



# Orbital Basics

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## Part A 5f subshell

Give the number of f-orbitals that comprise the 5f subshell.

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## Part B Number of electrons

Give the maximum number of electrons that can occupy a single orbital.

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## Part C Electrons in the second shell

Give the maximum number of electrons that can occupy the second shell.

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## Part D 3d subshell

Give the maximum number of unpaired electrons that can occupy the 3d subshell.

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### Part E    Unpaired electrons

Give the number of unpaired electrons in the ground state of an oxygen atom.

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### Part F    Paired electrons

Give the number of paired electrons in the ground state of the  $\text{Na}^+$  ion.

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Based on questions D2.1 and D2.2 from Physical Chemistry book

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## Essential Pre-Uni Chemistry D2.3

Identify the subshell to which each of the orbitals below belongs.

### Part A (a)

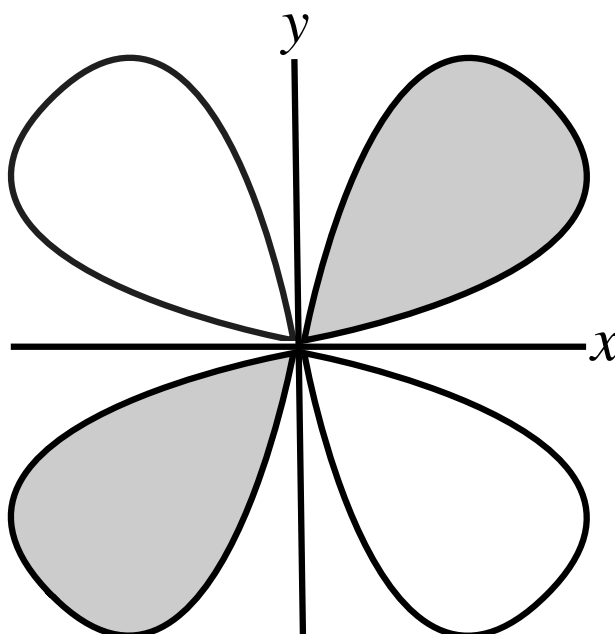


Figure 1: Unknown Orbital

What kind of orbital is depicted above?

- ☐ s
- ☐ p
- ☐ d
- ☐ f

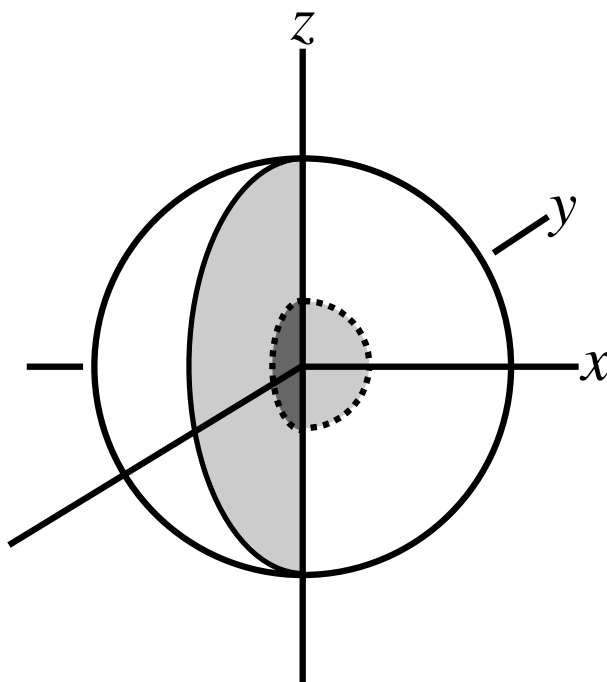


Figure 2: Unknown Orbital

What kind of orbital is depicted above?

