SCH4U – F2018B – p2 Saxena

Nar

Atomic Theory Quiz

16 /16 Excellent

or full marks, please ensure that all questions have complete and concise answers

1. Many atomic models were proposed before the quantum mechanical model of the explained. Briefly describe Rutherford's model of the atom and explain one part that was proven to be correct. (2 marks)

Rutherford's model was a dense positi
charged nucleus in the center of the atom
electrons orbiting the nucleus. The idea that
there was a dense positively charged nucleus
has been proven correct and shown in the gold foil
experiment however Rutherford did not know about
neutrons.

2. Write out a short hand electron configuration for uranium. (1 mark)

[Rn] $7s^2 5f^4$ ✓

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10} 6p^6 7s^2$ 6 + 14

2 2 6 10 2 6 10 14 2 6 10 14 2 6 10 14 2 6 10 14 2 6 10 14

1

3. Draw an orbital diagram for ruthenium. (1 mark)

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^6$

1s 2s 2p 3s 3p 4s 3d 4p 5s 4d

1

4. Draw an energy level diagram for the aluminum ion. (1 mark)

next time draw every arrow

Al^{3+} $1s^2 2s^2 2p^6$ ~~$3s^2 3p^1$~~

next time draw empty boxes

2p

2s

1s

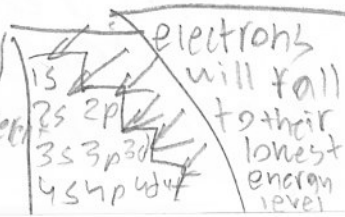
energy

1

5. What is the Aufbau Principle? Explain how this principle is used to describe the arrangement of electrons in an atom. (2 marks)

The Aufbau principle is an explanation of how electrons fill orbitals and shells. It follows the staircase met
So first 1s is filled then 2s, 2p, 3s, 3p, 4s, 3d
This shows how different orbitals exist at differe
energy levels other then the ones in their shell

2



Name:

6. Is the following set of quantum numbers allowed? Explain your answer. (2 marks)

$n = 2$ $l = 2$ $m_l = 1$ $m_s = 1/2$

This is not allowed l can be from 0 to (n-1) but in this case l is 2 which is greater than (n-1) = (2-1) = 1 l can be from 0 to 1 in this case. (2)

7. Explain why the following ground-state electron configuration is NOT allowed: (1 mark)

$1s^2 2s^2 2p^6 3s^2 3p^1 4s^2 3d^{10}$

In this case 3p orbital was not filled yet 4s and 3d were. According to Aufbau's principle 3p must be filled before 4s and 3d ✓ (1)

8. Write a set of quantum numbers for the third electron to enter the 3d orbital. (2 marks)

$n=3$ $l=2$ $m_l=0$ $m_s=+1/2$ ✓ (2)

9. State how many unpaired electrons are found in the following atoms or ions. (2 marks)

a) Silver atom 1

$[Kr]5s^2 4d^9$

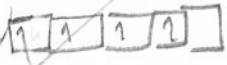
1 electron is unpaired ✓

b) Iron 2+ ion 4

Fe^{2+} 24 e⁻

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

4 electrons are unpaired



(2)

10. Which atom would you expect to have a smaller first ionization energy: chlorine or argon? Explain. (2 marks)

Chlorine would have a smaller first ionization energy as Argon is a noble gas and has a full valence shell. The noble gas structure of Argon means it is extremely difficult to remove the electron as it has such a stable shell. Chlorine however does not have a full valence so will have a weaker pull. (2)