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71	
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Chemistry

Assessment Unit AS 1

assessing

Module 1: Basic Concepts in Physical and Inorganic Chemistry

[AC111]



WEDNESDAY 3 JUNE, 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 seventeen** 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 seven** 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)(i)**.

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

In Section B the figures in the 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	
17	
Total Marks	

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 How many electrons are present in a potassium ion, K^+ ?
- A 18
B 19
C 20
D 39
- 2 Which one of the following represents the first five ionisation energies in kJ mol^{-1} of an s-block element?
- | | 1 st | 2 nd | 3 rd | 4 th | 5 th |
|---|-----------------|-----------------|-----------------|-----------------|-----------------|
| A | 580 | 1800 | 2700 | 11 600 | 14 800 |
| B | 740 | 1500 | 7700 | 10 500 | 13 600 |
| C | 1000 | 2300 | 3400 | 4600 | 7000 |
| D | 14 800 | 11 600 | 2700 | 1800 | 580 |
- 3 A sample of 4.64 g of hydrated sodium carbonate, $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$, was dissolved in 1 dm^3 of water. 25.0 cm^3 of this solution required 20.0 cm^3 of 0.05 mol dm^{-3} hydrochloric acid for neutralisation. Which one of the following is the value of x ?
- A 0.5
B 5
C 7
D 13
- 4 Which one of the following contains a coordinate bond?
- A Ammonium, NH_4^+
B Boron trifluoride, BF_3
C Sulphur hexafluoride, SF_6
D Water, H_2O

- 5 Which one of the following lists the colour of solid iodine and of iodine dissolved in the solvent stated?

	Solid	Water	Hexane
A	grey/black	purple	yellow/brown
B	dark purple	yellow/brown	purple
C	yellow/brown	grey/black	yellow/brown
D	grey/black	yellow/brown	purple

- 6 Which one of the following does **not** show the number of each bond present in the named molecules?

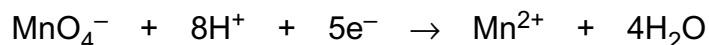
	Molecule	Single bond	Double bond	Triple bond
A	Ethene, C ₂ H ₄	2	1	0
B	Nitrogen, N ₂	0	0	1
C	Carbon dioxide, CO ₂	0	2	0
D	Beryllium chloride, BeCl ₂	2	0	0

- 7 In which one of the following molecules does the named element have two lone pairs of electrons?

- A Beryllium in BeCl₂
- B Carbon in CH₄
- C Nitrogen in NH₃
- D Oxygen in H₂O

- 8 Using the half-equations below, which one of the following is the balanced equation for the reaction between acidified manganate(VII) ions and ethanedioate ions.

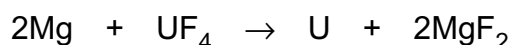
Acidified manganate(VII) ions:



Ethanedioate ions:



- A $2\text{MnO}_4^- + 16\text{H}^+ + \text{C}_2\text{O}_4^{2-} \rightarrow 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 2\text{CO}_2$
 B $\text{MnO}_4^- + 8\text{H}^+ + 5\text{C}_2\text{O}_4^{2-} \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O} + 10\text{CO}_2$
 C $2\text{MnO}_4^- + 16\text{H}^+ + 5\text{C}_2\text{O}_4^{2-} \rightarrow 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 10\text{CO}_2$
 D $5\text{MnO}_4^- + 40\text{H}^+ + 2\text{C}_2\text{O}_4^{2-} \rightarrow 5\text{Mn}^{2+} + 20\text{H}_2\text{O} + 4\text{CO}_2$
- 9 Which one of the following molecules is non-polar?
- A Ammonia, NH_3
 B Carbon dioxide, CO_2
 C Hydrogen fluoride, HF
 D Water, H_2O
- 10 The extraction and purification of uranium from its ore involves the following reaction between uranium(IV) fluoride and magnesium.



What mass of uranium can be extracted from 500 tonnes of uranium(IV) fluoride and 50 tonnes of magnesium?

- A 192 tonnes
 B 246 tonnes
 C 379 tonnes
 D 495 tonnes

Section B

Answer **all seven** questions in this section

- 11 (a) Complete the table naming the strongest intermolecular force between molecules in each of the following liquids.

Liquid	Intermolecular force
Ammonia, $\text{NH}_3(\text{l})$	
Hydrogen chloride, $\text{HCl}(\text{l})$	
Methane, $\text{CH}_4(\text{l})$	

[3]

- (b) Explain why ice has a lower density than water.

[2]

- (c) Draw and explain the shape of an ammonia molecule.

