DPP - Daily Practice Problems

Name : | Date :

Start Time : | End Time :

CHEMISTRY 03

SYLLABUS : Atomic structure 1 (Fundamental Particles, Atomic Models, Bohr's Atomic Model, Hydrogen spectrum, Sommerfield's Model)

Max. Marks : 120 | **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE choice is correct.

Q.1 For cathode rays, the value of e/m -
(a) is independent of the nature of the cathode and the gas filled in the discharge tube
(b) is constant
(c) is -1.7588×10^8 coulombs/g
(d) All of the above are correct

Q.2 Arrange the following particles in increasing order of values of e/m ratio : electron (e), proton (p), neutron (n) and α-particle (α) -
(a) n, p, e, α (b) n, α, p, e
(c) n, p, α, e (d) e, p, n, α

Q.3 The wavelengths of two photons are 2000Å and 4000Å respectively. What is the ratio of their energies?
(a) 1/4 (b) 4
(c) 1/2 (d) 2

Q.4 Which type of radiation is not emitted by the electronic structure of atoms?
(a) Ultraviolet light (b) X-rays
(c) Visible light (d) γ-Rays

Q.5 An oil drop has 6.39×10^{-19} C charge. Find out the number of electrons in this drop -
(a) 4 (b) 3
(c) 6 (d) 8

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

Q.6 Find out the number of wave made by a Bohr electron in one complete revolution in its 3rd orbit of hydrogen atom -

(a) 4 (b) 3 (c) 6 (d) 8

Q.7 The ionization energy of He^+ is 19.6×10^{-18} J $atom^{-1}$. The energy of the first stationary state of Li^{2+} will be -

(a) 21.2×10^{-18} J/atom (b) 44.10×10^{-18} J/atom
(c) 63.2×10^{-18} J/atom (d) 84.2×10^{-18} J/atom

Q.8 The ionization energy of hydrogen atom is 13.6 eV. What will be the ionization energy of He^+ –

(a) 13.6 eV (b) 27.2 eV (c) 54.4 eV (d) 122.4 eV

Q.9 The ionization energy of H-atom is 13.6 eV. The ionization energy of Li^{+2} ion will be -

(a) 13.6 eV (b) 27.2 eV (c) 54.4 eV (d) 122.4 eV

Q.10 Which transition of the hydrogen spectrum would have the same length as the Balmer transition, n = 4 to n = 2 of He^+ spectrum?

(a) $n_2 = 2$ to $n_1 = 1$ (b) $n_2 = 3$ to $n_1 = 1$
(c) $n_2 = 4$ to $n_1 = 2$ (d) $n_2 = 5$ to $n_1 = 3$

Q.11 Given $R = 1.0974 \times 10^7\ m^{-1}$ and $h = 6.626 \times 10^{-34}$ Js. The ionization energy of one mole of Li^{+2} ions will be as follows-

(a) 11240 kJ $mole^{-1}$ (b) 11180 kJ $mole^{-1}$
(c) 12350 kJ $mole^{-1}$ (d) 15240 kJ $mole^{-1}$

Q.12 Calculate the energy emitted when electrons of 1.0 g atom of hydrogen undergo transition giving the spectral line of lowest energy in the visible region of its atomic spectrum -

($R_H = 1.1 \times 10^7\ m^{-1}$, $c = 3 \times 10^8\ ms^{-1}$, $h = 6.62 \times 10^{-34}$ Js).

(a) 182.5 kJ (b) 132.5 kJ (c) 112.5 kJ (d) 122.5 kJ

Q.13 The shortest wavelength in H spectrum of Lyman series when $R_H = 109678\ cm^{-1}$ is -

(a) 1215.67 Å (b) 911.7 Å
(c) 1002.7 Å (d) 1127.30 Å

Q.14 The energy of an electron in the second and third Bohr orbits of the hydrogen atom is -5.42×10^{-12} ergs and -2.41×10^{-12} erg respectively. Calculate the wavelength of the emitted radiation when the electron drops from third to second orbit –

(a) 5.6×10^3 Å (b) 6.6×10^2 Å
(c) 6.6×10^3 Å (d) 10.6×10^3 Å

Q.15 Find the number of quanta of radiations of frequency $4.75 \times 10^{13}\ sec^{-1}$, required to melt 100 g of ice. The energy required to melt 1 g of ice is 350 J -

(a) 1113×10^{20} (b) 1113×10^{18}
(c) 1113×10^{15} (d) 1113×10^{21}

Q.16 The energy absorbed by each molecule (A_2) of a substance is 4.4×10^{-19} J and bond energy per molecule is 4.0×10^{-19} J. The kinetic energy of the molecule per atom will be:

(a) 2.2×10^{-19} J (b) 2.0×10^{-19} J
(c) 4.0×10^{-20} J (d) 2.0×10^{-20} J

Q.17 If an electron is present in n = 6 level. How many spectral lines would be observed in case of H atom?

