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ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2013

Chemistry

Assessment Unit AS 1
assessing
Basic Concepts in Physical and Inorganic Chemistry

[AC112]

AC112

WEDNESDAY 12 JUNE, AFTERNOON

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(b)(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 the Elements, containing some data, is included in this question paper.

8181.04**R**

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

Section A

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

Select the correct response in each case and mark its code letter by connecting the [...] **as illustrated on the answer sheet.**

1   Which one of the following is the formula for nitrogen(I) oxide?

    A   NO

    B NO_2

    C N_2O

    D N_2O_4

2   Which one of the following is the number of atoms present in 0.25 moles of $C_{12}H_{22}O_{11}$?

    A 6.8×10^{24}

    B 1.4×10^{25}

    C 2.7×10^{25}

    D 1.1×10^{26}

3   Which one of the following is a molecular covalent substance?

    A   CaO

    B   CO

    C Cr_2O_3

    D   CuO

4   A caesium atom differs from a caesium ion because the atom has a greater

    A   atomic number.

    B   mass number.

    C   number of electrons.

    D   number of protons.

5 Part of the mass spectrum for aspirin is shown below. Which one of the following numbers is the molecular ion peak?
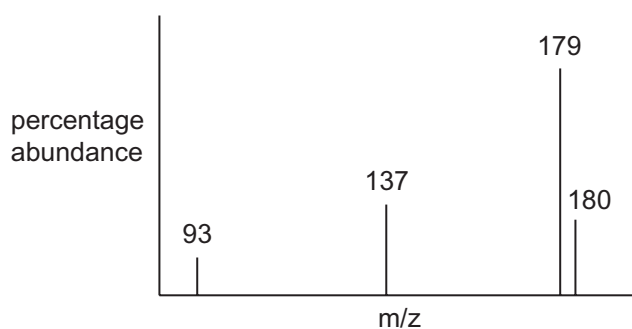
A   93

B   137

C   179

D   180

6 In which one of the following liquids are the van der Waals forces greatest?

A   Argon

B   Krypton

C   Neon

D   Xenon

7 Prozac tablets contain 20 mg of fluoxetine ($C_{17}H_{18}F_3NO$) in each tablet. The number of moles of fluoxetine in each tablet is

A 6.47×10^{-5}

B 1.39×10^{-4}

C 6.47×10^{-2}

D 1.39×10^{-1}

8 Which one of the following does **not** have a total of 14 electrons?

   A CO

   B Li_2O

   C N_2

   D S^{2-}

9 Successive ionisation energies for elements X and Y are shown below.

Ionisation energy $(kJ\,mol^{-1})$	1st	2nd	3rd	4th	5th	6th	7th	8th
X	578	1817	2745	11577	14842	18379	23326	27465
Y	1314	3388	5301	7469	10990	13327	71330	84078

   Which one of the following is the formula for a compound of X and Y?

   A XY_2

   B X_2Y

   C X_2Y_3

   D X_3Y_2

10 Hexan-1-ol can be converted to hex-1-ene as follows:

$$C_6H_{13}OH \rightarrow C_6H_{12} + H_2O$$
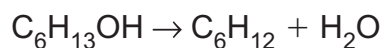
40.0 g of hexan-1-ol produced 24.7 g of hex-1-ene. Which one of the following is the percentage yield?

   A 24.7%

   B 50.8%

   C 72.0%

   D 75.0%

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(Questions continue overleaf)

Section B

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

11 (a) Atoms consist of protons, neutrons and electrons.

(i) Complete the table below giving the properties of a proton, a neutron and an electron.

	Relative mass	**Relative charge**
Proton		
Neutron		
Electron		

[3]

(ii) Element 116, ununhexium, was added to the Periodic Table in June 2011. Complete the table below.

Atomic number	116
Mass number	
Number of protons	
Number of neutrons	177
Number of electrons	

[3]

(b) Iron is the sixth most abundant element in the Universe. It has four isotopes as shown in the table.

Isotope	^{54}Fe	^{56}Fe	^{57}Fe	^{58}Fe
Percentage abundance	5.84	91.76	2.12	0.28

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

_____

_____ [2]

(ii) Use the table to calculate the relative atomic mass of iron to **two** decimal places.

_____

_____

_____ [2]

12 The emission spectrum for atomic hydrogen has been used to provide evidence for discrete electron energy levels in atoms.

