage by mass of nitrogen 47%
- percentage by mass of oxygen 53%

What is the empirical formula of this oxide?
[A_r: N, 14; O, 16]

A NO **B** NO_2 **C** N_2O **D** N_2O_3

4 What is the percentage, by mass, of nitrogen in the fertiliser $(NH_4)_3PO_4$?
[A_r: H, 1; N, 14; O, 16; P, 31]

A 9.4% **B** 18.8% **C** 28.2% **D** 37.6%

5 Iron can react with sulfur to form two ionic compounds.

The iron is present as Fe^{2+} in one compound and as Fe^{3+} in the other compound.

The sulfur ion is present as S^{2-} in both compounds.

What are the formulae of the two compounds?

A FeS and Fe_2S_3

B FeS and Fe_3S_2

C FeS_2 and Fe_3S_2

D FeS_2 and Fe_2S_3

6 The empirical formula of a liquid compound is C_2H_4O.

To find the empirical formula, it is necessary to know the

A density of the compound.

B percentage composition of the compound.

C relative molecular mass of the compound.

D volume occupied by 1 mole of the compound.

7 What is the relative molecular mass M_r of $CuSO_4.5H_2O$?

A 160 **B** 178 **C** 186 **D** 250

8 The M_r of oxygen, O_2, is 32 and the M_r of sulfur is 256.

What is the formula of a molecule of sulfur?

A S_2 **B** S_4 **C** S_8 **D** S_{16}

9 An organic compound has the molecular formula $C_8H_{16}O_4$.

What is the empirical formula of the compound?

A C_2H_4O **B** $C_4H_8O_2$ **C** $C_6H_{12}O_3$ **D** $C_8H_{16}O_4$

10 What is the relative molecular mass, M_r, of $CuSO_4.5H_2O$?

A 127 **B** 160 **C** 178 **D** 250

11 What is the mass of oxygen contained in 72 g of pure water?
[Relative atomic masses: H = 1; O = 16]

A 16 g **B** 32 g **C** 64 g **D** 70 g

12 Which compound is present in sand in the largest proportion?

A Al_2O_3 **B** $CaSO_4$ **C** $NaCl$ **D** SiO_2

13 Two different hydrocarbons each contain the same percentage by mass of hydrogen.

It follows that they have the same

A empirical formula.

B number of isomers.

C relative molecular mass.

D structural formula.

14 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

15 The compound ethyl mercaptan, C_2H_5SH, has a very unpleasant smell.

What is its relative molecular mass?

A 34 **B** 50 **C** 61 **D** 62

16 The oxide Pb_3O_4 reacts with dilute nitric acid to form lead(II) nitrate, lead(IV) oxide and another product.

What is the equation for this reaction?

A $Pb_3O_4 + 4HNO_3 \rightarrow 2Pb(NO_3)_2 + PbO_2 + 2H_2O$

B $Pb_3O_4 + 2HNO_3 \rightarrow 2PbNO_3 + PbO_4 + H_2$

C $Pb_3O_4 + 4HNO_3 \rightarrow Pb(NO_3)_4 + 2PbO + 2H_2O$

D $2Pb_3O_4 + 2HNO_3 \rightarrow 2Pb_2NO_3 + 2PbO_2 + H_2$

17 Iron forms an oxide with the formula Fe_2O_3.

What is the relative formula mass of this compound?

A 76 **B** 100 **C** 136 **D** 160

18 A compound containing only the elements carbon and hydrogen has 80.0% by mass of carbon.

What is its empirical formula?

A C_3H **B** CH_3 **C** CH_4 **D** C_2H_6

19 Ammonium nitrate, NH_4NO_3, is an artificial fertiliser produced from ammonia.

What is an advantage of using ammonium nitrate as a fertiliser?

A It contains a large percentage by mass of nitrogen.

B It gives off ammonia gas.

C Nitrates are insoluble.

D Nitrates can cause eutrophication.

20 One mole of a sample of hydrated sodium sulphide contains 162 g of water of crystallisation.

What is the correct formula of this compound?

A $Na_2S.3H_2O$ **B** $Na_2S.5H_2O$ **C** $Na_2S.7H_2O$ **D** $Na_2S.9H_2O$

21 What is the percentage, by mass, of nitrogen in the fertiliser $(NH_4)_3PO_4$?
[A_r: H, 1; N, 14; O, 16; P, 31]

A 9.4% **B** 18.8% **C** 28.2% **D** 37.6%

22 What is the empirical formula of a compound containing 12 g of carbon, 2 g of hydrogen and 16 g of oxygen only?

A CHO **B** CHO_2 **C** CH_2O **D** C_2HO

23 Analysis of a sample of an oxide of nitrogen gave the following data.

- percentage by mass of nitrogen 47%
- percentage by mass of oxygen 53%

What is the empirical formula of this oxide?
[A_r: N, 14; O, 16]

A NO **B** NO_2 **C** N_2O **D** N_2O_3

24 The incomplete equation for the reaction between ethyne, C_2H_2, and oxygen is shown.

$$2C_2H_2(g) + ...O_2(g) \rightarrow ....CO_2(g) + ...H_2O(g)$$

When the equation is balanced, what is the correct value for $O_2(g)$?

A 2 **B** 3 **C** 4 **D** 5

25 A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass.

The relative molecular mass of the compound is between 55 and 65.

What is the molecular formula of the compound?

A CH_2O **B** C_2H_4O **C** $C_2H_4O_2$ **D** $C_2H_6O_2$

26 Argon is a noble gas used to fill light bulbs.

What is the approximate percentage of argon in air?

