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General Certificate of Education
January 2009

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71	
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Candidate Number

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Chemistry

Assessment Unit AS 1

assessing

Basic Concepts in Physical
and Inorganic Chemistry

[AC111]



FRIDAY 16 JANUARY, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Answer **all sixteen** questions.

Answer **all ten** questions in **Section A**. Record your answers by marking the appropriate letter on the answer sheet provided. Use only the spaces numbered 1 to 10. Keep in sequence when answering.

Answer **all six** questions in **Section B**. Write your answers in the spaces provided in this question paper.

INFORMATION FOR CANDIDATES

The total mark for this paper is 100.

Quality of written communication will be assessed in question **16(a)(iii)**.

In Section A all questions carry equal marks, i.e. **two** marks for each question.

In Section B the figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

A Periodic Table of Elements (including some data) is provided.

For Examiner's use only	
Question Number	Marks
Section A	
1-10	
Section B	
11	
12	
13	
14	
15	
16	

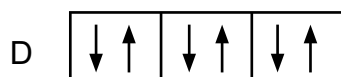
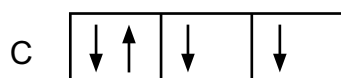
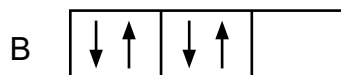
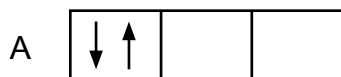
Total Marks	
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Section A

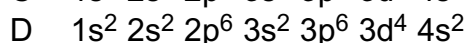
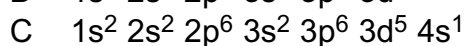
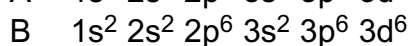
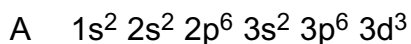
For each of the following questions only **one** of the lettered responses (A – D) is correct.

Select the correct response in each case and mark its code letter by connecting the dots as illustrated on the answer sheet

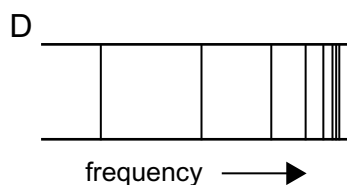
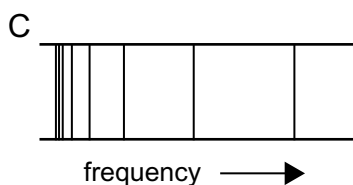
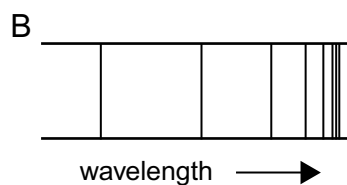
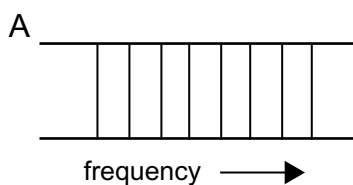
1 Which one of the following represents the p electrons in an oxide, O^{2-} ion?



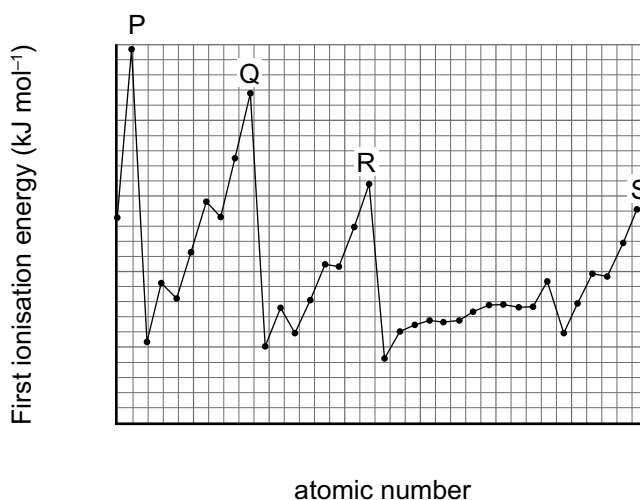
2 Which one of the following represents the electronic configuration for a chromium atom in its ground state?



3 Which one of the following represents the line emission spectrum of atomic hydrogen?



- 4 The intermolecular forces of attraction in solid iodine are
- covalent bonds.
 - hydrogen bonds.
 - permanent dipole attractions.
 - van der Waals forces.
- 5 Which one of the following molecules contains the most polar bond?
- CH_4
 - NH_3
 - H_2O
 - HF
- 6 The graph below represents the variation in the first ionisation energy with atomic number.



The elements indicated by the letters P, Q, R and S are

- alkali metals.
- halogens.
- noble gases.
- transition metals.

- 7 The melting point of the elements going across the Periodic Table from sodium to chlorine is
- A increases steadily.
 - B decreases steadily.
 - C increases to silicon and then decreases.
 - D decreases to silicon and then increases.

