

Electron Configuration Practice Test (Sample)

Study Guide



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SAMPLE

Questions

1. Identify the element with the electron configuration [Ar] $4s^2 3d^2$.
 - A. Scandium (Sc)
 - B. Iron (Fe)
 - C. Vanadium (V)
 - D. Titanium (Ti)
2. What term describes the ability of an atom to attract electrons?
 - A. Ionic radius
 - B. Electronegativity
 - C. Ionization energy
 - D. Electron affinity
3. Which element is represented by the configuration [Xe] $6s^2 4f^{14}$?
 - A. Ytterbium (Yb)
 - B. Europium (Eu)
 - C. Plutonium (Pu)
 - D. Samarium (Sm)
4. Which element is associated with the configuration [Xe] $6s^2 4f^{14} 5d^{10}$?
 - A. Mercury (Hg)
 - B. Vanadium (V)
 - C. Lead (Pb)
 - D. Osmium (Os)
5. What is the electron configuration for Francium (Fr)?
 - A. [Rn] $7s^1$
 - B. [Xe] $6s^2$
 - C. [Rn] $7s^2$
 - D. [Rn] $6d^5$

6. Which quantum number designates the orientation of an orbital?
- A. Principal quantum number (n)
 - B. Orbital quantum number (l)
 - C. Magnetic quantum number (m)
 - D. Spin quantum number (s)
7. Which rule states that electrons will fill lower-energy orbitals before filling higher-energy orbitals?
- A. Pauli Exclusion Principle
 - B. Aufbau Principle
 - C. Hund's Rule
 - D. Quantum Mechanical Model
8. Which subshell is filled after 3p in the order of electron configuration?
- A. 3d
 - B. 4s
 - C. 4p
 - D. 5s
9. Which element falls under the electron configuration [Xe] $4f^{14} 5d^{10} 6s^2 6p^1$?
- A. Thallium (Tl)
 - B. Lead (Pb)
 - C. Indium (In)
 - D. Selenium (Se)
10. How do you represent an electron configuration in shorthand notation?
- A. By listing each orbital separately
 - B. Using the atomic number only
 - C. Using the nearest noble gas followed by the remaining electron configuration
 - D. By using only the highest energy level

Answers

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1. D
2. B
3. A
4. A
5. A
6. C
7. B
8. B
9. A
10. C

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Explanations

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1. Identify the element with the electron configuration [Ar] 4s² 3d².

- A. Scandium (Sc)**
- B. Iron (Fe)**
- C. Vanadium (V)**
- D. Titanium (Ti)**

The electron configuration [Ar] 4s² 3d² corresponds to the element Titanium (Ti). In this configuration, the notation [Ar] indicates that the core electrons of Argon are included, and the remaining electrons are added in specific orbitals. Starting from the Argon configuration, the 4s orbital is filled first with 2 electrons, followed by the 3d orbital, which contains 2 electrons in this case. This means that Titanium has a total of 22 electrons: 18 from Argon, 2 in the 4s orbital, and 2 in the 3d orbital. The specific configuration of Titanium is essential for understanding its chemical properties, such as its ability to exhibit multiple oxidation states and to form compounds with other elements. The configuration highlights that Titanium is positioned in the transition metals section on the periodic table, specifically in group 4. Other elements listed do not match this electron configuration. Scandium has more electrons and a different configuration; Iron has more electrons in the d orbitals (specifically 3d⁶); and Vanadium has a different configuration with one fewer d electron (3d³). Therefore, the accurate identification of Titanium based on its unique electron configuration

2. What term describes the ability of an atom to attract electrons?

- A. Ionic radius**
- B. Electronegativity**
- C. Ionization energy**
- D. Electron affinity**

The term that describes the ability of an atom to attract electrons is electronegativity. This concept is fundamental in understanding how atoms interact in chemical bonding. Electronegativity is a measure of an atom's tendency to attract and bond with electrons in a covalent bond. Higher electronegativity values indicate a stronger ability to attract electrons when forming bonds with other atoms, while lower values suggest a weaker attraction. In the context of the other options: ionic radius refers to the size of an ion in a crystal lattice, which does not directly relate to an atom's ability to attract electrons. Ionization energy is the energy required to remove an electron from an atom, which pertains more to how easily an atom can lose electrons rather than gain them. Electron affinity measures the energy change when an electron is added to a neutral atom, which is related but focuses specifically on the energy aspect rather than the attraction itself. Thus, electronegativity is the most appropriate term for an atom's ability to attract electrons.