(a) Complete the diagram to show the electron transitions associated with the first **two** lines of the hydrogen emission spectrum in the visible region.

n = 5 _____

n = 4 _____

n = 3 _____

n = 2 _____

n = 1 _____ [2]

(b) The convergence limit of the hydrogen spectrum in the ultraviolet region is at 3.28×10^{15} Hz. Calculate the ionisation energy of hydrogen in $kJ\,mol^{-1}$.

_____

_____

_____ [3]

(c) The emission spectra of elements give rise to characteristic flame colours. Complete the table below.

Flame colour	Formula of metal ion
Blue-green	
Crimson	
Green	

[3]

13 Wood vinegar, which contains ethanoic acid, is formed when wood is heated. The percentage by mass of ethanoic acid in wood vinegar can be found by titration with standard sodium hydroxide solution.

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

_____ [1]

(ii) Write the equation for the reaction between ethanoic acid and sodium hydroxide.

_____ [1]

(b) $25.0\,cm^3$ of wood vinegar were diluted to $250\,cm^3$ in a volumetric flask. $25.0\,cm^3$ of the diluted wood vinegar required $30.3\,cm^3$ of $0.1\,mol\,dm^{-3}$ sodium hydroxide solution for neutralisation.

(i) How many moles of sodium hydroxide were required?

_____ [1]

(ii) How many moles of ethanoic acid were present in the $25.0\,cm^3$ of diluted wood vinegar?

_____ [1]

(iii) How many moles of ethanoic acid were present in $25.0\,cm^3$ of undiluted wood vinegar?

_____ [1]

(iv) What was the mass of ethanoic acid in the $25.0\,cm^3$ of undiluted wood vinegar?

_____ [1]

(v) What was the percentage of ethanoic acid by mass in the wood vinegar? Assume that the density of wood vinegar is $1.02\,g\,cm^{-3}$.

_____

_____ [1]

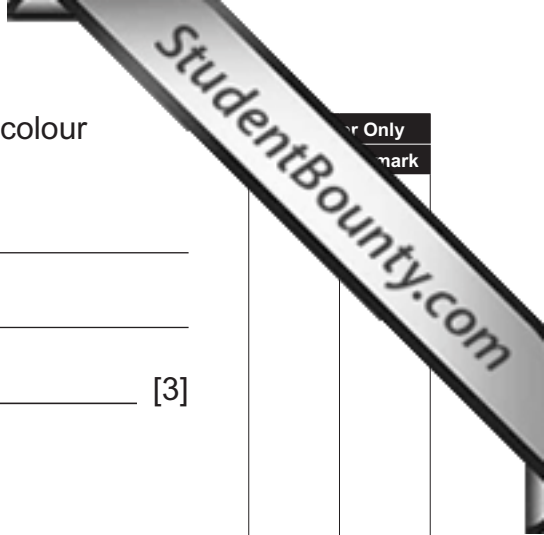**(c)** Suggest a suitable indicator for the titration and state the colour change at the end point.

Indicator: _____

Colour change: from _____

to _____ [3]

14 The Third Period from sodium to argon can be used to illustrate trends in the Periodic Table.

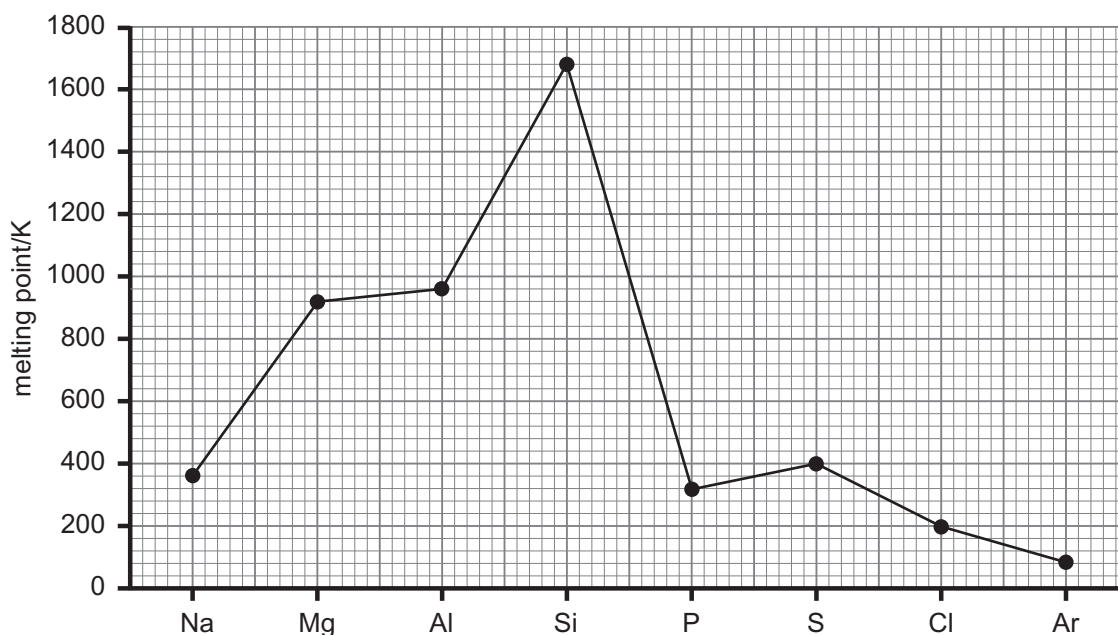**(a)** In which block of the Periodic Table is argon found? Explain your answer.