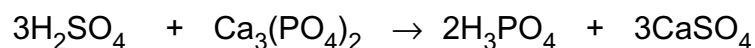
- 8 How many moles of hydrogen ions are present in 40 cm³ of 0.2 M sulphuric acid?

- A 8×10^{-3}
- B 1.6×10^{-2}
- C 0.2
- D 0.4

- 9 In which one of the following do both molecules obey the octet rule?

- A BeCl₂ and NH₃
- B BF₃ and CH₄
- C CH₄ and NH₃
- D BF₃ and BeCl₂

- 10 Phosphoric acid is manufactured by the reaction of sulphuric acid with calcium phosphate according to the equation:



What mass of phosphoric acid would be obtained from reacting 60 kg of sulphuric acid with 60 kg of calcium phosphate?

- A 19 kg
- B 38 kg
- C 40 kg
- D 60 kg

Section B

Answer **all six** questions in this section

11 Complete the table stating the shape of each of the molecules.

Molecule	Shape
Ammonia	
Carbon dioxide	
Methane	

[3]

- 12 (a) Metal ions can be identified by the characteristic flame colour observed when their solutions are sprayed into a blue Bunsen flame.

Complete the table by stating the flame colour for each of the ions listed.

Metal ion	Flame colour
Ba ²⁺	
Ca ²⁺	
Cu ²⁺	

[3]

- (b) Explain, with the help of an energy level diagram, how flame colours arise.

[3]

- (c) Flame colours are a consequence of the emission spectrum of an element.

Explain how the emission spectrum can be used to calculate the first ionisation energy of an element.

[2]

13 Washing soda is hydrated sodium carbonate and can be represented by the formula $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$. The value of x can be found by titrating a solution of washing soda against standard hydrochloric acid solution.

(a) (i) What is meant by the term **standard** solution?

_____ [1]

(ii) Write the equation for the reaction between sodium carbonate, Na_2CO_3 , and excess hydrochloric acid.

_____ [2]

(b) In one experiment a 2.80 g sample of washing soda was made up to 250 cm^3 of solution in a volumetric flask. 25 cm^3 of this solution required 22.4 cm^3 of 0.1 M hydrochloric acid for neutralisation. Find the value of x using the following headings.

Moles of hydrochloric acid used

Moles of sodium carbonate in 25 cm^3

Moles of sodium carbonate in the sample

Mass of sodium carbonate in the sample

Mass of water in the sample

Moles of water in the sample

Value of x

_____ [5]

(c) Suggest a suitable indicator for the titration, stating the colour change expected.

Indicator: _____

Colour change: from _____ to _____ [3]

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14 (a) Magnesium is extracted from dolomite, $\text{MgCO}_3 \cdot \text{CaCO}_3$. Dolomite is heated to form the metal oxides and carbon dioxide. After purification the magnesium oxide is heated with coke (carbon) in a stream of chlorine to form magnesium chloride and carbon monoxide. Magnesium is formed by the electrolysis of molten magnesium chloride.

(i) Write the equation for the effect of heat on dolomite.

_____ [2]

(ii) Write the equation for the formation of magnesium chloride from magnesium oxide.

_____ [2]

(iii) Magnesium chloride is ionic. Explain why it must be molten for the electrolysis to take place.

_____ [1]

(iv) Draw dot and cross diagrams to show the formation of magnesium and chlorine atoms from their ions.

[4]

(b) Magnesium is a typical metal.

(i) Draw a labelled diagram to show the bonding in magnesium metal.

[2]

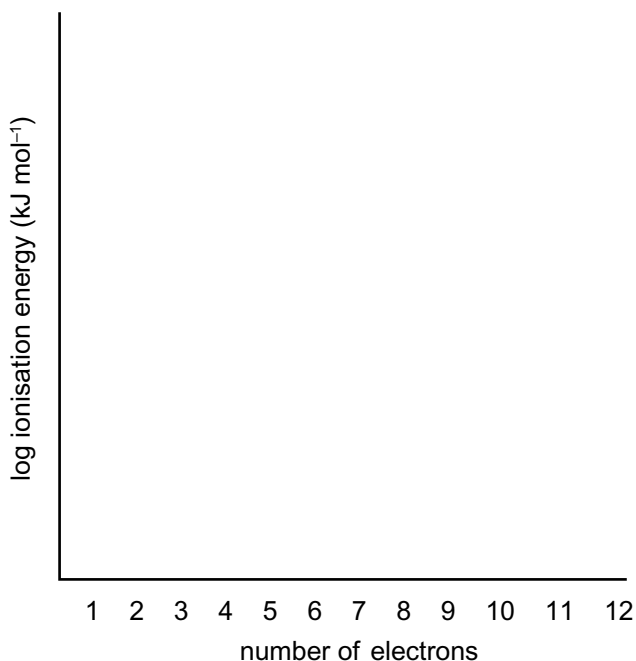
(ii) Explain why magnesium conducts electricity.