(a) 10 (b) 15
(c) 20 (d) 25

Q.18 Naturally occuring boron consists of two isotops whose atomic weights are 10.01 and 11.01. The atomic weight of natural boron is 10.81. Calculate the percentage of each isotope in natural boron-

(a) 20,80 (b) 30,70
(c) 10,90 (d) 15,85

Q.19 From the following list of atoms, choose the no. of pairs of isotopes, isobars and isotones respectively

${}^{16}_{8}O$, ${}^{39}_{19}K$, ${}^{235}_{92}U$, ${}^{40}_{19}K$, ${}^{14}_{7}N$, ${}^{18}_{8}O$, ${}^{14}_{6}C$, ${}^{40}_{20}Ca$, ${}^{238}_{92}U$

(a) 3, 2, 2 (b) 2, 3, 2
(c) 2, 2, 3 (d) 2, 2, 2

RESPONSE GRID					
	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ	

Space for Rough Work

Q.20 Atomic radius is of the order of 10^{-8} cm. and nuclear radius is of the order of 10^{-13} cm. Calculate what fraction of atom is occupied by nucleus?

(a) 10^{-10} (b) 10^{-15} (c) 10^{-12} (b) 10^{-9}

Q.21 Nitrogen atom has atomic number 7 & oxygen has atomic number 8. Calculate the total number of electrons in nitrate ion-

(a) 40 (b) 64 (c) 16 (d) 32

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct

(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 For the table -

Atom/ion	Atomic Number (Z)	Mass No.	Protons	Neutrons	Electrons
		(A)	(p)	(n)	(e)
Al^{3+}	13	x		14	
Cu	29	63		y	
Mg^{2+}	12	24		z	12

Choose the correct options –

(1) x=27 (2) y=34 (3) z=12 (4) z=25

Q.23 Choose the correct statements –

(1) The difference in energy between 1st and 2nd Bohr orbit for a H atom is + 10.2 eV

(2) At minimum atomic no. 2, a transition from n = 2 to n = 1 energy level would result in the emission of X-ray with $\lambda = 3.0 \times 10^{-8}$ m.

(3) The difference in energy between 1st and 2nd Bohr orbit for a H atom is + 12.1 eV

(4) At minimum atomic no. 4, a transition from n = 2 to n = 1 energy level would result in the emission of X-ray with $\lambda = 3.0 \times 10^{-8}$ m.

Q.24 Choose the correct options for hydrogen atom -

(1) $E_2 = -\frac{13.6}{9}$ eV (2) $E_6 = -\frac{13.6}{36}$ eV

(3) $E_6 = -\frac{13.6}{25}$ eV (4) $E_2 - E_1 > E_6 - E_2$

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

SOMMERFIELD'S CONCEPT

(a) Sommerfield in 1915, introduced a new atomic model to explain line spectrum of hydrogen atom

(b) He proposed that the moving electron might describe elliptical orbits in addition to circular orbits, and the nucleus is situated at one of the foci.

(c) During motion on a circle, only the angle of revolution changes while the distance from the nucleus remains the same but in elliptical motion both the angle of revolution and the distance of the electron from the nucleus change.

(d) The distance from the nucleus is termed as radius vector and the angle of revolution is known as azimuthal angle.

(e) The tangential velocity of the electron at a particular instant can be resolved into two components. One along the radius vector called radial velocity and the other perpendicular to the radius vector called transverse or angular velocity.

(f) These two velocities give rise to radial momentum and angular or azimuthal momentum.

