

Atomic structure (Unit-2)

1. Energy of H-atom in the ground state is -3.6eV. Hence calculate the energy in the second excited state. [Ans. -1.51eV]
2. Uncertainty in the position of a particle of 25g in space is 10^{-5} m. Hence calculate the uncertainty in velocity (ms^{-1}). (Planck constant= 6.6×10^{-34} Js) [Ans. 2.1×10^{-28}]
3. Which of the following ions has the maximum magnetic moment?
a) Mn^{2+} b) Fe^{2+} c) Ti^{2+} d) Cr^{2+} [Ans. a]
4. In Bohr series of lines of hydrogen spectrum, the third line from the red end corresponds to which one of the following inter-orbit jumps of the electron for Bohr orbits in an atom of hydrogen?
a) 3 to 2 b) 5 to 2 c) 4 to 1 d) 2 to 5 [Ans. 5 to 2]
5. Calculate the de Broglie wavelength of a tennis ball of mass 60g moving with a velocity of 10 meters per second. [Ans. 10^{-33} m]
6. The orbital angular momentum for an electron revolving in an orbit is given by $\sqrt{l(l+1)}h/2\pi$. Calculate the momentum for an s electron. [Ans. zero]
7. Which one of the following grouping represents a collection of isoelectronic species?
a) Na^+ , Ca^{2+} , Mg^{2+} b) N^{3-} , F^- , Na^+ c) Be , Al^{3+} , Cl^- d) Ca^{2+} , Cs^+ , Br [Ans. b]
8. Calculate the number of d electrons retained in Fe^{2+} . [Ans. 6 e]
9. Write the quantum number set for an electron in 4f orbital.
10. Consider the ground state of Cr atom ($Z=24$). Calculate the no. of electrons with the azimuthal quantum numbers, $l = 1$ and $l = 2$. [Ans. 12 and 5]
11. What will be the wavelength of the radiation emitted, when in a hydrogen atom electron falls from infinity to 1st stationary state?
(Given, Rydberg constant= $1.097 \times 10^7 \text{ m}^{-1}$) [Ans. 91 nm]
12. In a multielectron atom, which of the following orbitals described by the three quantum numbers will have the same energy in the absence of magnetic field and electric fields?
a) $n=1, l=0, m=0$
b) $n=2, l=0, m=0$
c) $n=3, l=1, m=1$
d) $n=3, l=2, m=1$
e) $n=3, l=2, m=0$
a) b and c b) d and e c) c and d d) a and b [Ans. b]
13. Which of the following statement in relation to the hydrogen atom is correct?
a) 3s and 3p orbitals are of lower energy than 3d orbital
b) 3p orbital is lower in energy than 3d orbital
c) 3s orbital is lower in energy than 3p orbital
d) 3s, 3p and 3d orbitals all have the same energy. [Ans. d]