_____

_____ [2]

(b) The graph below shows the melting points of the elements in the Third Period.

(i) Explain the rise in melting point from sodium to magnesium.

_____

_____

_____ [2]

(ii) Explain why silicon has the highest melting point.

_____

_____

_____ [2]

(iii) Explain why the melting point of sulfur, S, is higher than phosphorus, P.

_____

_____

_____ [2]

(c) State and explain the trend in atomic radius across the Third Period.

_____

_____

_____

_____ [3]

15 Aluminium chloride exists as the molecule $AlCl_3$ in the vapour state. This molecule contains covalent bonds and does not obey the octet rule.

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

_____

_____ [2]

(ii) Explain what is meant by the term **octet rule**.

_____

_____ [2]

(b) Aluminium chloride reacts with chloride ions as follows:

$$AlCl_3 + Cl^- \rightarrow AlCl_4^-$$

(i) Draw dot and cross diagrams, using outer electrons only, to show the bonding in $AlCl_3$ and $AlCl_4^-$.

[4]

(ii) What type of bond is formed between $AlCl_3$ and the Cl^- ion?

_____ [1]

(iii) Draw and name the shapes of $AlCl_3$ and $AlCl_4^-$.

[4]

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(Questions continue overleaf)

16 The halogens form Group VII of the Periodic Table.

(a) The table below gives some of the physical properties of the halogens.

Element	Atomic radius (nm)	Boiling point (°C)	Electronegativity value	First ionisation energy (kJ mol⁻¹)
Fluorine	0.133	⁻187	4.0	1618
Chlorine	0.181	⁻35	3.0	1256
Bromine	0.196	59	2.8	1143
Iodine	0.219	183	2.0	1009

(i) Explain why the atomic radii of the halogens increase as the Group is descended.

_____

_____ [1]

(ii) Explain the trend in the boiling points of the halogens.

_____

_____ [2]

(iii) Explain what is meant by the term **electronegativity**.

_____

_____ [1]

(iv) Explain the trend in electronegativity values of the halogens.

_____

_____

_____ [2]

(v) Write an equation, including state symbols, for the first ionisation energy of fluorine.

_____ [2]

(vi) Explain the trend in the first ionisation energy of the halogens.

_____

_____

_____ [2]

(b) Chlorine is used to sterilise water.

(i) Write an equation for the reaction of chlorine with water.

_____ [1]

(ii) Using changes in oxidation number explain why this is considered to be a disproportionation reaction.

_____

_____

_____ [3]

(iii) Ultraviolet light does not react with water and is equally effective as chlorine at sterilising water. Suggest the advantages and disadvantages of storing and using chlorine to sterilise water.

_____

_____

_____

_____

_____ [3]

Quality of written communication   [2]

(c) Iodide ions react with a variety of reagents. For each of the following state what you would observe and write an equation for the reaction.

(i) Chlorine gas with aqueous iodide ions.

Observation _____

Equation _____ [3]

(ii) A solution containing *excess* Fe^{3+} ions with aqueous iodide ions.

Observation _____

Equation _____ [3]

(iii) Silver nitrate solution with aqueous iodide ions.

Observation _____

Equation _____ [3]

_____

THIS IS THE END OF THE QUESTION PAPER
_____

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