(g) Sommerfield proposed that both the momenta must be integral multiples, radial momentum $= n_r \frac{h}{2\pi}$, Azimuthal momentum $= n_\phi \frac{h}{2\pi}$

Q.25 To give designation to an orbital, we need -

(a) Principal and azimuthal quantum numbers

(b) Principal and magnetic quantum numbers

(c) Azimuthal and magnetic quantum numbers

(d) Principal, azimuthal and magnetic quantum numbers

RESPONSE GRID	
	20. ⓐⓑⓒⓓ 21. ⓐⓑⓒⓓ 22. ⓐⓑⓒⓓ 23. ⓐⓑⓒⓓ 24. ⓐⓑⓒⓓ
	25. ⓐⓑⓒⓓ

Q.26 The elliptical orbits of electron in the atom were proposed by -

(a) Thomson (b) Bohr

(c) Sommerfield (d) De Broglie

Q.27 Choose the correct statements –

(a) Sommerfield model gives introduction of elliptical orbitals.

(b) Energies of subshells follow the order s < p < d < f.

(c) The relation between principal (n) and azimuthal (ℓ) quantum numbers is $\frac{n}{\ell} = \frac{\text{length of major axis}}{\text{length of minor axis}}$

(d) All of these

DIRECTIONS (Q.28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement - 1 is False, Statement-2 is True.

(d) Statement - 1 is True, Statement-2 is False.

Q.28 Statement 1 : The atoms of different elements having same mass number but different atomic number are known as isobars.

Statement 2 : The sum of protons and neutrons, in the isobars is always different.

Q.29 Statement 1 : The value of n for a line in Balmer series of hydrogen spectrum having the highest wavelength is 4 and 6.

Statement 2 : For Balmer series $n_1 = 2$ and $n_2 = 3, 4, 5$

Q.30 Statement 1 : The transition of electrons $n_3 \rightarrow n_2$ in H atom will emit greater energy than $n_4 \rightarrow n_3$.

Statement 2 : n_3 and n_2 are closer to nucleus than n_4.

RESPONSE GRID	26.ⓐⓑⓒⓓ	27.ⓐⓑⓒⓓ	28.ⓐⓑⓒⓓ	29.ⓐⓑⓒⓓ	30.ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 3 - CHEMISTRY

Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	32	Qualifying Score	52
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS — CHEMISTRY SOLUTIONS 03

(1) (d) Cathode rays consist of electrons which are fundamental particles of matter.

(2) (b)

	Electron	Proton	Neutron	α -particle
e	1 unit	1 unit	zero	2 units
m	1/1837 unit	1 unit	1 unit	4-units
e/m	1837	1	zero	1/2

(3) (d) $E_1 = h.\frac{c}{\lambda_1}$; $E_2 = h.\frac{c}{\lambda_2}$

$$\frac{E_1}{E_2} = \frac{hc}{\lambda_1} \times \frac{\lambda_2}{hc} = \frac{\lambda_2}{\lambda_1} = \frac{4000}{2000} = 2$$

(4) (d) γ-Rays emission occurs due to radioactive change, a nuclear phenomenon.

(5) (a) Charge on an oil drop = 6.39×10^{-19} C

Now we know that

1.602×10^{-19} C is the charge on one 1 electron

∴ 6.39×10^{-19} C charge will be on

$$= \frac{6.39 \times 10^{-19}}{1.602 \times 10^{-19}} = 4 \text{ electrons}$$

(6) (b) We know that $r_n = r_0 \times n^2$

∴ $r_3 = 0.529 \times 10^{-8}\text{ cm} \times (3)^2$

($\because r_0 = 0.529 \times 10^{-8}$ cm)

Also we know that

$u_n = \frac{u_0}{n}$ ∴ $u_3 = \frac{2.19 \times 10^8}{3}$

($\because u_0 = 2.19 \times 10^8\text{ cm sec}^{-1}$)

No. of waves in one round

$$= \frac{2\pi r_3}{\lambda} = \frac{2\pi r_3}{h/mu_3} = \frac{2\pi r_3 \times u_3 \times m}{h}$$

Substituting the values of the different constants

No. of waves in one round

$$= \frac{2 \times 3.14 \times 0.529 \times 10^{-8} \times 9 \times 2.19 \times 10^8 \times 9.108 \times 10^{-28}}{3 \times 6.62 \times 10^{-27}} = 3$$

(7) (b) E_1 for $Li^{+2} = E_1$ for H $\times Z^2{}_{Li}$ = E_1 for H × 9

E_1 for $He^+ = E_1$ for H $\times Z^2{}_{He}$ = E_1 for H × 4

or E_1 for $Li^{+2} = \frac{9}{4}$ E_1 for He^+

$= 19.6 \times 10^{-18} \times \frac{9}{4} = 44.10 \times 10^{-18}$ J/atom

(8) (c) He^+ is a hydrogen like species i.e., the electron is ionised from first orbit.

