Practice Test Questions 5
Electron Configurations and Periodic Trends

1. Complete the following table. *Do not use the noble gas abbreviation.*

Symbol	**Electronic Configuration**	**Number of Valence Electrons**
Se		
Fe		
S^{2-}		

2. For each of the following electron configurations, indicate whether or not it correctly describes a ground state atom. For each incorrect electron configuration, explain what is wrong with it. For each correct electron configuration, identify the element.

Electron Configuration	Could describe a ground state atom? Circle yes or no.	If no, why not? If yes, name the element.
$1s^2\ 2s^2\ 2p^2$	YES / NO	
$1s^1\ 2s^2$	YES / NO	
$1s^2\ 2s^2\ 2p^5$	YES / NO	
$1s^2\ 2s^2\ 3s^2$	YES / NO	

3. For this question, do not use the noble gas abbreviation.

(a) Write the ground state electron configuration for F.

(b) Write an electron configuration for F in any excited state.

4. For this question, **use** the noble gas abbreviation.

(a) Write the ground state electron configuration for Cu.

(b) Write the ground state electron configuration for Cu^+.

(c) Is Cu^+ diamagnetic or paramagnetic? Justify your answer using 10 words or less.

5.

(a) Write the complete electron configuration for a ground state neutral atom of phosphorus.

(b) Draw an orbital occupancy diagram showing the valence electrons of a ground state neutral atom of phosphorus. Label the subshells on your diagram.

(c) Is a phosphorus atom paramagnetic or diamagnetic?

6. Consider an atom of titanium (Ti) in the ground state.

(a) Draw an orbital occupancy diagram for an atom of titanium in the ground state.

(b) On your diagram, clearly identify the core and valence electrons.

(c) Is this atom paramagnetic or diamagnetic?

(d) Predict the charge of the most common titanium ion. Justify your answer.

7. Consider an atom of tin (Sn) in the ground state.

(a) Write the electron configuration for a ground state atom of tin. Use the noble gas abbreviation.

(b) Give a valid set of quantum numbers for the highest energy electron in a ground state atom of tin.

8. Fill in the blanks.

(a) If bromine forms an ion, its charge is _____.

(b) If aluminium forms an ion, its charge is _____.

(c) If thallium (Tl) forms an ion, its charge is either _____ or _____.

9.

(a) Suggest **two** different cations with the following electron configuration:

$$1s^2\ 2s^2\ 2p^6$$

(b) Draw an orbital occupancy diagram **for the neutral parent atom** for one of the cations that you suggested in part (a). Your diagram should show all electrons in this atom.

10.

(a) Write the electron configuration for a ground state neutral atom of zirconium (Zr) using the noble gas abbreviation.

(b) Write the electron configuration for Zr^{4+} using the noble gas abbreviation.

(c) Which is larger, a Zr atom or a Zr^{4+} cation? Justify your answer.

11.

(a) Write the complete ground state electron configurations for fluorine (F) and fluoride (F^{-1}).

(b) Which of these two species has a higher effective nuclear charge on its valence electrons? Justify your answer.

12. Briefly explain why Fe^{2+} has a larger atomic radius than Fe^{3+}.

13. Which element has a larger electron affinity, F or Ne? Briefly explain your answer.

14. Consider a calcium atom (Ca) and a calcium cation (Ca^{2+}). Which of these two species would you expect to have a larger radius? Justify your answer.

15. Identify **one** neutral element which meets each description.

Description	Element
An element with a larger first ionization energy than chlorine.	
The Group 13 element with the smallest atomic radius.	
The element which has the following electron configuration: [Ar] $4s^2\ 3d^8$	
An element whose trication (cation with +3 charge) has the same number of electrons as vanadium (V).	

An element whose dianion (anion with -2 charge) has the same electron configuration as krypton (Kr).	
The first element to have an electron in a *d* orbital when in the ground state. *("first" = "with smallest atomic number")*	

16.

(a) Write the ground state electron configurations for selenium (Se) and krypton (Kr) using the noble gas abbreviation.

(b) Which of these two species has the larger first ionization energy? Justify your answer.

(c) Which of these two species has the larger electron affinity? Justify your answer.

17. Consider the following three ions, F^-, Na^+ and Mg^{2+}
Which of these three species would you expect to have the smallest radius?
Justify your answer.

18. Consider an atom that has electrons in both 2*s* and 2*p* orbitals. ***Briefly*** explain why an electron in a 2*s* orbital has a lower energy than an electron in a 2*p* orbital.

19. The second ionization energy of an atom is generally larger than the first but, even taking this general observation into account, the second ionization energies of some elements are particularly large. Boron is one such element. Its first ionization energy is 800.6 kJ/mol while its second ionization energy is 2427.0 kJ/mol.

Explain why the second ionization energy of boron is so much larger than its first ionization energy.

20.

(a) Write a balanced chemical equation for the first ionization of beryllium.

(b) Write a balanced chemical equation for the fourth ionization of beryllium

(c) Which is larger, the first ionization energy of beryllium or the fourth ionization energy of beryllium? Briefly justify your answer.

(d) Which is easier to calculate, the first ionization energy of beryllium or the fourth ionization energy of beryllium? Briefly justify your answer.

(e) Calculate the ionization energy that was your answer to part (d).
Report your answer in kJ/mol.

21. Give the name and symbol for the neutral element matching each of the following descriptions. Consider only ground state atoms.

(a) "I have 6 valence electrons, and my most common isotope has 8 neutrons."

(b) "Half of my electrons are valence electrons."

(c) "I have twice as many valence electrons as core electrons."

(d) "I have twice as many core electrons as valence electrons."
(bonus: identify all three elements fitting this description)

22. For a neutral ground state nickel atom,

(a) Write the complete electron configuration.

(b) Write the electron configuration using the noble gas abbreviation.

(c) Draw an orbital occupancy diagram showing the valence electrons. Label each subshell.

(d) Use the table below to list a set of quantum numbers describing the valence electrons. *Use as many rows as necessary; the correct answer may include one or more empty rows.*

Electron	n	l	m_ℓ	m_s
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				