- ☐ s
- ☐ p
- ☐ d
- ☐ f

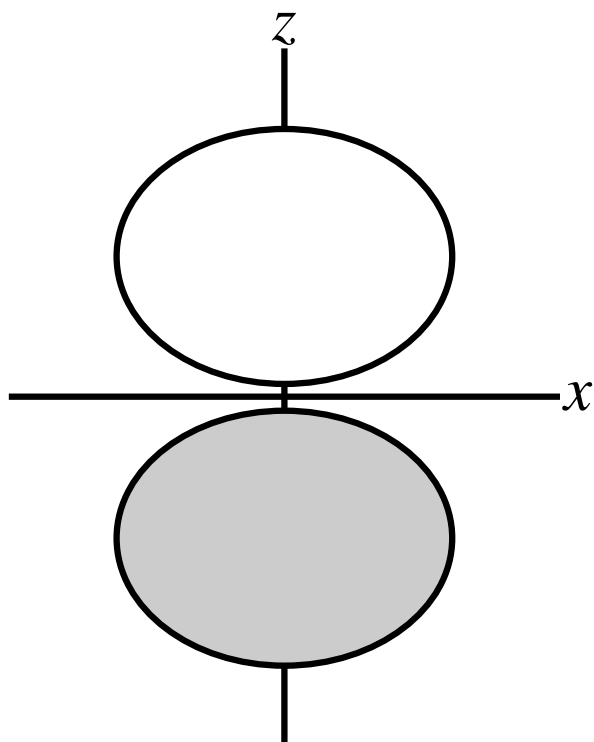


Figure 3: Unknown Orbital

What kind of orbital is depicted above?

- ☐ s
- ☐ p
- ☐ d
- ☐ f

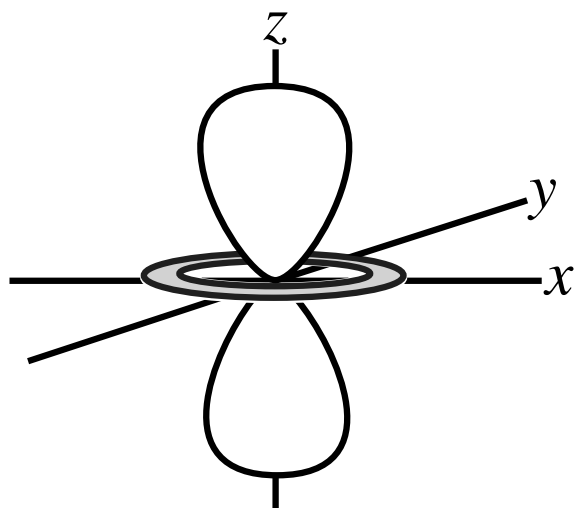


Figure 4: Unknown Orbital

What kind of orbital is depicted above?

- ☐ s
- ☐ p
- ☐ d
- ☐ f



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# Orbitals and Subshells

A Level

## Part A Vanadium

Give the number of occupied orbitals in the ground state of a vanadium atom.

## Part B Titanium

Give the highest occupied subshell in the  $\text{Ti}^{4+}$  ion.

## Part C Bismuth

Give the number of electrons in p-orbitals in the ground state of the  $\text{Bi}^{3+}$  ion.

Based on questions D2.4, D2.5 and D2.6 from the Physical Chemistry book

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## Electron Configurations (D1.3)



Complete the following ground state electron configurations.

### Part A K

What is the ground-state electron configuration of K?

Items:

[Ar]

[Kr]

[Xe]

3s

4s

2p

4p

3d

1

2

6

### Part B Sc

What is the ground-state electron configuration of Sc?

[Ar] 3d

Items:

3s

4s

3p

4p

1

2

3

4

5

6



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**Part C** Cr

What is the ground-state electron configuration of Cr?

[Ar] 3d

Items:

3s  4s  3p  4p  1  2  3  4  5  6

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**Part D** Co

What is the ground-state electron configuration of Co?

[Ar] 3d

Items:

3s  4s  4p  1  2  3  5  6  7  8

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Part E Cu

What is the ground-state electron configuration of Cu?

