OXFORD
INTERNATIONAL
AQA EXAMINATIONS

OXFORD AQA INTERNATIONAL A-LEVEL
CHEMISTRY
(9620)

PAPER 1

Specimen 2018 Morning Time allowed: 1 hour 30 minutes

Materials
For this paper you must have:
- a pencil
- a ruler
- a calculator
- a data booklet

Instructions
- use black ink or ball-point pen
- answer **all** questions
- show all your working.

Information
- The marks for questions are shown in brackets
- The maximum mark for this paper is 70 marks

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Forename(s) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Candidate signature _____

Answer **all** questions in the spaces provided.

1 A sample of magnesium consisting of three isotopes has a relative atomic mass of 24.31.

Table 1 gives the relative abundance of two of the isotopes.

Table 1

Mass number of isotope	24	25
Relative abundance / %	78.8	11.7

0 1 . 1 Use this information to determine the relative abundance and hence the mass number of the third isotope.

Give your answer to the appropriate number of significant figures.

[4 marks]

Mass number = _____

0 1 . 2 Describe how ions are formed in a time of flight (TOF) mass spectrometer.

[2 marks]

0 1 . 3 A TOF mass spectrometer can be used to determine the relative molecular mass of molecular substances.

Explain why it is necessary to ionize molecules when measuring their mass in a TOF mass spectrometer.

[2 marks]

2 This question is about the first ionisation energies of some elements in the Periodic Table.

0 2 . 1 Write an equation, including state symbols, to show the reaction that occurs when the first ionisation energy of calcium is measured.

[2 mark]

0 2 . 2 State and explain the general trend in first ionisation energies for the Period 2 elements boron to neon.

[3 marks]

Trend _____

Explanation _____

0 2 . 3 There is a similar general trend in first ionisation energies for the Period 5 elements indium to xenon.

State how tellurium deviates from this general trend and explain your answer.

[3 marks]

0 2 . 4 Suggest why the first ionisation energy of xenon is lower than the first ionisation energy of krypton.

[1 mark]

0 2 . 5 **Table 2** below gives the successive ionisation energies of an element.

Table 2

	First	Second	Third	Fourth	Fifth
Ionisation energy / kJ mol^{-1}	738	1451	7733	10543	13630

Deduce the group in the Periodic Table that contains this element.

[1 mark]

0 2 . 6 Identify the element that has a 5+ ion with an electron configuration of $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}4s^2\ 4p^6\ 4d^{10}$

[1 mark]

3 When heated, iron(III) nitrate (*M*r = 241.8) is converted into iron(III) oxide, nitrogen dioxide and oxygen.

$4Fe(NO_3)_3(s) \rightarrow 2Fe_2O_3(s) + 12NO_2(g) + 3O_2(g)$

A 1.48 g sample of iron(III) nitrate was completely converted into the products shown.

0 3 . 1 Calculate the amount, in moles, of iron(III) nitrate in the 1.48 g sample.

Give your answer to 3 significant figures.

[1 mark]

0 3 . 2 Calculate the amount, in moles, of oxygen gas produced in this reaction.

[1 mark]

0 3 . 3 Calculate the volume, in m^3, of **nitrogen dioxide** gas at 293 ºC and 100 kPa produced from 1.48g of iron(III) nitrate.

The gas constant is $R = 8.31\ JK^{-1}\ mol^{-1}$.

(If you have been unable to obtain an answer to Question 3.1 you may assume the number of moles of iron(III) nitrate is 0.00893. This is not the correct answer.)

[4 marks]

0 3 . 4 Suggest a name for this type of reaction that iron(III) nitrate undergoes.

[1 mark]

0 3 . 5 Suggest why the iron(III) oxide obtained is pure. Assume a complete reaction.

[1 mark]

4 Aluminium and thallium are elements in Group 3 of the Periodic Table.
Both elements form compounds and ions containing halide ions.

0 4 . 1 Write an equation for the formation of aluminium bromide from its elements.

[1 mark]

0 4 . 2 An aluminium bromide molecule reacts with a bromide ion to form the $AlBr_4^-$ ion.
Name the type of bond formed in this reaction. Explain how this type of bond is formed in the $AlBr_4^-$ ion.

[2 marks]

Type of bond _____

Explanation _____

0 4 . 3 Aluminium bromide has a relative molecular mass of 533.4 in the gas phase.

Deduce the formula of the aluminium compound that has a relative molecular mass of 533.4

[1 mark]

0 4 . 4 Deduce the name or formula of a compound that has the same number of atoms, the same number of electrons and the same shape as the $AlBr_4^-$ ion.

[1 mark]

0 4 . 5 Draw and name the shape of the TlF_5^{2-} ion.

[2 marks]

Shape of the TlF_5^{2-} ion.

Name of shape _____

_____

0 4 . 6 Draw the shape of the TlF_5^{2-} ion.

