Electron Configuration & Structure

Question Paper

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	The Core Principles of Chemistry
Sub Topic	Electron Configuration & Structure
Booklet	Question Paper

Time Allowed: **44 minutes**

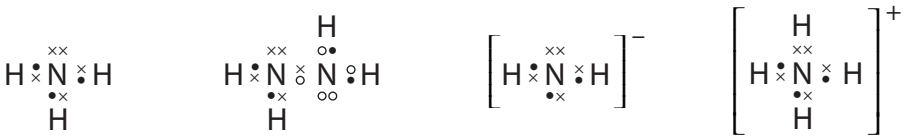
Score: **/36**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 Nitrogen can form the following species with hydrogen:



NH_3 NH_2NH_2 NH_2^- NH_4^+

Which of these species has a dative covalent bond?

☒ **A** NH_3

☒ **B** NH_2NH_2

☒ **C** NH_2^-

☒ **D** NH_4^+

(Total for Question 1 = 1 mark)

2 Which of the following is isoelectronic with the chloride ion, Cl^-?

☒ **A** F^-

☒ **B** Br^-

☒ **C** Na^+

☒ **D** Ar

(Total for Question 2 = 1 mark)

3 A sample of oxygen contains the isotopes ^{16}O, ^{17}O, ^{18}O.

How many peaks would there be for the O_2^+ ions in the mass spectrum of this sample of oxygen?

☒ **A** 3

☒ **B** 5

☒ **C** 6

☒ **D** 9

(Total for Question 3 = 1 mark)

4 In which order do the electrons fill the orbitals of an atom?

☒ **A** 1s 2s 2p 3s 3p 4s 4p 3d

☒ **B** 1s 2s 2p 3s 3d 3p 4s 4p

☒ **C** 1s 2s 2p 3s 3p 3d 4s 4p

☒ **D** 1s 2s 2p 3s 3p 4s 3d 4p

(Total for Question 4 = 1 mark)

5 An ion, X^-, contains 36 electrons.

In which block of the Periodic Table would element **X** be found?

☒ **A** s

☒ **B** p

☒ **C** d

☒ **D** f

(Total for Question 5 = 1 mark)

6 Ions with the same electronic configuration are said to be **isoelectronic**.

Which of the following compounds is made up of isoelectronic ions?

☒ **A** CaO

☒ **B** $CaBr_2$

☒ **C** Na_2O

☒ **D** LiF

(Total for Question 6 = 1 mark)

7 Which species has a dative covalent bond?

- ☒ **A** H_3O^+
- ☒ **B** H_2O
- ☒ **C** OH^-
- ☒ **D** O_2

(Total for Question 7 = 1 mark)

8 Which of the following molecules contains a double bond?

- ☒ **A** F_2
- ☒ **B** F_2O
- ☒ **C** C_2F_4
- ☒ **D** C_2F_6

(Total for Question 8 = 1 mark)

9 The number of unpaired electrons in a nitrogen atom in its ground state is

- ☒ **A** 0
- ☒ **B** 1
- ☒ **C** 2
- ☒ **D** 3

(Total for Question 9 = 1 mark)

10 The first ionization energies for the elements in Period 3 of the Periodic Table are

Element	Na	Mg	Al	Si	P	S	Cl	Ar
First ionization energy / kJ mol^{-1}	496	738	578	789	1012	1000	1251	1521

(a) (i) Complete the electronic configuration of phosphorus, using the electrons-in-boxes notation.

Write the symbols for the sub-shells on the dotted lines.

(2)

1s ....

*(ii) The first ionization energies generally increase from left to right across the period.

Explain why the first ionization energy of sulfur is **lower** than that of phosphorus.

(2)

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(iii) Write an equation, with state symbols, to show the **third** ionization energy of phosphorus.

(2)

*(b) (i) Explain why the first ionization energy of nitrogen is greater than the first ionization energy of phosphorus.

(3)

(ii) Draw a dot and cross diagram to show the bonding in a molecule of nitrogen.

Show **outer** electrons only.

(2)

(c) Solid white phosphorus exists as P_4 molecules.

Calculate the number of molecules in 24.8 g of white phosphorus.

[The Avogadro constant, $L = 6.02 \times 10^{23}$ mol^{-1}]

(2)

(Total for Question 10 = 13 marks)

11 This question is about atomic structure.

(a) Draw diagrams to show the shape of an s-orbital and of a p-orbital.

(2)

s-orbital	p-orbital

(b) Complete the table to show the number of electrons that **completely** fill the following regions.

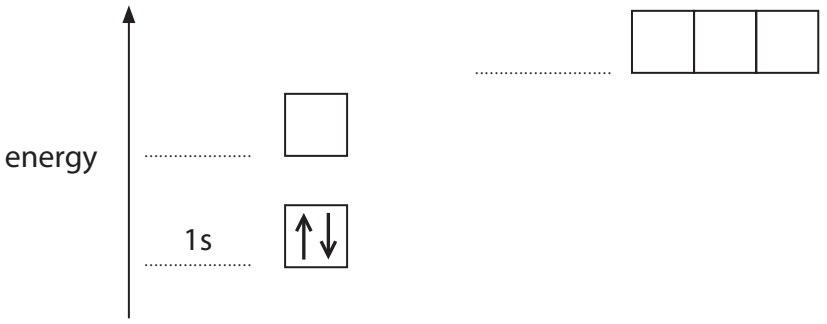
(3)

Region	Number of electrons present when completely filled
a d-orbital	
a p sub-shell	
the third shell (n = 3)	

(c) The energy diagram below is for the eight electrons present in an oxygen atom. Complete the diagram for an oxygen atom by adding

- labels to identify the other occupied sub-shells
- arrows to show how the remaining six electrons are arranged in the orbitals.

(2)



(d) Successive ionization energies provide evidence for the arrangement of electrons in atoms. The eight successive ionization energies of oxygen are shown in the table below.

Ionization number	1st	2nd	3rd	4th	5th	6th	7th	8th
Ionization energy / kJ mol^{-1}	1314	3388	5301	7469	10989	13327	71337	84080

(i) Define the term **first ionization energy**.

(3)

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(ii) Write an equation, with state symbols, to show the **third** ionization energy of oxygen.

(2)

*(iii) Explain how the data in the table provide evidence that there are two occupied electron shells in an oxygen atom.

(2)

(Total for Question 11 = 14 marks)