3. Which element is represented by the configuration [Xe] 6s² 4f¹⁴?

A. Ytterbium (Yb)

B. Europium (Eu)

C. Plutonium (Pu)

D. Samarium (Sm)

The electron configuration [Xe] 6s² 4f¹⁴ corresponds to the element Ytterbium (Yb), which has the atomic number 70. In this configuration, the notation [Xe] represents the electron configuration of Xenon, which accounts for the first 54 electrons. The additional 16 electrons are accounted for by the 6s² and 4f¹⁴ orbitals. Ytterbium, a member of the lanthanide series, has two electrons in the 6s subshell and a filled 4f subshell with 14 electrons. This configuration indicates that Yb has reached a stable state by filling the 4f block, which is characteristic of the lanthanides. The other elements listed do not match this configuration. Europium (Eu) has the configuration [Xe] 6s² 4f⁷, which shows that it has 7 electrons in the 4f subshell rather than the 14 seen in Ytterbium. Plutonium (Pu), an actinide, has a different arrangement entirely, with electrons filling the 5f and 6d orbitals. Samarium (Sm) also has a different electron

4. Which element is associated with the configuration [Xe] 6s² 4f¹⁴ 5d¹⁰?

A. Mercury (Hg)

B. Vanadium (V)

C. Lead (Pb)

D. Osmium (Os)

The electron configuration [Xe] 6s² 4f¹⁴ 5d¹⁰ indicates that the element in question has completely filled orbitals beyond the xenon core, specifically filling the 6s, 4f, and 5d subshells. This configuration reveals that we are looking at an element in the d-block of the periodic table, particularly one that is also a transition metal. The 4f subshell has 14 electrons, which is characteristic of lanthanides, and the 5d subshell holds 10 electrons, typical for elements that follow the lanthanides. To identify the element, consider its position on the periodic table. The configuration corresponds to mercury, which is located in group 12 and period 6. Specifically, mercury has an atomic number of 80, and its electron configuration is correctly represented by [Xe] 6s² 4f¹⁴ 5d¹⁰, confirming it as the element associated with this electron configuration. Other elements such as vanadium, lead, and osmium have different configurations and would not fit the provided description. Vanadium specifically has a much simpler configuration and is in period 4, while lead would

5. What is the electron configuration for Francium (Fr)?

A. [Rn] 7s¹

B. [Xe] 6s²

C. [Rn] 7s²

D. [Rn] 6d⁵

Francium, with the atomic number 87, is an alkali metal located in Group 1 of the periodic table. To determine its electron configuration, it's essential to note how electrons are arranged in the different energy levels or shells surrounding the nucleus. The electron configuration begins with the noble gas preceding francium in the periodic table, which is radon (Rn). Following radon, francium requires additional electrons to fill its configuration. For francium, after the [Rn] core, it has one electron in the 7s orbital. Since it is in Group 1, it only contains one additional electron in the outermost shell, making the complete electron configuration [Rn] 7s¹. This reflects the fact that francium is the most reactive of the alkali metals and its single outer electron is characteristic of its reactivity. In contrast, configurations that suggest two electrons in the 7s orbital or those involving 6d sublevels are not appropriate for francium's position and electron count according to its atomic number. Thus, the answer accurately represents the electron configuration for francium.

6. Which quantum number designates the orientation of an orbital?

A. Principal quantum number (n)

B. Orbital quantum number (l)

C. Magnetic quantum number (m)

D. Spin quantum number (s)

The magnetic quantum number is the one that designates the orientation of an orbital within a given subshell. It provides information on the specific spatial orientation of an orbital in relation to the three axes in space (x, y, and z). For instance, in a p subshell (where the orbital quantum number l equals 1), there are three possible orientations corresponding to the values of the magnetic quantum number: -1, 0, and +1. This means there are three distinct p orbitals oriented along different axes. In contrast, the principal quantum number indicates the overall energy level and size of the orbital, while the orbital quantum number describes the shape of the orbital. The spin quantum number relates to electron spin and does not provide information about orbital orientation. Therefore, the magnetic quantum number is crucial in determining how orbitals are aligned in a given atom.