[3]

12 Neon has several isotopes.

(a) Complete the table below.

	Number of protons	Number of electrons	Number of neutrons
Neon-20			
Neon-21			
Neon-22			

[2]

(b) The table below gives the abundance of each isotope of neon.

Calculate the relative atomic mass of neon to two decimal places.

Isotope	% abundance
Neon-20	90.92
Neon-21	0.26
Neon-22	8.82

[2]

(c) Name the isotope used as the standard to compare the relative atomic mass of atoms.

[1]

(d) Label the sub-shells below and draw the electronic structure of neon in the ground state.

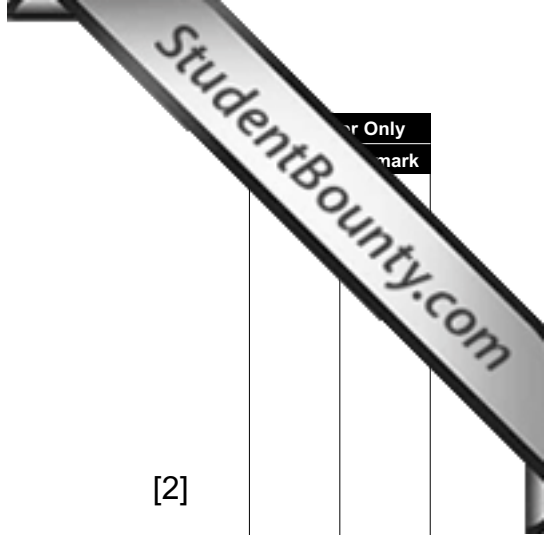
[2]

(e) Draw the shape of an s and of a p orbital.

s orbital

p orbital

[2]



For Only
mark

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13 The percentage of calcium carbonate present in egg shells can be found by back titration using excess hydrochloric acid and standard sodium hydroxide solution.

(a) Write an equation for the reaction between calcium carbonate and hydrochloric acid.

_____ [2]

(b) Explain what is meant by a **standard** solution.

_____ [1]

(c) 1.12 g of an egg shell was reacted with 20.0 cm³ of 2M hydrochloric acid and the solution formed made up to 250 cm³ in a volumetric flask. 25.0 cm³ of this solution completely reacted with 18.6 cm³ of 0.1 M sodium hydroxide.
Calculate the percentage of calcium carbonate in the egg shell using the headings below.

Moles of hydrochloric acid added to the egg shell

Moles of sodium hydroxide used

Moles of hydrochloric acid in 250 cm³

Moles of hydrochloric acid which reacted with the egg shell

Mass of calcium carbonate in the egg shell

Percentage of calcium carbonate in the egg shell

_____ [6]

14 The Periodic Table identifies various relationships between elements.

(a) (i) What property is used to order the elements in the Periodic Table?

_____ [1]

(ii) Explain why transition metals are classified as d-block elements.

_____ [1]

(b) A number of distinct trends can be seen in the 3rd period from sodium to argon.

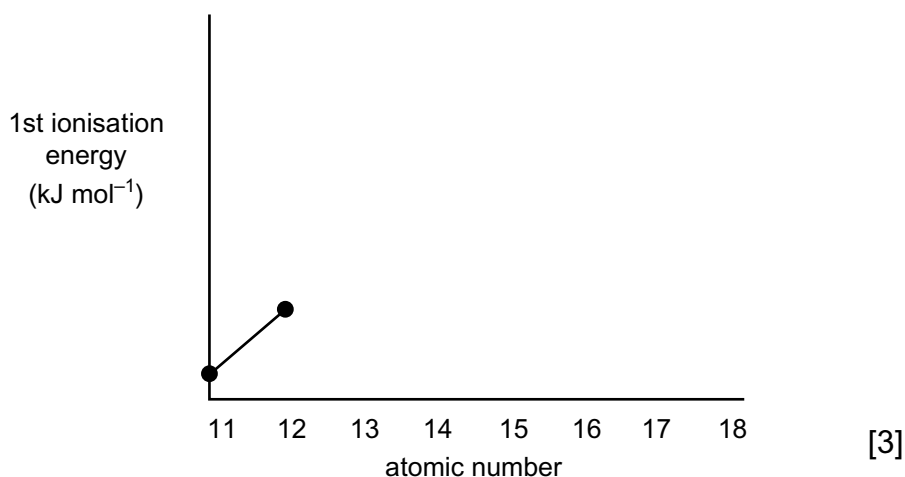
(i) Describe the change in melting point across this period.

_____ [2]

(ii) Describe and explain the change in atomic radius across this period.

