A-Level Edexcel

CHEMISTRY

UNIT 1(IAL)

2015 — 2019

1 - (CHEM-S 2015-Unit 1(IAL)-Q4) - *Formulae, Equations & amount of substance*

Solutions of barium chloride and silver nitrate are mixed together.
The reaction that takes place is an example of

☒ **A** displacement.

☒ **B** neutralization.

☒ **C** oxidation.

☒ **D** precipitation.

2 - (CHEM-S 2015-Unit 1(IAL)-Q5) - *Formulae, Equations & amount of substance*

The Avogadro constant is numerically equal to the number of

- ☒ **A** ions in 1 mol of sodium chloride, NaCl
- ☒ **B** atoms in 1 mol of hydrogen gas, H_2
- ☒ **C** electrons in 1 mol of helium gas, He
- ☒ **D** molecules in 1 mol of oxygen gas, O_2

3 - (CHEM-S 2015-Unit 1(IAL)-Q6) - *Formulae, Equations & amount of substance*

10 g of magnesium is added to 1 dm^3 of 1 mol dm^{-3} copper(II) sulfate solution and the mixture is stirred until no further reaction occurs.

Which of the following is a result of this reaction?

☒ **A** The resulting solution is colourless.

☒ **B** 10 g of copper is displaced.

☒ **C** 63.5 g of copper is displaced.

☒ **D** All the magnesium reacts.

4 - (CHEM-S 2015-Unit 1(IAL)-Q7) - *Formulae, Equations & amount of substance*

Which of the following gas samples has the same volume as 7.0 g of carbon monoxide?

All volumes are measured at the same temperature and pressure.

☒ **A** 1.0 g of hydrogen

☒ **B** 3.5 g of nitrogen

☒ **C** 10.0 g of argon

☒ **D** 35.5 g of chlorine

5 - (CHEM-S 2015-Unit 1(IAL)-Q8) - *Formulae, Equations & amount of substance*

Which of the following aqueous solutions contains the greatest number of **negative** ions?

- ☒ **A** 500 cm^3 of 0.10 mol dm^{-3} $Na_2SO_4(aq)$
- ☒ **B** 250 cm^3 of 0.12 mol dm^{-3} $BaCl_2(aq)$
- ☒ **C** 250 cm^3 of 0.15 mol dm^{-3} $KI(aq)$
- ☒ **D** 500 cm^3 of 0.10 mol dm^{-3} $Zn(NO_3)_2(aq)$

6 - (CHEM-S 2015-Unit 1(IAL)-Q9) - *Formulae, Equations & amount of substance*

In an experiment carried out at 200 °C and 1 atm pressure, 20 cm^3 of ammonia gas reacted with an excess of heated copper(II) oxide.

$$3CuO(s) + 2NH_3(g) \rightarrow 3Cu(s) + 3H_2O(g) + N_2(g)$$

If all measurements were made at 200 °C and 1 atm pressure, what would be the total volume, in cm^3, of gaseous products?

☒ **A** 10

☒ **B** 20

☒ **C** 30

☒ **D** 40

7 - (CHEM-S 2015-Unit 1(IAL)-Q10) - *Formulae, Equations & amount of substance*

Ammonia is manufactured from hydrogen and nitrogen in the Haber process.

$$3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$$

If 60 tonnes of hydrogen produces 80 tonnes of ammonia, what is the percentage yield in the reaction?