A 1% **B** 20% **C** 79% **D** 99%

27 The formulae of some ions are shown.

positive ion	negative ion
Ti^{4+}	PO_4^{3-}
Al^{3+}	SO_4^{2-}
Mg^{2+}	NO_3^-
K^+	Cl^-

Which formula is **not** correct?

A $Al_3(SO_4)_2$ **B** K_3PO_4 **C** $Mg(NO_3)_2$ **D** $TiCl_4$

28 The formulae of some ions are shown.

positive ions	negative ions
Al^{3+}	Br^-
Ca^{2+}	CO_3^{2-}
Cu^{2+}	NO_3^-
Fe^{3+}	S^{2-}
K^+	SO_4^{2-}

In which row is the formula **not** correct?

	compound	formula
A	aluminium sulfate	$Al_2(SO_4)_3$
B	calcium nitrate	$Ca(NO_3)_2$
C	iron(III) bromide	Fe_3Br
D	potassium sulfide	K_2S

29 Iron(III) chromate is a yellow solid. It contains the ions Fe^{3+} and CrO_4^{2-}.

What is the formula of iron(III) chromate?

A $FeCrO_4$ **B** $Fe_3(CrO_4)_2$ **C** Fe_2CrO_4 **D** $Fe_2(CrO_4)_3$

30 Boron, B, forms an oxide.

Which equation is correctly balanced?

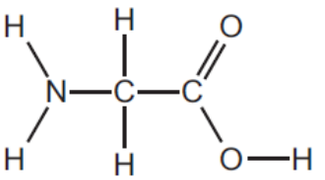
A $2B + 3O_2 \rightarrow B_2O_3$

B $2B + 3O_2 \rightarrow 2B_2O_3$

C $4B + 2O_2 \rightarrow 2B_2O_3$

D $4B + 3O_2 \rightarrow 2B_2O_3$

31 The structure of glycine is shown.



Which row is correct?

	formula of glycine	number of different elements in glycine
A	CH_5O_2N	10
B	$C_2H_5O_2N$	4
C	$C_2H_5O_2N$	10
D	$H_2NCHCOOH$	4

32 Calcium phosphate forms when calcium chloride and sodium phosphate solutions react together.

$$x\,CaCl_2 + y\,Na_3PO_4 \rightarrow 2Ca_3(PO_4)_2 + 12NaCl$$

Which values of *x* and *y* balance the equation?

	x	*y*
A	2	2
B	3	4
C	6	3
D	6	4

33 The relative molecular mass, M_r, of copper(II) sulphate, $CuSO_4$, is 160.

The relative molecular mass, M_r, of water is 18.

What is the percentage by mass of water in copper(II) sulphate crystals, $CuSO_4.5H_2O$?

A $\frac{18 \times 100}{160}$ **B** $\frac{5 \times 18 \times 100}{160 + 18}$ **C** $\frac{18 \times 100}{160 + 18}$ **D** $\frac{5 \times 18 \times 100}{160 + (5 \times 18)}$

34 Which substance has the highest percentage by mass of nitrogen?

A NH_4NO_3 $M_r = 80$

B $(NH_4)_2SO_4$ $M_r = 132$

C $CO(NH_2)_2$ $M_r = 60$

D $(NH_4)_3PO_4$ $M_r = 149$

35 The incomplete equation for the reaction between ethyne, C_2H_2, and oxygen is shown.

$$2C_2H_2(g) + ...O_2(g) \rightarrow ....CO_2(g) + ...H_2O(g)$$

When the equation is balanced, what is the correct value for $O_2(g)$?

A 2 **B** 3 **C** 4 **D** 5

36 A compound contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen by mass.

The relative molecular mass of the compound is between 55 and 65.

What is the molecular formula of the compound?

A CH_2O **B** C_2H_4O **C** $C_2H_4O_2$ **D** $C_2H_6O_2$

37 The relative molecular mass of a compound is 166.

What is a possible molecular formula of this compound?

A $C_4H_3O_2$ **B** $C_6H_4O_4$ **C** $C_6H_8O_2$ **D** $C_8H_6O_4$

38 Which sulphide contains the greatest mass of sulphur in a 10 g sample?

sulphide	formula	mass of one mole / g
A	NiS	90
B	FeS_2	120
C	MoS_2	160
D	PbS	239

mass of one mole = M_r

39 124 g of phosphorus vapour has the same volume as 71 g of chlorine gas at the same temperature and pressure.

What is the formula of a molecule of phosphorus?

A P_8 **B** P_4 **C** P_2 **D** P

40 The formula of an oxide of uranium is UO_2.

What is the formula of the corresponding chloride?

A UCl_2 **B** UCl_4 **C** U_2Cl **D** U_4Cl

41 The formula of china clay (aluminium silicate) was shown in an old book as $Al_2O_3.2SiO_2.2H_2O$.

This formula is shown in a modern book as $Al_2(OH)_xSi_2O_y$.

What are the values of *x* and *y* in the modern formula?

	x	*y*
A	2	4
B	2	5
C	4	3
D	4	5

42 The symbols and electronic structures for some elements are shown below.

silicon, Si (2,8,4) oxygen, O (2,6) hydrogen, H (1)
fluorine, F (2,7) nitrogen, N (2,5)

Which formula is correct for a compound containing silicon?

A Si_4F **B** SiH_4 **C** SiN_5 **D** Si_2O

Answers	Chemical Bonding				
1		21		41	
2		22		42	
3		23		43	
4		24		44	
5		25		45	
6		26		46	
7		27		47	
8		28		48	
9		29		49	
10		30		50	
11		31		51	
12		32		52	
13		33		53	
14		34		54	
15		35		55	
16		36		56	
17		37		57	
18		38		58	
19		39		59	
20		40		60	
				61	