InkChemistry

QUESTION WORKBOOK

Electron configuration: shells, subshells and orbitals

Atomic structure · Unit C01

AQA 3.1.1.3 · OCR A 2.2.1

16 questions · 55 marks

NAVY SCREEN EDITION

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SECTION A · Short, 1 to 2 marks

A1 ECS-Q10
Name one positive ion and one negative ion that have the electron configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$. [2]

A2 ECS-Q20
Identify which of the configurations $1s^2\ 2s^2\ 2p^2$ and $1s^2\ 2s^1\ 2p^3$ is the ground state of a carbon atom, and give a reason. [2]

SECTION B · Standard, 3 to 5 marks

B1 ECS-Q1
State the number of orbitals in an s, a p and a d subshell, and describe the shapes of an s orbital and of a p orbital. [4]

B2 ECS-Q2
Deduce the number of unpaired electrons in each of Ti^{2+}, Cr^{3+}, Ni^{2+} and Zn^{2+}. Their atomic numbers are 22, 24, 28 and 30. [4]

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B3 ECS-Q3

Give the full and the shortened electron configurations of a sulfur atom and of a sulfide ion, S^{2-}. Sulfur is element 16. [4]

B4 ECS-Q7

Explain, using the Pauli principle and Hund's rule, how the 2p electrons are arranged in a carbon atom and in an oxygen atom. [4]

B5 ECS-Q11

Suggest why the d block of the periodic table is ten elements wide, and why potassium is placed at the start of Period 4 rather than at the end of Period 3. [4]

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B6 ECS-Q14 Compare the electron configurations of a Mn^{2+} ion and an Fe^{3+} ion, and the way each forms from its atom. Manganese is element 25 and iron is element 26. [4]

B7 ECS-Q4 Give the full electron configurations of a chromium atom (Z = 24), a gallium atom (Z = 31) and a Ga^{3+} ion. [3]

B8 ECS-Q5 Explain why the electron configuration of chromium is [Ar] $3d^5\ 4s^1$ rather than [Ar] $3d^4\ 4s^2$. [3]

B9 ECS-Q6 Explain why the 4s subshell fills before the 3d subshell, but the 4s electrons are removed first when a transition metal forms an ion. [3]

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B10 ECS-Q9 Identify the element whose atoms have the configuration [Ar] $3d^{10}$ $4s^2$ $4p^5$, state the block it is in, and give the number of unpaired electrons in one atom. [3]

B11 ECS-Q12 Suggest the electron configuration of a Zn^{2+} ion, and suggest why zinc does not form a 3+ ion in its compounds. Zinc is element 30. [3]

B12 ECS-Q16 Evaluate a student's answer that the configuration of Fe^{3+} is [Ar] $3d^3$ $4s^2$. [3]

B13 ECS-Q18 Explain how a sodium street lamp produces its yellow light, using the terms ground state and excited state. [3]

SECTION C · Long, 6 marks or more

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C1 ECS-Q15 Explain, in terms of subshells and their energies, why the third shell holds only eight electrons from argon to calcium although it can hold eighteen, and why the GCSE pattern of 2, 8, 8 fails from scandium onwards. [6]

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