☒ **A** $\frac{80}{170} \times 100\%$

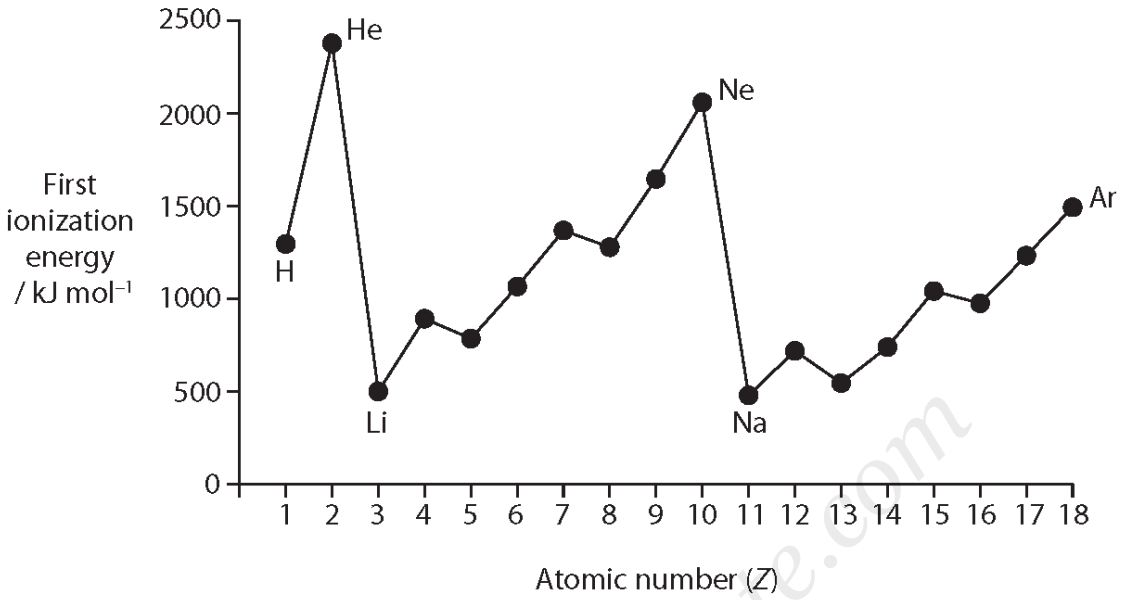
☒ **B** $\frac{80}{340} \times 100\%$

☒ **C** $\frac{30}{80} \times 100\%$

☒ **D** $\frac{60}{80} \times 100\%$

8 - (CHEM-S 2015-Unit 1(IAL)-Q24) - *Formulae, Equations & amount of substance, Atomic structure & Periodic table*

The diagram below shows the pattern in the first ionization energies of the first 18 elements.



(a) Give the equation, including state symbols, for the first ionization energy of fluorine.

(2)

*(b) Explain why there is a **general** increase in the first ionization energies from sodium to argon.

(3)

(c) *(i) Explain why the first ionization energy of aluminium ($Z = 13$) is less than that of magnesium ($Z = 12$).

(2)

*(ii) Explain why the first ionization energy of sulfur ($Z = 16$) is less than that of phosphorus ($Z = 15$).

(2)

(d) The table below, which is incomplete, refers to the elements sodium to sulfur.

Element	Na	Mg	Al	Si	P	S
Melting temperature	low	high				
Structure		giant				
Electrical conductivity		high				

(i) Complete the **melting temperature** row by using only the words 'high' or 'low'.

(2)

(ii) Complete the **structure** row by using only the words 'giant' or 'molecular'.

(2)

(iii) Complete the **electrical conductivity** row by using only the words 'high' or 'low'.

(1)

(e) In an experiment, 2.76 g of sodium completely reacted with water to form 500 cm^3 of aqueous sodium hydroxide.

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

(i) Calculate the number of moles of sodium that reacted.

(1)

(ii) Calculate the maximum volume, in dm^3, of hydrogen that can be formed at room temperature and pressure.

[1 mol of any gas occupies 24 dm^3 at room temperature and pressure.]

(2)

(iii) Calculate the concentration, in mol dm^{-3}, of the sodium hydroxide solution, NaOH(aq), formed in the experiment.

(2)

9 - (CHEM-S 2016-Unit 1(IAL)-Q1) - *Formulae, Equations & amount of substance*

Cold water fish require a minimum of 8 parts per million by mass (ppm) of oxygen dissolved in water.

The minimum mass of oxygen required in 1 kg of water is

☒ **A** 8×10^{-6} g

☒ **B** 8×10^{-3} g

☒ **C** 8×10^{-2} g

☒ **D** 8×10^{-1} g

10 - (CHEM-S 2016-Unit 1(IAL)-Q2) - *Formulae, Equations & amount of substance*

Calculate the total number of **atoms** in 8.5 g of CH_2Cl_2.

DATA: Molar mass of $CH_2Cl_2 = 85\ g\ mol^{-1}$.

