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VCE Chemistry ½

Trends in the Periodic Table [1.2]

Test Solutions

19 Marks. 1 Minute Reading. 15 Minutes Writing.

Results:

Test Questions	_____ / 15
Extension	_____ / 4

Section A: Test Questions (15 Marks)

INSTRUCTION: 15 Marks. 1 Minute Reading. 12 Minutes Writing.

Question 1 (3 marks)

Tick whether the following statements are **true** or **false**.

	True	False
a. Periods correspond to the number of electron shells in an atom.	✓	
b. Electronegativity increases across a period from left to right.	✓	
c. Non-metallic character is strongest in the top right of the periodic table.	✓	
d. The first ionisation energy of an element refers to the energy required to remove the most tightly bound electron.		✓
e. Down a group, the effective nuclear charge experienced by valence electrons decreases due to increased shielding.		✓
f. As effective nuclear charge increases, electronegativity generally increases.	✓	

Space for Personal Notes

Question 2 (7 marks)

Consider the element phosphorus ($z = 15$), which can be found in plant fertiliser.

a. What is its ground-state electron configuration? (1 mark)

$z = 15; 1s^2 2s^2 2p^6 3s^2 3p^3$

b. Identify whether the atom has a metallic or non-metallic character. Explain. (1 mark)

Non-metallic: It has 5 valence electrons and will more likely gain 3 electrons to obtain a full outer shell.

c. Identify the block (s, p, d or f), it will be found in. (1 mark)

p block

d. Explain whether it has a higher or lower electronegativity than chlorine. (2 marks)

Phosphorus would have a lower electronegativity than chlorine. It has a lower effective nuclear charge, which results in electrons being pulled less strongly to the nucleus.

e. Explain whether it would have a larger or smaller atomic size than nitrogen. (2 marks)

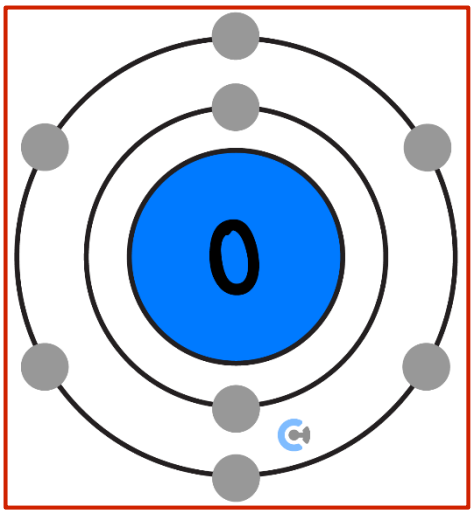
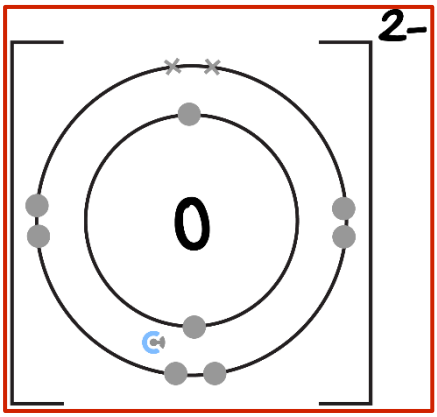
Phosphorus has a larger atomic size than nitrogen, as it has more electron shells; the valence electrons are located further away (3^{rd} shell vs. 2^{nd} shell), which increases atomic size.

Space for Personal Notes

Question 3 (5 marks)

A neutral oxygen atom (O) and oxide (O^{2-}) are to be investigated.

a. Complete the following table. (3 marks)

Substance	**Oxygen atom (O)**	**Oxide (O^{2-})**
Number of protons	8	8
Number of electrons	8	10
Shell Diagram		
Effective Nuclear Charge	+6	+6

b. State and explain which substance is likely to have a higher first ionisation energy. (2 marks)

Oxide: As it contains a full outer shell, it is stable. As such, it is more difficult to remove electrons from the atom, resulting in a higher first ionisation energy as more energy is required.

Section B: Extension (4 Marks)

INSTRUCTION: 4 Marks. 3 Minutes Writing.

Question 4 (4 marks)

Rubidium and calcium are two elements that are to be investigated.

a. Calculate the effective nuclear charge (Z_{eff}) for both elements. (1 mark)

+1 for rubidium and +2 for calcium.

b. Compare the first ionisation energies of rubidium and calcium. Which element has lower ionisation energy, and why? (2 marks)

Rubidium has lower first ionisation energy as it has a smaller effective nuclea charge, has an additional electron shell, and thus has weaker attraction to the nucleus.

c. Write the condensed Schrodinger's electron configuration of rubidium. (1 mark)

$[Kr]\ 5s^1$

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