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

Items:

4s  4p  1  2  3  4  7  8  9  10

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Based on question D1.3 from Physical Chemistry book

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## Electron Configurations (D1.6)



Complete the following ground state electron configurations.

### Part A $\text{Ti}^{3+}$

What is the ground-state electron configuration of  $\text{Ti}^{3+}$ ?

Items:

[Ar]

[Kr]

3s

4s

3p

3d

4d

1

2

3

4

### Part B $\text{Fe}^{2+}$

What is the ground-state electron configuration of  $\text{Fe}^{2+}$ ?

Items:

[Ar]

[Kr]

3s

4s

3p

3d

4d

2

4

6

8

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**Part C**     $\text{Ni}^{2+}$

What is the ground-state electron configuration of  $\text{Ni}^{2+}$ ?

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Items:

[Ar]	[Kr]	3s	4s	3p	3d	4d	2	4	6	8	10
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**Part D**     $\text{Cu}^+$

What is the ground-state electron configuration of  $\text{Cu}^+$ ?

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Items:

[Ar]	[Kr]	3s	4s	3p	3d	4d	2	4	6	8	10
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**Part E**    $\text{Zn}^{2+}$

What is the ground-state electron configuration of  $\text{Zn}^{2+}$ ?

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

Items:

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Based on question D1.6 from Physical Chemistry book

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## Essential Pre-Uni Chemistry D1.10



A  $1^+$  ion, in an excited state due to X-ray bombardment, is found to have an electron configuration  $1s^2 2s^1 2p^6 3s^2 3p^6 3d^6 4s^2 4p^1$  in the gas phase.

Name the element whose ion this is.

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# No Paired p-Electrons

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Select which of the following elements has *no* paired p electrons in a single uncombined atom of the element:

- ☐ Magnesium
- ☐ Carbon
- ☐ Oxygen
- ☐ Neon
- ☐ Silicon

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Adapted with permission from UCLES, A Level Chemistry, June 1990, Paper 1, Question 6

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# First Configurations

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## Part A Unpaired electron

Specify the symbol of the element with the lowest atomic number that satisfies the following property: it has an unpaired electron in its ground-state configuration.

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## Part B Incomplete shell, no unpaired electrons

Specify the symbol of the element with the lowest atomic number that satisfies the following property: it has an incomplete shell, but no unpaired electrons in its ground-state configuration.

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## Part C Cation with unpaired electron

Specify the symbol of the element with the lowest atomic number that satisfies the following property: its singly-charged cation has an unpaired electron in its ground-state configuration.

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**Part D** Full shell configuration  $^{2-}$  anion

Specify the symbol of the element with the lowest atomic number that satisfies the following property: its doubly-charged anion has only full shells in its ground-state configuration.

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**Part E** Cation and anion

Specify the symbol of the element with the lowest atomic number that satisfies the following property: both its singly-charged cation and its singly-charged anion have two unpaired electrons in their ground-state configurations.

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**Part F** Partially-filled p-orbital

Specify the symbol of the element with the lowest atomic number that satisfies the following property: it has a partially-filled p-orbital in its ground-state configuration.

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**Part G** Fully-filled p-orbital

Specify the symbol of the element with the lowest atomic number that satisfies the following property: it has a fully-filled p-orbital in its ground-state configuration.

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**Part H**    **Six unpaired electrons**

Specify the symbol of the element with the lowest atomic number that satisfies the following property: it has six unpaired electrons in its ground-state configuration.

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**Part I**    **Fully-filled d-orbital**

Specify the symbol of the element with the lowest atomic number that satisfies the following property: it has a fully-filled d-orbital in its ground-state configuration.

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**Part J**    **Fully-filled d-subshell**

Specify the symbol of the element with the lowest atomic number that satisfies the following property: it has a fully-filled d-subshell in its ground-state configuration.

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