14. According to Bohr theory the angular momentum of an electron in 5th orbit is---
 a) $25h/\pi$ b) $1.0h/\pi$ c) $10 h/\pi$ d) $2.5h/\pi$ [Ans. d]
15. Which of the following sets of quantum numbers represents the highest energy of an atom?
 a) $n=3, l=2, m=1, s=+1/2$
 b) $n=4, l=0, m=0, s=+1/2$
 c) $n=3, l=0, m=0, s=+1/2$
 d) $n=3, l=1, m=1, s=+1/2$ [Ans. a]
16. In an atom an electron is moving with a speed of 600m/s with an accuracy of 0.005%. Calculate the certainty with which the position of the electron can be located. Given $h=6.6 \times 10^{-34} \text{ Kg m}^2 \text{ s}^{-1}$ and mass of electron is $9.1 \times 10^{-31} \text{ kg}$. [Ans. $1.92 \times 10^{-3} \text{ m}$]
17. Calculate the wavelength(in nanometer) associated with a proton moving at $1.0 \times 10^3 \text{ ms}^{-1}$ (mass of proton= $1.67 \times 10^{-27} \text{ Kg}$ and $h=6.63 \times 10^{-34} \text{ Js}$) [Ans. 0.40nm]
18. Ionization energy of He^+ is $19.6 \times 10^{-18} \text{ J atom}^{-1}$. Calculate the energy of the first stationary state ($n=1$) of Li^{2+} . [Ans. $-4.41 \times 10^{-17} \text{ J atom}^{-1}$]
19. The energy required to break one mole of Cl-Cl bonds in Cl_2 is 242 KJ mol^{-1} . Calculate the longest wavelength of light capable of breaking a single Cl-Cl bond. [Ans. 494 nm]
20. A gas absorbs a photon of 355nm and emits at two wavelengths. If one of the emissions is at 680 nm, the other is at:
 a) 743 nm b) 376nm c) 453nm d) 581nm [Ans. a]
21. The electrons identified by quantum numbers n and l are...
 i) $n=4, l=0$ ii) $n=4, l=1$ iii) $n=3, l=1$ iv) $n=3, l=2$ can be placed in order of increasing energy as
 a) $4 < 2 < 3 < 1$ b) $2 < 4 < 1 < 3$ c) $1 < 3 < 2 < 4$ d) $3 < 4 < 2 < 1$ [Ans. a]
22. Calculate the wavelength of light required to excite an electron in a hydrogen atom from level $n=1$ to $n=2$. [Ans. $1.214 \times 10^{-7} \text{ m}$]
23. If the shortest wavelength of H atom in Lyman series is 'a', then longest wavelength in Balmer series of He^+ is.....
 a) $a/4$ b) $5a/9$ c) $4a/9$ d) $9a/5$ [Ans. d]
24. If the radius of the first Bohr orbit is 'a', then de Broglie wavelength of electron in 3rd orbit is nearly....
 a) $2\pi a$ b) $6\pi a$ c) $3a$ d) $a/3$ [Ans. b]
25. An electron in a hydrogen atom in its ground state absorbs 50 times as much energy as the minimum required for it to escape from the atom. What is the wavelength of the emitted electron? [Ans. 4.7 angstrom]
26. Probability of finding the electron ψ^2 of s orbital doesn't depend upon...
 a) Azimuthal quantum number.
 b) Energy of s orbital
 c) Principal quantum number
 d) Distance from nucleus(r) [Ans. a]

27. In the following questions a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

Assertion (A) : All isotopes of a given element show the same type of chemical behaviour.

Reason (R) : The chemical properties of an atom are controlled by the number of electrons in the atom.

- a) Both A and R are true and R is the correct explanation of A.
- b) (ii) Both A and R are true but R is not the correct explanation of A.
- c) (iii) A is true but R is false.
- d) (iv) Both A and R are false.

28. Assertion (A) : Black body is an ideal body that emits and absorbs radiations of all frequencies.

Reason (R) : The frequency of radiation emitted by a body goes from a lower frequency to higher frequency with an increase in temperature.

- a) Both A and R are true and R is the correct explanation of A.
- b) Both A and R are true but R is not the explanation of A.
- c) A is true and R is false.
- d) Both A and R are false.

29. Assertion (A) : It is impossible to determine the exact position and exact momentum of an electron simultaneously.

Reason (R) : The path of an electron in an atom is clearly defined.

- a) Both A and R are true and R is the correct explanation of A.
- b) (ii) Both A and R are true and R is not the correct explanation of A.
- c) (iii) A is true and R is false.
- d) (iv) Both A and R are false.

30. Threshold frequency, ν_0 is the minimum frequency which a photon must possess to eject an electron from a metal. It is different for different metals. When a photon of frequency $1.0 \times 10^{15} \text{ s}^{-1}$ was allowed to hit a metal surface, an electron having

$1.988 \times 10^{-19} \text{ J}$ of kinetic energy was emitted. Calculate the threshold frequency of this metal. Show that an electron will not be emitted if a photon with a wavelength equal to 600 nm hits the metal surface.