THIS IS A NEW SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

**ADVANCED SUBSIDIARY GCE**

# CHEMISTRY A

Atoms, Bonds and Groups

# F321

Candidates answer on the Question Paper

**OCR Supplied Materials:**
- *Data Sheet for Chemistry A* (inserted)

**Other Materials Required:**
- Scientific calculator

**Thursday 14 January 2010**
**Morning**

**Duration:** 1 hour

| Candidate Forename | | Candidate Surname | |
|---|---|---|---|

| Centre Number | | | | | | Candidate Number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|

## MODIFIED LANGUAGE

**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- Where you see this icon you will be awarded marks for the quality of written communication in your answer.

  This means for example you should:
  - ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
  - organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry A* is provided as an insert with this question paper.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **60**.
- This document consists of **12** pages. Any blank pages are indicated.

© OCR 2010 [D/500/7833]
OCR is an exempt Charity

Answer **all** the questions.

**1** Europium, atomic number 63, is used in some television screens to highlight colours. A chemist analysed a sample of europium using mass spectrometry. The results are shown in **Table 1.1** below.

| isotope | relative isotopic mass | abundance (%) |
|---|---|---|
| $^{151}Eu$ | 151.0 | 47.77 |
| $^{153}Eu$ | 153.0 | 52.23 |

**Table 1.1**

**(a)** Define the term *relative isotopic mass*.

.....

.....

.....

..... **[2]**

**(b)** Using **Table 1.1**, calculate the relative atomic mass of the europium sample.
Give your answer to **two** decimal places.

answer = ..... **[2]**

© OCR 2010

**(c)** Isotopes of europium have differences and similarities.

**(i)** How is an atom of $^{151}Eu$ **different** from an atom of $^{153}Eu$ in terms of protons, neutrons and electrons?

.....

..... **[1]**

**(ii)** How is an atom of $^{151}Eu$ **similar** to an atom of $^{153}Eu$ in terms of protons, neutrons and electrons?

.....

..... **[1]**

**(d)** Modern plasma television screens emit light when mixtures of noble gases, such as neon and xenon, are ionised.

The first ionisation energies of neon and xenon are shown in the table below.

| element | 1st ionisation energy / kJ mol$^{-1}$ |
|---|---|
| neon | +2081 |
| xenon | +1170 |

Explain why xenon has a lower first ionisation energy than neon.

.....

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

**[Total: 9]**

© OCR 2010

**2** A student carries out experiments using acids, bases and salts.

**(a)** Calcium nitrate, $Ca(NO_3)_2$, is an example of a salt.

The student prepares a solution of calcium nitrate by reacting dilute nitric acid, $HNO_3$, with the base calcium hydroxide, $Ca(OH)_2$.

**(i)** Why is calcium nitrate an example of a salt?

.....

..... **[1]**

**(ii)** Write the equation for the reaction between dilute nitric acid and calcium hydroxide. Include state symbols.

..... **[2]**

**(iii)** Explain how the hydroxide ion in aqueous calcium hydroxide acts as a base when it neutralises dilute nitric acid.

.....

.....

..... **[1]**

© OCR 2010

**(b)** A student carries out a titration to find the concentration of some sulfuric acid.

The student finds that 25.00 $cm^3$ of 0.0880 mol $dm^{-3}$ aqueous sodium hydroxide, NaOH, is neutralised by 17.60 $cm^3$ of dilute sulfuric acid, $H_2SO_4$.

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

**(i)** Calculate the amount, in moles, of NaOH used.

answer = ..... mol **[1]**

**(ii)** Determine the amount, in moles, of $H_2SO_4$ used.

answer = ..... mol **[1]**

**(iii)** Calculate the concentration, in mol $dm^{-3}$, of the sulfuric acid.

answer = ..... mol $dm^{-3}$ **[1]**

**(c)** After carrying out the titration in **(b)**, the student left the resulting solution to crystallise. White crystals were formed, with a formula of $Na_2SO_4 \bullet \boldsymbol{x} H_2O$ and a molar mass of 322.1 g $mol^{-1}$.

**(i)** What term is given to the '$\bullet \boldsymbol{x} H_2O$' part of the formula?

..... **[1]**

**(ii)** Calculate the value of ***x*** using the molar mass of the crystals.

answer = ..... **[2]**

**[Total: 10]**

© OCR 2010

**3** This question is about different models of bonding and molecular shapes.

**(a)** Magnesium sulfide shows ionic bonding.

**(i)** What is meant by the term *ionic bonding*?

.....

..... **[1]**

**(ii)** Draw a '*dot-and-cross*' diagram to show the bonding in magnesium sulfide.
Show outer electron shells only.

**[2]**

**(b)** '*Dot-and-cross*' diagrams can be used to predict the shape of covalent molecules.

Fluorine has a covalent oxide called difluorine oxide, $F_2O$. The oxygen atom is covalently bonded to each fluorine atom.

**(i)** Draw a '*dot-and-cross*' diagram of a molecule of $F_2O$.
Show outer electron shells only.

**[2]**

© OCR 2010

**(ii)** Predict the bond angle in an $F_2O$ molecule. Explain your answer.

.....

.....

.....

.....

.....

.....

.....

.....