∴ Ionization energy of $He^+ = \frac{Z^2 E_H}{n^2}$

$$= \frac{4 \times 13.6}{1^2} = 54.4\text{eV}$$

(9) (d) E_1 for $Li^{+2} = E_1$ for H $\times Z^2$ [for Li, Z = 3]

$= 13.6 \times 9 = 122.4$ eV

(10) (a) For He^+ ion, we have

$$\frac{1}{\lambda} = R_H Z^2 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right]$$

$$= R_H [2]^2 \left[\frac{1}{2^2} - \frac{1}{4^2}\right] = \frac{3}{4} R_H \quad \text{...(A)}$$

Now for H atom

$$\frac{1}{\lambda} = R_H \left[\frac{1}{n_1^2} - \frac{1}{n_2^2}\right] \quad \text{...(B)}$$

Equating eqs. (A) and (B), we have

$$\frac{1}{n_1^2} - \frac{1}{n_2^2} = \frac{3}{4}$$

Obviously $n_1 = 1$ and $n_2 = 2$. Hence the transition $n_2 = 2$ to $n_1 = 1$ in hydrogen atom will have the same length as the transition n = 4 to n = 2 in He^+ species.

(11) (b) The expression of ionization energy is :

$\Delta E = RZ^2 hc$

For Li^{+2} ion, Z = 3, hence

$\Delta E = (1.0974 \times 10^7\text{ m}^{-1}) \times (9) \times (6.626 \times 10^{-34}\text{ J.S.}) \times (3 \times 10^8\text{ ms}^{-1}) = 1.964 \times 10^{-17}$ J

For one mole of ions, we have

$\Delta E' = N_A . \Delta E = (6.023 \times 10^{23}\text{ mol}^{-1})(1.964 \times 10^{-17}\text{ J})$

$= 1.118 \times 10^7\text{ J mol}^{-1} = 11180\text{ kJ mol}^{-1}$

(12) (a) The spectral line lies in the visible region i.e., it corresponds to the Balmer series i.e. $n_2 = 2$ and hence $n_1 = 3, 4, 5$, etc.

For lowest energy of Balmer series, $n_1 = 3$

Substituting the values in the following relation.

$$\frac{1}{\lambda} = R_H \left[\frac{1}{n_2^2} - \frac{1}{n_1^2}\right] = 1.1 \times 10^7 \times \left[\frac{1}{4} - \frac{1}{9}\right]$$

$$= 1.1 \times 10^7 \times \frac{5}{36}$$

$$\lambda = \frac{36}{1.1 \times 10^7 \times 5} = 6.55 \times 10^{-7}\text{ m}$$

Now, we know that, $E = h\nu = h \times \frac{c}{\lambda}$

$$= \frac{6.62 \times 10^{-34} \times 3 \times 10^{8}}{6.55 \times 10^{-7}} = 3.03 \times 10^{-19} J$$

$\therefore$ Energy corresponding to 1g atom of hydrogen
$= 3.03 \times 10^{-19} \times 6.02 \times 10^{23}$
$= 18.25 \times 10^{4}$ J = 182.5 kJ

(13) **(b)** For Lyman series, $n_1 = 1$

For shortest wavelength of Lyman series the energy differnece in two levels showing transition should be maximum, (i.e., $n_2 = \infty$).

$$\frac{1}{\lambda} = R_H \left[\frac{1}{1^2} - \frac{1}{\infty^2}\right] = 109678$$

$\therefore \lambda = 911.7 \times 10^{-8} = 911.7$ Å

(14) **(c)** Here, $h = 6.62 \times 10^{-27}$ erg

$E_3 = -2.41 \times 10^{-12}$ erg

$E_2 = -5.42 \times 10^{-12}$ erg

$\Delta E = E_3 - E_2 = -2.41 \times 10^{-12} + 5.42 \times 10^{-12}$

Now, we know that, $\Delta E = h\nu$

$$\nu = \frac{\Delta E}{h} = \frac{3.01 \times 10^{-12}}{6.62 \times 10^{-27}}$$

Since $\nu = \frac{c}{\lambda}$; $\lambda = \frac{c}{\nu}$

$$\therefore \lambda = \frac{6.62 \times 10^{-27} \times 3 \times 10^{8}}{3.01 \times 10^{-12}}.$$

