



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2014

Centre Number

71

Candidate Number

Chemistry

Assessment Unit AS 1

assessing

Basic Concepts in Physical
and Inorganic Chemistry

[AC112]



THURSDAY 9 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 **12(d)(iv)**.

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, containing some data, is included in this question paper.

For Examiner's
use only

Question Number	Marks
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Section A

1–10	
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Section B

11	
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12	
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13	
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14	
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15	
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16	
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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 An element in the Periodic Table has the following successive ionisation energies (kJ mol^{-1}).

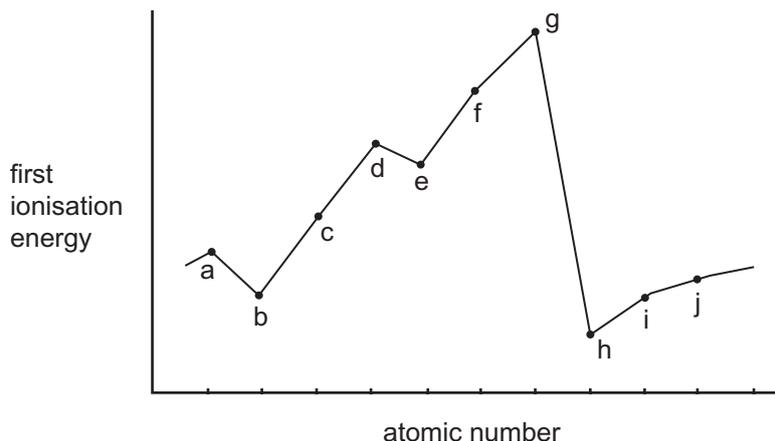
590 1145 4912 6474 8144 10496 12320

In which one of the following groups is this element found?

- A Group I
B Group II
C Group III
D Group IV
- 2 Which one of the following is the oxidation number of hafnium in HfF_7^{3-} ?
- A -3
B $+3$
C -4
D $+4$
- 3 Boron consists of the isotopes $^{10}_5\text{B}$ and $^{11}_5\text{B}$. The relative atomic mass of the element is 10.80. Which one of the following is the approximate ratio of the number of lighter atoms to heavier atoms?
- A 1:3
B 1:4
C 1:9
D 4:1

- 4 Which one of the following equations shows hydrogen peroxide, H_2O_2 , behaving as a reducing agent?
- A $2\text{Fe}^{2+} + \text{H}_2\text{O}_2 + 2\text{H}^+ \rightarrow 2\text{Fe}^{3+} + 2\text{H}_2\text{O}$
- B $2\text{I}^- + \text{H}_2\text{O}_2 + 2\text{H}^+ \rightarrow \text{I}_2 + 2\text{H}_2\text{O}$
- C $\text{MnO}_2 + 2\text{H}^+ + \text{H}_2\text{O}_2 \rightarrow \text{Mn}^{2+} + 2\text{H}_2\text{O} + \text{O}_2$
- D $\text{PbS} + 4\text{H}_2\text{O}_2 \rightarrow \text{PbSO}_4 + 4\text{H}_2\text{O}$
- 5 The electronegativity values, not in order, for caesium, cobalt, fluorine and nitrogen are listed below. Which one of the following is the value for the cobalt atom?
- A 0.70
- B 1.80
- C 3.00
- D 4.00
- 6 Which one of the following molecules is linear?
- A CH_3CH_3
- B CO_2
- C H_2O_2
- D H_2Te
- 7 Which one of the following is the reason why water boils at 100°C while the hydrides of the other Group VI elements boil below 0°C ?
- A Hydrogen bonding between water molecules
- B Ionic bonding in water molecules
- C The lower molar mass of water molecules
- D The stability of the bonding in water molecules

8 The first ionisation energy is shown against increasing atomic number.



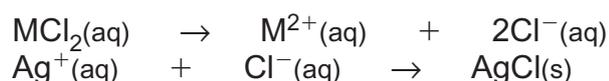
Which one of the following shows a Group I element together with a Group VII element?

	Group I	Group VII
A	b	f
B	b	g
C	h	f
D	h	g

9 Which one of the following properties is a characteristic of astatine?

- A It has an electronegativity value greater than that of iodine.
- B It is a solid at room temperature and pressure.
- C It oxidises bromide ions to bromine.
- D Its hydride exhibits more hydrogen bonding than hydrogen iodide.

10 3.12 g of MCl_2 were dissolved in water and made up to one litre of solution. 25.0 cm³ of this solution reacts with 7.5 cm³ of 0.100 M silver nitrate solution.



Which one of the following Group II elements is M?

- A barium
- B calcium
- C magnesium
- D strontium

Section B

Answer **all six** questions in this section.