_____ [2]

(c) (i) Write the equation, including state symbols, for the first ionisation energy of magnesium.

_____ [2]

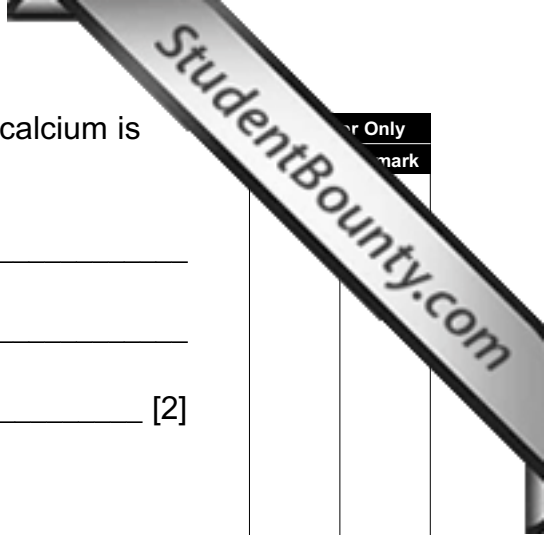
(ii) Using the axes below, sketch a graph to show the twelve successive ionisation energies of magnesium.



[2]

(iii) State **two** reasons why the first ionisation energy of calcium is less than that of magnesium.

[2]



For Only
mark

15 Xenon was first isolated by Ramsey and Travers in 1898.

(a) Xenon makes up 1 part in 20 000 000 by volume of air.

Calculate the number of atoms of xenon in 1 dm³ of air at room temperature and pressure using the following headings.

Molar gas volume = 24 dm³ at room temperature and pressure.

Number of moles in 1 dm³ of air.

Number of particles (atoms and molecules) in 1 dm³ of air.

Number of atoms of xenon in 1 dm³ of air.

_____ [3]

(b) Xenon has a number of naturally occurring isotopes. The table lists the principal isotopes of xenon.

Relative isotopic mass	% abundance
129	27
131	23
132	28
134	12
136	10

(i) Explain what is meant by the term **isotope**.

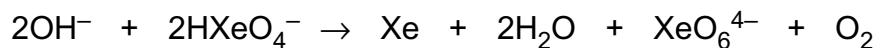
 _____ [2]

(ii) Use the information in the table to calculate the relative atomic mass of xenon.

 _____ [2]

(c) The first compounds of xenon were isolated by Bartlett in 1962.

The reaction between the hydrogenxenate and hydroxide ions can be represented as follows:



(i) Deduce the oxidation number of xenon in each of the following.

HXeO_4^- _____

Xe _____

XeO_6^{4-} _____ [3]

(ii) Explain why this is considered to be a disproportionation reaction.

_____ [2]

16 The halogens are found in Group VII of the Periodic Table.

(a) (i) Complete the table.

	Fluorine	Chlorine	Bromine	Iodine
Atomic number	9	17	35	53
Appearance at 20 °C	Yellow gas	Green-yellow gas		
Boiling point (°C)	-188	-35	59	183
Electro-negativity	4.1	2.9	2.8	2.2

[2]

(ii) Explain the change in boiling point of the halogens.

[2]

(iii) State what is meant by the term **electronegativity** and explain the trend for the halogens.

[3]

Quality of written communication

[2]

(b) Chlorine reacts with cold dilute sodium hydroxide to form sodium chlorate(I) and with hot concentrated sodium hydroxide to form sodium chlorate(V).

(i) Write the equation for the reaction of chlorine with cold dilute sodium hydroxide.

_____ [2]

(ii) What is the formula of sodium chlorate(V)?

_____ [1]

(c) Iodine is more soluble in hexane than in water.

(i) Explain why iodine is more soluble in hexane.

_____ [2]

(ii) What colour is a solution of iodine in hexane?

_____ [1]

(d) The hydrogen halides can be formed by the reaction of concentrated sulphuric acid with the corresponding solid sodium halide.

(i) Write the equation for the reaction of concentrated sulphuric acid with solid sodium chloride at room temperature.

_____ [2]

(ii) Name **two** products, other than hydrogen iodide, which are formed when sodium iodide reacts with concentrated sulphuric acid.

_____ [2]

(iii) State and explain the trend in thermal stability of the hydrogen halides.

_____ [2]

(e) The presence of halide ions can be detected using silver ions and aqueous ammonia.

(i) Write the ionic equation for the reaction between silver ions and chloride ions.

_____ [1]

(ii) Complete the table below.

Halide ion	Colour of silver salt	Effect of adding aqueous ammonia	
		dilute	concentrated
Chloride			
Bromide			
Iodide			

[3]

(f) Explain why the public water supply may be fluoridated and why some people are opposed to this.

 _____ [2]

THIS IS THE END OF THE QUESTION PAPER