7. Which rule states that electrons will fill lower-energy orbitals before filling higher-energy orbitals?

A. Pauli Exclusion Principle

B. Aufbau Principle

C. Hund's Rule

D. Quantum Mechanical Model

The principle that describes how electrons occupy atomic orbitals is foundational in understanding electron configurations. The Aufbau Principle specifically states that electrons will first fill the lowest-energy orbitals available before moving on to higher-energy orbitals. This establishes a more stable electron configuration since lower-energy states are more favorable energetically. In the atomic structure, orbitals are arranged in a hierarchy of energy levels. For example, the 1s orbital has lower energy than the 2s and 2p orbitals. According to the Aufbau Principle, electrons will fill the 1s orbital fully before any electrons are placed in the 2s or 2p orbitals. This systematic filling order helps to predict and explain the arrangement of electrons in an atom, which in turn influences the atom's chemical properties and reactivity. Understanding the Aufbau Principle is essential in chemistry and helps guide the overall structure of the periodic table and the behavior of elements during chemical bonding.

8. Which subshell is filled after 3p in the order of electron configuration?

A. 3d

B. 4s

C. 4p

D. 5s

The correct answer is based on the order of filling subshells in electron configurations, which follows the Aufbau principle. According to this principle, electrons fill the lowest available energy levels first before moving to higher levels. After the 3p subshell is fully occupied, the next subshell to be filled is the 4s subshell. This is because the 4s subshell is actually at a lower energy level than the 3d subshell, despite being part of a higher principal energy level ($n=4$). Therefore, it takes precedence and gets filled before moving on to the 3d subshell. In contrast, the 3d subshell, while part of the third shell, has a higher energy than the 4s subshell and thus is filled after 4s. The 4p and 5s subshells come into play later in the electron configuration sequence, being filled after the 4s and 3d respectively. Hence, the filling of the subshells follows a specific order that reflects their energies, making 4s the right choice after 3p.

9. Which element falls under the electron configuration [Xe] $4f^{14} 5d^{10} 6s^2 6p^1$?

A. Thallium (Tl)

B. Lead (Pb)

C. Indium (In)

D. Selenium (Se)

The electron configuration [Xe] $4f^{14} 5d^{10} 6s^2 6p^1$ corresponds to the element thallium (Tl). This configuration indicates that it has filled 4f and 5d orbitals along with partially filled 6s and 6p orbitals. To break down the configuration: - The notation [Xe] indicates that the element has the same core electron configuration as xenon, which accounts for the first 54 electrons. - The $4f^{14}$ part signifies that there are 14 electrons in the 4f subshell, which is characteristic of elements in the lanthanide series. - The $5d^{10}$ indicates that the 5d subshell is fully filled with 10 electrons, a common feature among transition metals. - The $6s^2$ indicates that there are 2 electrons in the 6s subshell, and - The final part, $6p^1$, shows that there is 1 electron in the 6p subshell. Thallium, which is in group 13 of the periodic table, has a total of 81 electrons. This matches the total count of electrons represented by the

10. How do you represent an electron configuration in shorthand notation?

A. By listing each orbital separately

B. Using the atomic number only

C. Using the nearest noble gas followed by the remaining electron configuration

D. By using only the highest energy level

In shorthand notation for electron configuration, the typical approach is to start with the nearest noble gas that precedes the element in the periodic table. This provides a stable reference point, as noble gases have complete valence shells, indicating a stable electron configuration. After citing the noble gas, the remaining electron configuration for the element is then written out, which includes the orbitals that still need to be populated with electrons. This method significantly simplifies writing the electron configurations, especially for elements with higher atomic numbers, as it avoids the need to specify all orbitals from hydrogen up to the element in question. By using this concise format, one can quickly reference the electron arrangement of an element without losing essential information about its electron structure. Other methods of representing electron configurations, such as listing each orbital separately or focusing solely on the atomic number or the highest energy level, do not convey the complete picture of the electron distribution in a compact and efficient manner. Thus, the shorthand notation proves to be both practical and informative in presenting electron configurations effectively.