[1 mark]

0 4 . 7 Explain why the $\mathbf{TlF_5^{2-}}$ ion has the shape that you have drawn in part (f)(i).

[1 mark]

_____

_____

0 4 . 8 Which **one** of the first, second or third ionisations of thallium produces an ion with the electron configuration [Xe] $5d^{10}6s^1$?

Tick (✓) one box.

[1 mark]

First ☐

Second ☐

Third ☐

5 This question is about enthalpy changes.

0 5 . 1 Define the term standard enthalpy of formation, $\Delta_f H^{\ominus}$

[2 marks]

0 5 . 2 State Hess's law.

[1 mark]

Nitrogen monoxide, NO, can be made reacting ammonia with oxygen.

$$4\ NH_3(g)\ +\ 5\ O_2(g) \rightarrow\ 4\ NO(g)\ +\ 6\ H_2O(g)$$

Table X shows some standard enthalpy of formation, $\Delta_f H^{\ominus}$

Table X

Substance	$NH_3(g)$	$O_2(g)$	$NO(g)$	$H_2O(g)$
$\Delta_f H^{\ominus}$ / kJ mol^{-1}	– 46	0	+ 90	– 242

0 5 . 3 State why the standard enthalpy of formation of $O_2(g)$ is zero.

[1 mark]

0 5 . 4 Use **Table X** and the equation to calculate the enthalpy change for the reaction of ammonia with oxygen to form nitrogen monoxide.

[2 marks]

Enthalpy change = _____ kJ mol^{-1}

6 Barium metal reacts with water.

0 6 . 1 Write an equation for this reaction.

[1 mark]

_____

_____

0 6 . 2 A solution containing barium ions can be used to show the presence of sulfate ions in an aqueous solution of sodium sulfate.

Write the **simplest ionic** equation for the reaction that occurs and state what is observed.

[3 marks]

Simplest ionic equation _____

_____

Observation _____

_____

0 6 . 3 State **one** use of barium sulfate in medicine. Explain why this use is possible, given that solutions containing barium ions are poisonous.

[1 mark]

Use _____

_____

Explanation _____

_____

7 A student carried out a laboratory experiment to determine the enthalpy change when a sample of ethanol was burned. The heat produced was used to warm some water in a copper calorimeter. The student found that the temperature of 75.0 g of water increased by 5.50 ºC when 2.40×10^{-3} mol of pure ethanol was burned in air.

0 7 . 1 Use the student's results to calculate a value, in kJ mol^{-1}, for the enthalpy change when one mole of ethanol is burned.

(The specific heat capacity of water is 4.18 J K^{-1} g^{-1})

Deduce **two** reasons why the student's value for the standard enthalpy of combustion of ethanol is different from a Data Book value of –1279 kJ mol^{-1}.

[5 marks]

0 7 . 2 The temperature of 75.0 g of water changed from 19.2 ^{o}C to 24.7 ^{o}C in the experiment.

The temperature change was 5.50 ^{o}C

The uncertainty of each reading of the thermometer is ±0.1 ^{o}C

What is the percentage uncertainty in the temperature change?

[1 mark]

Percentage uncertainty = _____ %

0 7 . 3 Suggest **one** way that the student could reduce the percentage uncertainty in the temperature change, using the same apparatus as this experiment.

[1 mark]

8 Concentrated sulfuric acid reacts with solid potassium iodide as shown in the equation.

$$8NaI + 9H_2SO_4 \longrightarrow 4I_2 + 4Na_2SO_4 + H_2S + 4H_2O$$

0 8 . 1 Give **two** observations that you would make when this reaction occurs.

In terms of electrons, state what happens to the iodide ions in this reaction.

State the **change** in oxidation state of sulfur that occurs during this formation of H_2S and deduce the half-equation for the conversion of H_2SO_4 into H_2S

[5 marks]

9 **Table 3** shows observations of changes from some test tube reactions of aqueous solutions of compounds Q, R and S with different aqueous reagents. The initial colours of the solutions are not given.

Table 3

	$BaCl_2$	$AgNO_3$	NaOH	HCl	H_2SO_4
Q	No change observed	Pale cream precipitate	White precipitate	No change observed	No change observed
R	No change observed	No change observed	No change observed	Bubbles of a gas	White precipitate, bubbles of a gas
S	White precipitate	No change observed	Gas produced turned red litmus blue	No change observed	No change observed

0 9 . 1 Identify each of the compounds **Q**, **R** and **S**. You are not required to explain your answers.

[6 marks]

Identity of Q _____

_____

Identity of R _____

_____

Identity of S _____

_____

0 9 . 2

Write ionic equations for each of the positive observations for Q. Write an ionic equation to show the identity of the gases produced by R with HCl and by S with NaOH.

[4 marks]

END OF QUESTIONS