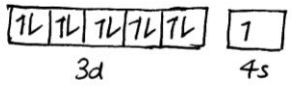
KSCP_2001_2002_Q3b

KSCP (2001/2002) Electronic Configuration

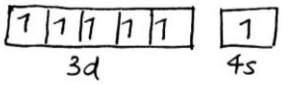
Q_3 (6) Magnetic properties of Cu and Cr

Cu ($Z = 29$) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$

Cr ($Z = 24$) $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

Cu : [Ar] 

← one unpaired electron

Cr : [Ar] 

← 6 unpaired electron.

Both Cu and Cr have unpaired electron - Therefore Cu and Cr are paramagnetic elements. But since Cr has 6 unpaired electron (more than Cu), it is strongly attracted toward magnet (strong magnetic properties.

Q_3 (c) 4th ionization energy for $_{13}Al$.

$Al\ 1s^2 2s^2 2p^6 3s^2 3p^1 \xrightarrow{IE_1} Al^+\ 1s^2 2s^2 2p^6 3s^2 \xrightarrow{IE_2} Al^{2+}\ 1s^2 2s^2 2p^6 3s^1 \xrightarrow{IE_3} Al^{3+}\ 1s^2 2s^2 2p^6 \xrightarrow{IE_4} Al^{4+}\ 1s^2 2s^2 2p^5$

4th ionization step :

$Al^{3+}\ 1s^2 2s^2 2p^6 \xrightarrow{IE_4} Al^{4+}\ 1s^2 2s^2 2p^5$ (not stable)

Al^{3+} pseudo-noble gas configuration (very stable)

Al^{3+} has pseudo-noble gas electronic configuration which is very stable. So to destroy the stable configuration, we require a lot of energy. Therefore 4th ionization energy is very large.

3rd ionization step :

$Al^{2+}\ 1s^2 2s^2 2p^6 3s^1 \xrightarrow{IE_3} Al^{3+}\ 1s^2 2s^2 2p^6$ pseudo-noble gas configuration - very stable.

Since the product Al^{3+} is very stable (pseudo-noble gas electronic configuration) So it is easily formed Therefore IE_3 is a small value.

$\therefore IE_3 < IE_4$ for Al atom.

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KSCP (2001/2002) Electronic Configuration

Q_3 (d) N^{3-}, O^{2-} and F^- – same electronic configuration (isoelectronic)

$$N\ 1s^2 2s^2 2p^3 \xrightarrow{+3e^-} N^{3-}\ 1s^2 2s^2 2p^6 \quad (7p^+, 10e^-)$$

$$O\ 1s^2 2s^2 2p^4 \xrightarrow{+2e^-} O^{2-}\ 1s^2 2s^2 2p^6 \quad (8p^+, 10e^-)$$

$$F\ 1s^2 2s^2 2p^5 \xrightarrow{+e^-} F^-\ 1s^2 2s^2 2p^6 \quad (9p^+, 10e^-)$$

F^- ion has $9p^+$. So the proton in the nucleus will strongly attract or pull the electrons toward the nucleus. So the ionic radius will be the smallest compared to O^{2-} and N^{3-}. In the case of N^{3-} ion, there are 10 electrons (only 7 protons in the nucleus). So expansion of electron cloud will occur caused the radius become larger.

Q_3 (e) Paramagnetic properties for Fe is larger than Br.

Fe ($Z = 26$): $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$

[Ar] | ↿⇂ | 1 | 1 | 1 | 1 | (3d) | ↿⇂ | (4s)

} Fe atom has four unpaired electron

Br ($Z = 35$): $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^5$

: $[Ar]\ 3d^{10} 4s^2 4p^5$

$3d^{10}\ 4s^2$ | ↿⇂ | ↿⇂ | 1 | (4p)

} Br atom has only one unpaired electron.

Since Fe atom has 4 unpaired electron compared to Br atom which has only a single unpaired electron, both atoms are paramagnetic atom but Fe atom has higher magnetic properties (strongly attracted) compared to Br atom.

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Prepared by
V. Manoharan
vmano@usm.my
manovv1955@yahoo.com
04-6533888 ext 3566