$\lambda = 6.6 \times 10^{-5}$ cm

Since, 1 Å = 10^{-8} cm

$\lambda = 6.6 \times 10^{3}$ Å

(15) **(d)** $E = nh\nu = n \times 6.62 \times 10^{-34}$ J sec $\times 4.75 \times 10^{13}$ sec^{-1}

$= n \times 31.445 \times 10^{-21}$ J

Energy required to melt 100 g ice = 350 J × 100
= 35000 J

$n \times 31.445 \times 10^{-21} = 35000$

$$n = \frac{35000}{31.445 \times 10^{-21}} = 1113 \times 10^{21}$$

(16) **(d)** K.E per atom

$$= \frac{(4.4 \times 10^{-19}) - (4.0 \times 10^{-19})}{2}$$

$$= \frac{0.4 \times 10^{-19}}{2} = 2.0 \times 10^{-20}$$

(17) **(b)** The no. of spectral lines is given by $\frac{n(n-1)}{2}$

when n = 6, then the no. of spectral lines

$$= \frac{6 \times (6-1)}{2} = \frac{6 \times 5}{2} = 15$$

(18) **(a)** Let the percentage of isotope with atomic wt. 10.01 = x

$\therefore$ Percentage of isotope with atomic wt. 11.01 = 100 – x

Average atomic wt. $= \frac{m_1x_1 + m_2x_2}{x_1 + x_2}$

or Average atomic wt.

$$= \frac{x \times 10.01 + (100 - x) \times 11.01}{100}$$

$$10.81 = \frac{x \times 10.01 + (100 - x) \times 11.01}{100} \Rightarrow x = 20$$

$\therefore$ % of isotope with atomic wt. 10.01 = 20

% of isotope with atomic wt. 11.01 = 100 – x = 80

(19) **(a)** Isotopes :

$({}^{16}_{8}O, {}^{18}_{8}O), ({}^{39}_{19}K, {}^{40}_{19}K), ({}^{235}_{92}U, {}^{238}_{92}U)$

Isobars : $({}^{40}_{19}K, {}^{40}_{20}Ca), ({}^{14}_{7}N, {}^{14}_{6}C)$

Isotones : $({}^{39}_{19}K, {}^{40}_{20}Ca), ({}^{14}_{6}C, {}^{16}_{8}O)$

(20) **(b)** Volume of nucleus = $(4/3)\pi r^3$

$= (4/3)\pi \times (10^{-13})^3$ cm^3

Volume of atom = $4/3\ \pi r^3 = (4/3)\pi \times (10^{-8})^3$ cm^3

$$\therefore \frac{V_{nucleus}}{V_{atom}} = \frac{10^{-39}}{10^{-24}} = 10^{-15}$$

or $V_{nucleus} = 10^{-15} \times V_{atom}$

(21) **(d)** No. of electrons in NO_3^-

= (Electrons in N) + (3 × electrons in O)
+ [1 (due to negative charge)]

= 7 + 3 × 8 + 1 = 32

(22) **(a)**

(1) Atomic number (Z) of Al = 13 = Number of protons

Number of electrons = 13 – 3 = 10

Mass number = n + p = 14 + 13 = 27

(2) Atomic number = Number of protons
= Number of electrons = 29

Mass number = n + p = 63

Since p = 29

$\therefore$ n = 63 – p = 63 – 29 = 34

(3) Number of protons = Z = 12

Number of electrons = 12 – 2 = 10

Mass number = n + p = 24

$\therefore$ n = 24 – p = 24 – 12 = 12

(23) **(b)** E_1 for H = – 13.6 eV

$\therefore$ E_2 for H = $(-13.6/2^2) = -13.6/4 = -3.4$ eV

$\therefore$ $E_2 - E_1 = -3.4 - (-13.6) = +10.2$ eV

Also for transition of H like atom ; $\lambda = 3.0 \times 10^{-8}$ m

$$\frac{1}{\lambda} = R_H . Z^2 \left[\frac{1}{1^2} - \frac{1}{2^2}\right]$$

$$\frac{1}{3 \times 10^{-8}} = 1.09 \times 10^7 \times Z^2 \times \frac{3}{4}$$

$\therefore$ $Z^2 = 4$ and $Z = 2$

(24) **(c)** