

# CHAPTER 2

## Atomic Structure

### Subatomic Particles, Atomic Models

1. The number of protons, neutrons and electrons in  ${}_{71}^{175}\text{Lu}$ , respectively, are : (2020)
- 104, 71 and 71
  - 71, 71 and 104
  - 175, 104 and 71
  - 71, 104 and 71

### Developments Leading to Bohr's Model of Atom

2. A particular station of All India Radio, New Delhi, broadcasts on a frequency of 1,368 kHz (kilohertz). The wavelength of the electromagnetic radiation emitted by the transmitter is: [speed of light,  $c = 3.0 \times 10^8 \text{ ms}^{-1}$ ] (2021)
- 219.2 m
  - 2192 m
  - 21.92 cm
  - 219.3 m
3. Which of the following series of transitions in the spectrum of hydrogen atom fall in visible region? (2019)
- Lyman series
  - Balmer series
  - Paschen series
  - Brackett series
4. Calculate the energy in joule corresponding to light of wavelength 45 nm (Planck's constant  $h = 6.63 \times 10^{-34} \text{ Js}$ ; speed of light  $c = 3 \times 10^8 \text{ ms}^{-1}$ ) (2014)
- $6.67 \times 10^{11}$
  - $4.42 \times 10^{-15}$
  - $4.42 \times 10^{-18}$
  - $6.67 \times 10^{15}$
5. The value of Planck's constant is  $6.63 \times 10^{-34} \text{ Js}$ . The speed of light is  $3 \times 10^8 \text{ ms}^{-1}$ . Which value is closest to the wavelength in nanometer of a quantum of light with frequency of  $6 \times 10^{15} \text{ s}^{-1}$ ? (2013)
- 10 nm
  - 25 nm
  - 50 nm
  - 75 nm

### Bohr's Model For Hydrogen Atom

6. If radius of second Bohr orbit of the  $\text{He}^+$  ion is 105.8 pm, what is the radius of third Bohr orbit of  $\text{Li}^{2+}$  ion? (2022)
- 158.7 Å
  - 158.7 pm
  - 15.87 pm
  - 1.587 pm

7. Based on equation,  $E = -2.178 \times 10^{-18} \text{ J} \left( \frac{Z^2}{n^2} \right)$  certain conclusions are written. Which of them is not correct? (2013)

- The negative sign in equation simply means that the energy of electron bound to the nucleus is lower than it would be if the electrons were at the infinite distance from the nucleus.
- Larger the value of  $n$ , the larger is the orbit radius.
- Equation can be used to calculate the change in energy when the electron changes orbit.
- For  $n = 1$ , the electron has a more negative energy than it does for  $n = 6$  which means that the electron is more loosely bound in the smallest allowed orbit.

### Quantum Mechanical Model of Atom

8. Identify the incorrect statements from the following. (2022)
- The shapes of  $d_{xy}$ ,  $d_{yz}$ , and  $d_{zx}$  orbitals are similar to each other; and  $d_{x^2-y^2}$  and  $d_{z^2}$  are similar to each other.
  - All the five 5d orbitals are different in size when compared to the respective 4d orbitals.
  - All the five 4d orbitals have shapes similar to the respective 3d orbitals.
  - In an atom, all the five 3d orbitals are equal in energy in free state.
9. The number of angular nodes and radial nodes in 3s orbital are (2020-Covid)
- 1 and 0, respectively
  - 3 and 0, respectively
  - 0 and 1, respectively
  - 0 and 2, respectively
10. 4d, 5p, 5f and 6p orbitals are arranged in the order of decreasing energy. The correct option is (2019)
- $5f > 6p > 5p > 4d$
  - $6p > 5f > 5p > 4d$
  - $6p > 5f > 4d > 5p$
  - $5f > 6p > 4d > 5p$

- $$\begin{array}{ccccc} 1s^2 & 2s^2 & 2p_x^1 & 2p_y^1 & 2p_z^1 \\ \boxed{\uparrow\downarrow} & \boxed{\uparrow\downarrow} & \boxed{\uparrow} & \boxed{\uparrow} & \boxed{\downarrow} \end{array}$$

- a. 3s 3p 4s 3d  
c. 4s 3s 3p 3d
- b. 3s 4s 3p 3d  
d. 3s 3p 3d 4s
17. The angular momentum of electron in 'd' orbital is equal to:  
(2015)
- a.  $2\sqrt{3}\hbar$   
c.  $\sqrt{6}\hbar$
- b.  $0\hbar$   
d.  $\sqrt{2}\hbar$
18. What is the maximum number of orbitals that can be identified with the following quantum numbers:  
 $n = 3, l = 1, m_l = 0$  (2014)
- a. 2  
c. 4
- b. 3  
d. 1
19. What is the maximum number of electrons that can be associated with the following set of quantum numbers?  
 $n = 3, \ell = 1$  and  $m = -1$ . (2013)
- a. 10  
c. 4
- b. 6  
d. 2

[illegible]