Avogadro constant = $6.0 \times 10^{23}\ mol^{-1}$

☒ **A** 1.8×10^{23}

☒ **B** 2.4×10^{23}

☒ **C** 3.0×10^{23}

☒ **D** 3.0×10^{24}

11 - (CHEM-S 2016-Unit 1(IAL)-Q3) - *Formulae, Equations & amount of substance*

50 cm^3 of hydrogen is mixed with 25 cm^3 of chlorine. The gases react as shown in the equation below.

$$H_2(g) + Cl_2(g) \rightarrow 2HCl(g)$$

What is the total volume of gas present at the end of the reaction?

[All gas volumes are measured at the same temperature and pressure.]

☒ **A** 75 cm^3

☒ **B** 100 cm^3

☒ **C** 125 cm^3

☒ **D** 150 cm^3

12 - (CHEM-S 2016-Unit 1(IAL)-Q4) - *Formulae, Equations & amount of substance*

Sodium hydrogencarbonate decomposes on heating.

$$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + CO_2(g) + H_2O(l)$$

What is the maximum volume of carbon dioxide, in dm^3, which could be obtained by heating 0.25 mol sodium hydrogencarbonate?

The gas volume is measured at room temperature and pressure when the molar volume of a gas = 24 $dm^3\,mol^{-1}$.

☒ **A** 3

☒ **B** 6

☒ **C** 12

☒ **D** 24

13 - (CHEM-S 2016-Unit 1(IAL)-Q5) - *Formulae, Equations & amount of substance*

An experiment was carried out to measure the enthalpy change of the following reaction.

$$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$$

50 cm^3 of hydrochloric acid was mixed with 50 cm^3 of sodium hydroxide solution.
Each solution contained 0.10 mol solute. The temperature rise was 12 °C.

Energy transferred (J) = mass of solution $\times$ 4.2 $\times$ change in temperature

Assume the density of all solutions is 1.0 g cm^{-3}.

What is the enthalpy change of the reaction in kJ mol^{-1}?

☒ **A** $-\frac{50 \times 4.2 \times 12}{0.1 \times 1000}$

☒ **B** $-\frac{50 \times 4.2 \times 12}{0.2 \times 1000}$

☒ **C** $-\frac{100 \times 4.2 \times 12}{0.1 \times 1000}$

☒ **D** $-\frac{100 \times 4.2 \times 12}{0.05 \times 1000}$

14 - (CHEM-S 2016-Unit 1(IAL)-Q6) - *Formulae, Equations & amount of substance*

In the synthesis of ammonia, 56.0 g nitrogen was reacted with excess hydrogen.

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

The mass of ammonia produced was 6.00 g.

What is the percentage yield of ammonia?

☒ **A** 5.66

☒ **B** 8.82

☒ **C** 9.10

☒ **D** 10.7

15 - (CHEM-S 2016-Unit 1(IAL)-Q8) - *Formulae, Equations & amount of substance*

Magnesium chloride crystals were prepared using the following reaction.

$$2HCl(aq) + MgO(s) \rightarrow MgCl_2(aq) + H_2O(l)$$

(a) The ionic equation for this reaction is

(1)

☒ **A** $2Cl^-(aq) + Mg^{2+}(s) \rightarrow MgCl_2(aq)$

☒ **B** $2Cl^-(aq) + MgO(s) \rightarrow MgCl_2(aq) + O^{2-}(l)$

☒ **C** $2H^+(aq) + 2Cl^-(aq) + MgO(s) \rightarrow Mg^{2+}(Cl^-)_2(aq) + H_2O(l)$

☒ **D** $2H^+(aq) + MgO(s) \rightarrow Mg^{2+}(aq) + H_2O(l)$

(b) The amount of hydrochloric acid used was 0.10 mol. Which of the following solutions of hydrochloric acid contains this amount of HCl?

(1)

☒ **A** 100 cm^3 of 0.10 mol dm^{-3}

☒ **B** 40 cm^3 of 0.25 mol dm^{-3}

☒ **C** 25 cm^3 of 0.40 mol dm^{-3}

☒ **D** 20 cm^3 of 5.00 mol dm^{-3}

(c) An **excess** of magnesium oxide was reacted with the 0.10 mol of hydrochloric acid.

