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# VCE Chemistry ½
## Models of Atoms [1.1]
## Test Solutions

20 Marks. 1 Minute Reading. 15 Minutes Writing.

**Results:**

| | |
|---|---|
| Test Questions | _____ / 15 |
| Extension | _____ / 5 |

## 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.** In $^{37}_{17}Cl$, there are 17 protons and 17 neutrons. | | ✓ |
| **b.** Bohr's model is different from the earlier model proposed by Rutherford, as it said that electrons can only revolve around the nucleus in circular orbits of fixed radii. | ✓ | |
| **c.** In Bohr's model, electrons can occupy any energy level in the atom. | | ✓ |
| **d.** Schrödinger's model predicts the same discrete energy levels for hydrogen as Bohr's model. | ✓ | |
| **e.** Copper's electron configuration is $[Ar]4s^2 3d^9$. | | ✓ |
| **f.** All elements in the same group have identical valence electron configurations. | | ✓ |

Space for Personal Notes

**Question 2** (8 marks)

**a.** Identify the three sub-atomic particles found in an atom and explain where each of them resides. (2 marks)

proton, neutron, electron
proton/neutron in nucleus, electron in electron cloud

**b.** How was the Bohr model different from the earlier model of the atom proposed by Rutherford? (1 mark)

**A.** Atoms contain a positive nucleus at the centre of the atom.

**B.** Atoms are mostly empty spaces.

**C.** Electrons revolve around the nucleus in circular orbits.

**D.** Electrons can only revolve around the nucleus in circular orbits of fixed radii.

**c.** Write the Bohr electron configuration for each of the following:

**i.** Silicon (Si). (1 mark)

2,8,4

**ii.** Calcium (Ca). (1 mark)

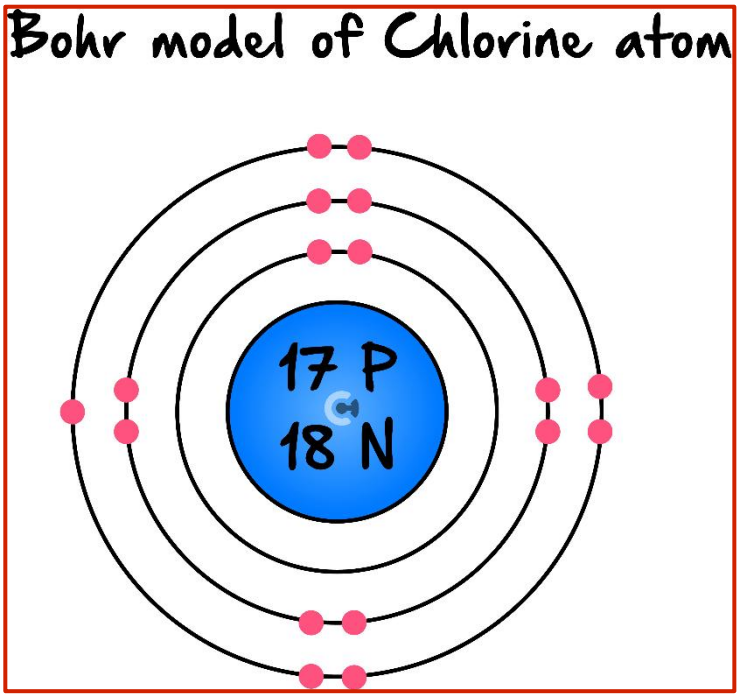
2,8,8,2

**iii.** Cobalt (Co). (1 mark)

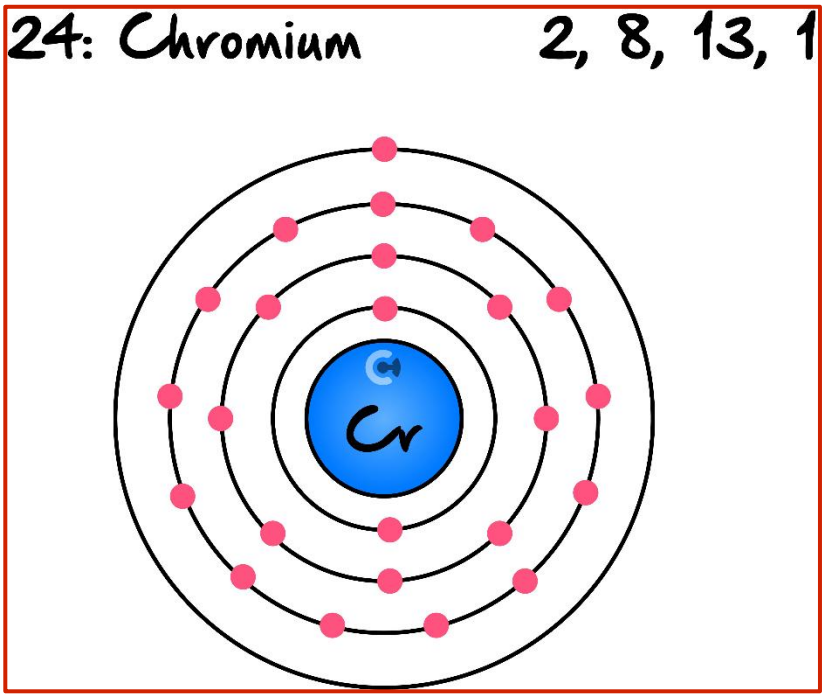
2,8,14,2

**d.** Draw the shell diagrams for each of the following:

**i.** Chlorine. (1 mark)




**ii.** Chromium. (1 mark)



**Question 3** (3 marks)

Schrodinger's electron configuration is an alternative method of depicting how electrons are arranged within an atom.

**a.** Write the ground state electron configuration of a potassium atom. (1 mark)

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

**b.** Write the electron configuration of $Co^{3+}$. (1 mark)

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$

**c.** Write the condensed electron configuration of chromium. (1 mark)

$[Ar]\ 4s^2 3d^5$

**d.** Identify the element that has an electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$ in the ground state. (1 mark)

Cu

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## Section B: Extension (5 Marks)

INSTRUCTION: 5 Marks. 3 Minutes Writing.

**Question 4** (5 marks)

Chromium and copper have atypical electron configurations.

**a.** Write the electron configuration for both elements and explain why their configurations deviate. (3 marks)

- Chromium (Cr):
  Expected: [Ar] $4s^2 3d^4$
  Actual (atypical): [Ar] $4s^1 3d^5$
  **Reason:** Chromium adopts this configuration for the extra stability of a half-filled $d$-orbital (5 electrons in $3d$).

- Copper (Cu):
  Expected: [Ar] $4s^2 3d^9$
  Actual (atypical): [Ar] $4s^1 3d^{10}$
  **Reason:** Copper adopts this configuration for the extra stability of a fully filled $d$-orbital (10 electrons in $3d$).

**b.** Predict whether the configuration of gold (Au) will be [Xe] $6s^2 4f^{14} 5d^9$ or [Xe] $6s^1 4f^{14} 5d^{10}$, and justify your answer. (2 marks)

[Xe] $6s^1 4f^{14} 5d^{10}$- Similar to copper, gold adopts an atypical configuration to achieve the extra stability of a fully filled $d$-orbital. Removing one electron from the $6s$ orbital minimises energy.

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