11 Complete the following table about the silver halides.

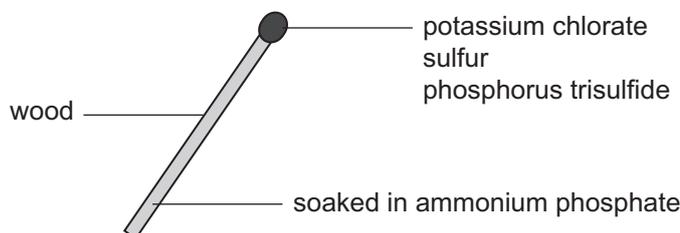
silver halide	formula	colour	ionic/ covalent	soluble in dilute ammonia solution	soluble in concentrated ammonia solution
silver fluoride	AgF	white	ionic	yes	yes
silver chloride					
silver bromide					
silver iodide					

[4]

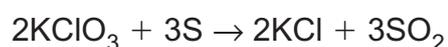
Examiner Only	
Marks	Remark

- 12 The creation of the friction match took many years and involved a variety of chemicals based on phosphorus.

The modern match is shown below. The head is a mixture of potassium chlorate, sulfur and phosphorus trisulfide held together by glue. The wood is soaked in ammonium phosphate which acts as a fire retardant.



- (a) Potassium chlorate reacts with the sulfur to form potassium chloride and sulfur dioxide as shown by the following equation.



- (i) Deduce the oxidation number for each element in the reactants.

_____ [1]

- (ii) Deduce the oxidation number for each element in the products.

_____ [1]

- (iii) Explain, using these oxidation numbers, why this is a redox reaction.

_____ [1]

- (b) Potassium chlorate, KClO_3 , is manufactured using the reaction between chlorine and potassium hydroxide.

- (i) Write the equation for the reaction.

_____ [2]

- (ii) State the conditions under which the reaction is carried out.

_____ [1]

Examiner Only	
Marks	Remark

(c) Phosphorus trisulfide is easily ignited. It provides the heat to initiate the reaction between potassium chlorate and sulfur.

(i) Phosphorus has an oxidation number of +3 in phosphorus trisulfide. State the formula of phosphorus trisulfide.

_____ [1]

(ii) Suggest whether phosphorus trisulfide is ionic or covalent. Explain your reasons.

_____ [1]

(iii) Name the **two** products formed when phosphorus trisulfide is completely burnt. No oxidation numbers are needed.

_____ [2]

(d) Ammonium phosphate is an ionic compound consisting of ammonium and phosphate ions, PO_4^{3-} .

(i) Write the formula of the ammonium ion.

_____ [1]

(ii) Name and draw the shape of the ammonium ion stating the interbond angle.

_____ [3]

(iii) Write the formula of ammonium phosphate.

_____ [1]

Examiner Only	
Marks	Remark

(iv) State and explain **three** physical properties you would expect ammonium phosphate to have.

Quality of written communication

[3]

[2]

Examiner Only	
Marks	Remark

- 13** Francium is found in Group I of the Periodic Table and was discovered by Marguerite Perey in 1939 in the Curie Laboratory in France. It was isolated from uranium ore. Since then it has been synthesised by the nuclear reaction of oxygen atoms with gold atoms. It exists as 34 isotopes.

In the Periodic Table it has an atomic number of 87 and is given a relative atomic mass of 223.

- (a)** Francium is found in period 7 of the Periodic Table and is regarded as an s-block element.

Suggest the subshell occupied by the outermost electron in a francium atom.

_____ [1]

- (b)** Francium was first synthesised according to the following equation.



The symbol n represents a neutron.

- (i)** What is the relative mass of a neutron?

_____ [1]

- (ii)** Using the relative mass of the neutron from part **(i)** show, by calculation, that the equation is balanced according to mass.

 _____ [2]

- (iii)** Why are electrons not used when balancing the equation according to mass?

 _____ [1]

Examiner Only	
Marks	Remark

(c) Francium is one of the least electronegative elements in the Periodic Table.

(i) Explain the meaning of the term **electronegativity**.

_____ [2]

(ii) State how electronegativity values change on going across a period.

_____ [1]

(d) Francium has a melting point of 27°C and would melt in the hand just as caesium does. It has the highest electrical conductivity of the alkali metals.

(i) Explain, in terms of metallic bonding, why francium has a low melting point.