Which of the following is the **smallest** mass which would provide an excess of magnesium oxide?

Molar mass of MgO = 40.3 g mol^{-1}

(1)

☒ **A** 1.50 g

☒ **B** 2.50 g

☒ **C** 3.00 g

☒ **D** 5.00 g

(d) What is the first step in obtaining pure hydrated crystals of magnesium chloride from the resulting reaction mixture?

(1)

☒ **A** Heating the mixture to concentrate it.

☒ **B** Allowing the mixture to evaporate slowly.

☒ **C** Filtering the mixture.

☒ **D** Distilling the mixture.

(e) Use the data below to calculate the number of moles of water of crystallization in each mole of hydrated magnesium chloride.

Substance	Molar mass / g mol^{-1}
Magnesium chloride	95.1
Hydrated magnesium chloride	203.1

(1)

☒ **A** 2

☒ **B** 4

☒ **C** 6

☒ **D** 8

16 - (CHEM-S 2016-Unit 1(IAL)-Q10) - *Formulae, Equations & amount of substance*

A compound has the composition by mass of 54.5% C, 9.1% H and 36.4% O.
What is its empirical formula?

☒ **A** C_2H_2O

☒ **B** C_2H_4O

☒ **C** C_4H_9O

☒ **D** C_6HO_4

17 - (CHEM-S 2017-Unit 1(IAL)-Q1) - *Formulae, Equations & amount of substance*

Sea water contains 2.7 mg of sulfate ions per kilogram.

What is the concentration of sulfate ions in parts per million by mass?

- ☒ **A** 2.7×10^{-6}
- ☒ **B** 2.7×10^{-3}
- ☒ **C** 2.7
- ☒ **D** 2.7×10^{3}

18 - (CHEM-S 2017-Unit 1(IAL)-Q6) - *Formulae, Equations & amount of substance*

Identify the atom with two unpaired electrons in its lowest energy state (ground state).

☒ **A** Be

☒ **B** C

☒ **C** Cl

☒ **D** Ca

19 - (CHEM-S 2017-Unit 1(IAL)-Q9) - *Formulae, Equations & amount of substance*

What is the sequence of the orbitals from which electrons are removed in the first four ionisations of boron?

	1st Ionisation	2nd Ionisation	3rd Ionisation	4th Ionisation
☒ **A**	1s	1s	2s	2s
☒ **B**	1s	2s	2s	2p
☒ **C**	2p	2s	2s	1s
☒ **D**	2p	2s	1s	1s

20 - (CHEM-S 2017-Unit 1(IAL)-Q10) - *Formulae, Equations & amount of substance*

Calcium chloride can be prepared by reacting calcium carbonate with dilute hydrochloric acid.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

(a) The ionic equation for the reaction is

(1)

☒ **A** $Ca^{2+}(s) + 2Cl^-(aq) \rightarrow CaCl_2(aq)$

☒ **B** $CaCO_3(s) + 2H^+(aq) \rightarrow Ca^{2+}(aq) + H_2O(l) + CO_2(g)$

☒ **C** $CO_3^{2-}(s) + 2H^+(aq) \rightarrow H_2O(l) + CO_2(g)$

☒ **D** $CaCO_3(s) + 2H^+(aq) + 2Cl^-(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

(b) An excess of calcium carbonate is used in the preparation. The sequence of processes needed to obtain crystals of calcium chloride from the reaction mixture is

(1)

☒ **A** filtering, concentrating the solution, slowly evaporating.

☒ **B** filtering, slowly evaporating, distilling.

☒ **C** concentrating the solution, filtering, distilling.

☒ **D** concentrating the solution, slowly evaporating, filtering.

(c) The excess calcium carbonate was added to 100 cm^3 of 2.00 mol dm^{-3} hydrochloric acid. The mass of calcium chloride crystals obtained was 10.4 g.

Molar mass of calcium chloride crystals, $CaCl_2.2H_2O$ = 147 g mol^{-1}.

The percentage yield, by mass, of calcium chloride crystals is

(1)

☒ **A** 71.2

☒ **B** 70.7

☒ **C** 35.4

☒ **D** 17.7