..... **[3]**

**(c)** Liquid ammonia, $NH_3$, and water, $H_2O$, both show hydrogen bonding.

**(i)** Draw a labelled diagram to show hydrogen bonding between two molecules of liquid **ammonia**.

**[3]**

**(ii)** Water has several anomalous properties as a result of its hydrogen bonding.

Describe and explain **one** anomalous property of water which results from hydrogen bonding.

.....

.....

.....

.....

..... **[2]**

**[Total: 13]**

© OCR 2010

**4** Chlorine and bromine are elements in Group 7 of the Periodic Table.

**(a)** Chlorine is used in water treatment.

State **one** advantage and **one** disadvantage of using chlorine in water treatment.

advantage: .....

.....

disadvantage: .....

..... **[2]**

**(b)** The electron configuration of bromine contains outermost electrons in the 4th shell.

Using your knowledge of Group 7 elements, complete the electron configuration of bromine.

$1s^2 2s^2 2p^6 3s^2 3p^6$ ..... **[1]**

**(c)** Displacement reactions can be used to detect bromide ions in solution.

A student has a solution that contains bromide ions. The student carries out the following experiment.

**Step 1**

- She bubbles some chlorine gas through a sample of the solution.
- The mixture changes colour.

**Step 2**

- The student then adds an organic solvent, cyclohexane, to the mixture.
- She shakes the contents and allows the layers to separate.

**(i)** Write the **ionic** equation for the reaction that takes place in **step 1**.

..... **[1]**

**(ii)** What colour does the cyclohexane layer turn in **step 2**?

..... **[1]**

© OCR 2010

**(d)** Chlorine reacts differently with dilute and concentrated aqueous solutions of sodium hydroxide.

- When chlorine reacts with dilute sodium hydroxide, one of the products is sodium chlorate(I). This is the reaction that is used to manufacture bleach.
- A different reaction takes place when chlorine is reacted with hot concentrated sodium hydroxide. One of the products is $NaClO_3$, used as a weedkiller.

Chlorine has been both oxidised and reduced in each reaction.

**(i)** What term is used to describe a redox reaction in which an element is both oxidised and reduced?

..... **[1]**

**(ii)** Write equations for these two reactions of chlorine with sodium hydroxide:

equation for reaction with **dilute** sodium hydroxide,

.....

equation for reaction with **hot concentrated** sodium hydroxide.

..... **[3]**

**(iii)** Chlorine forms another chlorate called sodium chlorate(VII), used in the manufacture of matches.

Suggest the formula of sodium chlorate(VII).

..... **[1]**

**[Total: 10]**

© OCR 2010

**5** Chemists use the Periodic Table to predict the behaviour of elements.

**(a)** Early attempts at developing a Periodic Table arranged elements in order of increasing atomic mass.

**(i)** State which two elements from the **first twenty** elements of the modern Periodic Table are not arranged in order of increasing atomic mass.

..... **[1]**

**(ii)** Why does the modern Periodic Table **not** arrange some elements, such as those in **a(i)**, in order of increasing atomic mass?

.....

.....

..... **[1]**

**(b)** Magnesium and strontium are in Group 2 of the Periodic Table.

**(i)** Magnesium reacts with oxygen to form a white powder called magnesium oxide.

Write the equation for the reaction of magnesium with oxygen.

..... **[1]**

**(ii)** Magnesium reacts with dilute acids.

Describe what you would expect to see when magnesium ribbon is added to an excess of dilute hydrochloric acid.

.....

..... **[2]**

**(iii)** Strontium reacts in a similar way to magnesium.

Describe **one** difference you might observe if strontium, instead of magnesium, was reacted with dilute hydrochloric acid.

..... **[1]**

© OCR 2010

**(c)** The third period of the Periodic Table features the elements magnesium and chlorine. The table below shows the melting points of these elements.

| element | melting point / °C |
|---|---|
| magnesium | 650 |
| chlorine | –101 |

Describe the structure and bonding shown by these elements. Use your answer to explain the difference in melting points.



*In your answer, you should use appropriate technical terms spelt correctly.*

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... **[6]**

**TURN OVER FOR PART (d)**

© OCR 2010

**(d)** The element strontium forms a nitrate, $Sr(NO_3)_2$, which decomposes on heating as shown below.

$$2Sr(NO_3)_2(s) \rightarrow 2SrO(s) + 4NO_2(g) + O_2(g)$$

**(i)** Using oxidation numbers, explain why the reaction involves both oxidation and reduction.

.....

.....

.....

..... **[3]**

**(ii)** A student heats 5.29 g of $Sr(NO_3)_2$ and collects the gas at room temperature and pressure, RTP.

$$2Sr(NO_3)_2(s) \rightarrow 2SrO(s) + 4NO_2(g) + O_2(g)$$

Calculate the volume of gas, in $dm^3$, obtained by the student at RTP.

Molar mass of $Sr(NO_3)_2 = 211.6\,g\,mol^{-1}$.

answer = ..... $dm^3$ **[3]**

**[Total: 18]**

**END OF QUESTION PAPER**

OCR
RECOGNISING ACHIEVEMENT

**Copyright Information**

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations, is given to all schools that receive assessment material and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

© OCR 2010