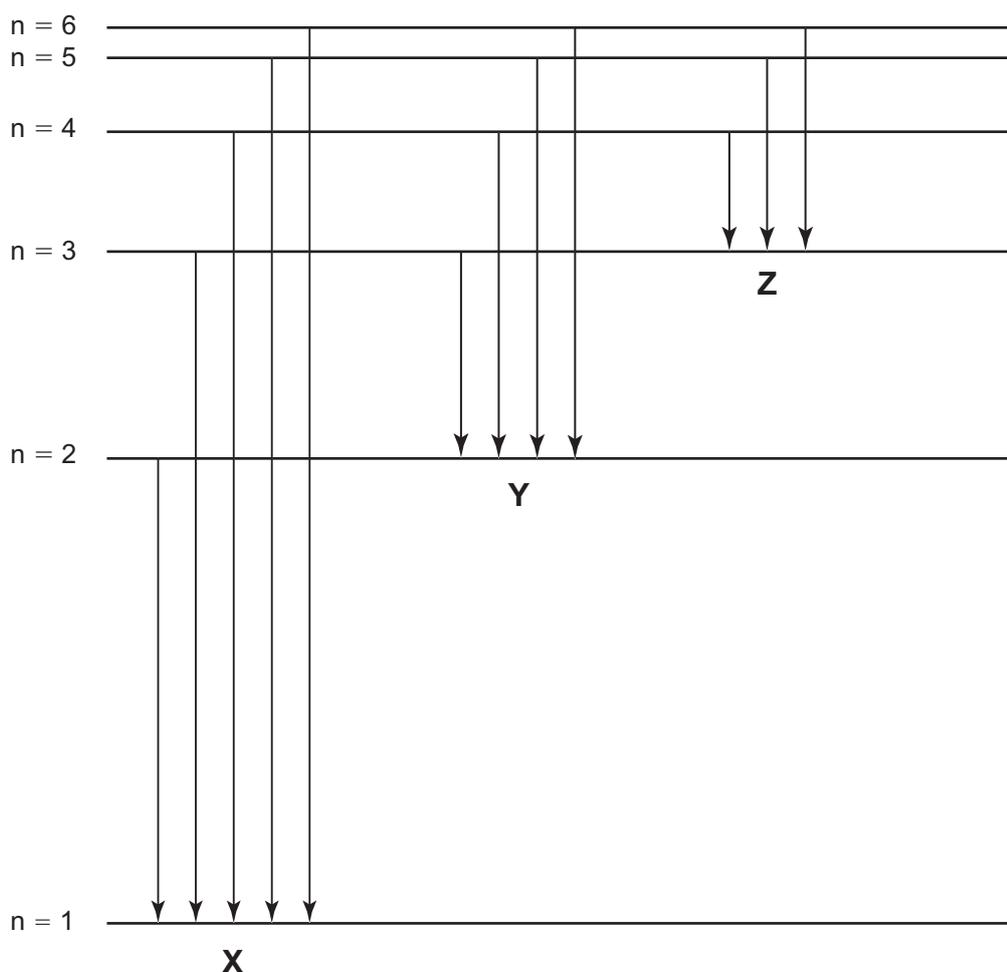
_____ [2]

(ii) Explain, in terms of metallic bonding, why francium has the highest electrical conductivity.

_____ [2]

Examiner Only	
Marks	Remark

14 The energy levels of a hydrogen atom are shown below and the arrows indicate the transition of electrons between successive energy levels.



The electromagnetic spectrum is shown below.

Radio waves	Microwaves	Infrared	Visible	Ultraviolet	X-rays	Gamma rays
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Energy increases →

(a) Write the equation that relates energy to frequency, explain the meanings of the symbols used and state the units in which they are measured.

[3]

Examiner Only	
Marks	Remark

(b) There are three series of lines. The first series **X** occurs in the ultraviolet region of the electromagnetic spectrum.

(i) In which part of the electromagnetic spectrum does the second series, **Y**, occur?

_____ [1]

(ii) Suggest in which part of the electromagnetic spectrum the third series, **Z**, occurs.

_____ [1]

(iii) What happens to the atom when its electron passes from energy level $n = 1$ to an infinite energy level?

_____ [1]

(c) (i) Use the energy level diagram below to show the ground state of a sodium atom. Use arrows to represent the sodium electrons.

3s _____

2p _____

2s _____

1s _____ [2]

(ii) What is the predominant colour in the emission spectrum of sodium?

_____ [1]

Examiner Only	
Marks	Remark

- (d) 14.1 g of the hydrated iron(II) chloride crystals contain 6.5 g of water. Use these figures to calculate the formula of the crystals.

mass of iron(II) chloride

moles of iron(II) chloride

moles of water

ratio of moles of water to moles of iron(II) chloride

formula of iron(II) chloride crystals

[5]

Examiner Only

Marks

Remark

Examiner Only	
Marks	Remark

16 Sulfur forms the following fluorides:

sulfur difluoride	SF_2
sulfur tetrafluoride	SF_4
sulfur hexafluoride	SF_6

Sulfur hexafluoride is the best known and can be used as a safe electrical insulator. The other fluorides are toxic.

(a) Draw the dot and cross diagrams showing the outer electrons only for each of the fluorides.

[3]

(b) (i) State the **octet rule**.

_____ [2]

(ii) Explain whether sulfur is obeying the octet rule in each fluoride.

_____ [2]

(c) Sulfur difluoride has the same shape as a water molecule but the bond angle is 6° smaller. Draw and name the shape of sulfur difluoride, stating its bond angle.

_____ [3]

Examiner Only	
Marks	Remark

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