_____ [2]

(iii) On the axes below sketch the change in the 1st ionisation energy across the 3rd period.



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(Questions continue overleaf)

15 (a) Diamond and graphite have giant covalent structures.

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

_____ [1]

(ii) Describe the structures of diamond and graphite.

Diamond: _____

_____ [2]

Graphite: _____

_____ [2]

(iii) Explain why graphite conducts electricity.

_____ [2]

(iv) Explain why diamond is exceptionally hard.

_____ [1]

(b) Carbon dioxide, CO_2 , and beryllium chloride, BeCl_2 , are both covalent compounds.

(i) Draw dot and cross diagrams for carbon dioxide and for beryllium chloride.

carbon dioxide

beryllium chloride

[2]

(ii) State the **octet rule** and explain why beryllium chloride does not obey it.

[2]

16 Rock salt, impure sodium chloride, is found in large underground deposits at Kilroot.

(a) (i) Describe how you would carry out chemical tests used to show that solid rock salt contains sodium chloride.

[5]

Quality of written communication

[2]

(ii) Draw dot and cross diagrams to show how sodium chloride is formed from sodium and chlorine atoms.

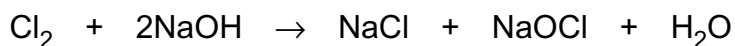
[4]

(b) Chlorine is manufactured by the electrolysis of concentrated sodium chloride solution.

(i) Explain why sodium chloride solution conducts electricity but solid sodium chloride does not.

[1]

- (ii) Household bleach is manufactured by reacting chlorine with sodium hydroxide solution.



Using oxidation numbers, explain why this reaction is described as disproportionation.

_____ [3]

- (iii) Describe what you would observe when chlorine is bubbled through a solution of potassium bromide.

_____ [2]

- (iv) Write an ionic equation for the reaction of chlorine with potassium bromide.

_____ [1]

- (c) Concentrated sulphuric acid reacts with sodium halides to form the corresponding hydrogen halide.

- (i) Write an equation for the reaction of concentrated sulphuric acid with sodium chloride.

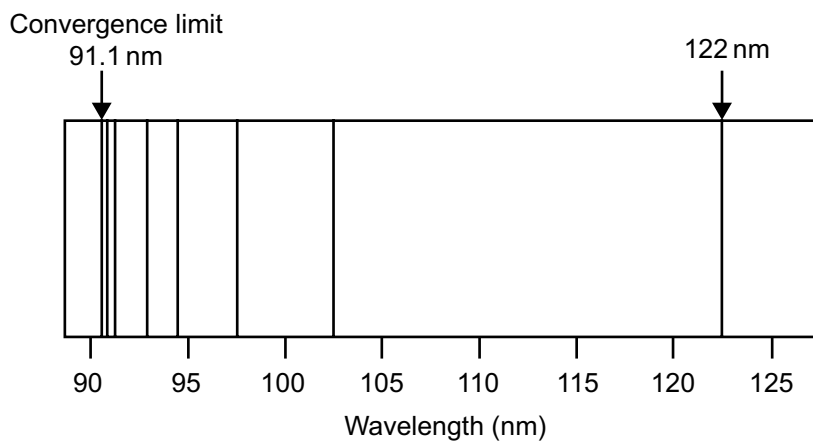
_____ [2]

- (ii) Give **two** observations when concentrated sulphuric acid is added to sodium iodide.

_____ [2]

17 The electronic structure of atoms has been interpreted from analysis of emission spectra.

The diagram below shows the emission spectrum of hydrogen in the ultraviolet region.



(a) Draw the electron transition responsible for the line at 122 nm.

n = 4 _____

n = 3 _____

n = 2 _____

n = 1 _____

[2]

(b) Explain what is meant by the convergence limit.

_____ [1]

(c) The convergence limit can be used to calculate the ionisation energy for hydrogen.

(i) Write an equation, including state symbols, for the ionisation of atomic hydrogen.

_____ [2]

(ii) Use the information below to calculate the frequency of the line at the convergence limit.

(speed of light = $3 \times 10^8 \text{ m s}^{-1}$, $1 \text{ nm} = 1 \times 10^{-9} \text{ m}$)

speed of light = frequency \times wavelength

_____ [1]

(iii) Use this frequency value to calculate the energy required to ionise one mole of hydrogen atoms.

Energy required to ionise one hydrogen atom

Energy required to ionise one mole of hydrogen atoms in kJ mol^{-1}

_____ kJ mol^{-1} [2]

THIS IS THE END OF THE QUESTION PAPER
