Exemplar problems

Q7. Two atoms are said to be isobars if
(a) they have same atomic number but different mass number.
(b) they have same number of electrons but different number of neutrons.
(c) they are same number of neutrons but different number of electrons.
(d) Sum of the number of protons and neutrons is same but the number of protons is different.
Sol: (d) Isobars have different atomic number, i.e., number of protons but same mass number, i.e., sum of number of protons and neutrons.

Q8. The number of radial nodes for 3p orbital is .
(a) 3 (b) 4 (c) 2 (d) 1
Sol: (d) Number of radial nodes = n-1 – 1
For 3p orbital, n = 3 – 1 – 1 = 1
Number of radial nodes = 3 – 1 – 1 = 1

Q9. Number of angular nodes for 4d orbital is _____ .
(a) 4 (b) 3 (c) 2 (d) 1
Sol: (c) Number of angular nodes in 4d orbital = l = 2

Q10. Which of the following is responsible to rule **out the existence of definite paths or trajectories of electrons?**
(a) Pauli's exclusion principle
(b) Heisenberg's uncertainty principle
(c) Hund's rule of maximum multiplicity
(d) Aufbau principle
Sol: (b) According to Heisenberg's uncertainty principle, the position and velocity of an electron cannot be determined simultaneously with accuracy which rules out the existence of fixed paths.

Q11. Total number of orbitals associated with third shell will be _____.
(a) 2
(b) 4
(c) 9
(d) 3
Sol: (c) No of orbitals in 3^{rd} shell (n = 3) = $n^2 = 3^2 = 9$.

12. Orbital angular momentum depends on
(a) l
(b) n and l
(c) n and m
(d) m and s

Sol. (a) Orbital angular momentum = $\sqrt{l(l+1)}\frac{h}{2\pi}$. Hence, it depends only on 'l'.

Q13. Chlorine exists in two isotopic forms, Cl-37 and Cl-35, but its atomic mass is 35.5. This indicates the ratio of Cl-37 and Cl-35 is approximately
(a) 1 : 2
(b) 1 : 1
(c) 1:3
(d) 3:1

Sol. (c) $^{37}_{17}Cl : ^{35}_{17}Cl$

1 : 3 Ratio

$$\text{Average atomic mass} = \frac{(37 \times 1) + (35 \times 3)}{1 + 3}$$

$$= \frac{142}{4} = 35.5$$

Q14. The pair of ions having same electronic configuration is _____

(a) Cr^{3+}, Fe^{3+} (b) Fe^{3+}, Mn^{2+} (c) Fe^{3+}, Co^{3+} (d) Sc^{3+}, Cr^{3+}

Sol. (b) Cr^{3+} $(Z = 24) = [Ar]\ 3d^3$

Fe^{3+} $(Z = 26) = [Ar]\ 3d^5$

Mn^{2+} $(Z = 25) = [Ar]\ 3d^5$

Co^{3+} $(Z = 27) = [Ar]\ 3d^6$

Sc^{3+} $(Z = 21) = [Ar]\ 3d^0$

Fe^{3+} and Mn^{2+} will have the same number of electrons, i.e., 23 and, hence, have the same electronic configuration.

Q15. For the electrons of oxygen atom, which of the following statements is correct?

(a) Z_{eff} for an electron in a 2s orbital is the same as Z_{eff} for an electron in a 2p
(b) An electron in the 2s orbital has the same energy as an electron in the 2p
(c) Z_{eff} for an electron in Is orbital is the same as Z_{eff} for an electron in a 2s orbital.
(d) The two electrons present in the ?s orbital have spin quantum numbers

m_s but of opposite sign.

Sol. (d)

(a) Electrons in $2s$ and $2p$ orbitals have different screening effect. Hence, their Z_{eff} is different. Z_{eff} of $2s$ orbital > Z_{eff} of $2p$ orbital
Therefore, it is not correct.

(b) Energy of $2s$ orbital < energy of $2p$ orbital.
Hence, it is not correct.

(c) Z_{eff} of $1s$ orbital ≠ Z_{eff} of 2s orbital
Hence, it is incorrect.

(d) For the two electrons of $2s$ orbital, the value of m_s is $+\frac{1}{2}$ and $-\frac{1}{2}$.
Hence, it is correct.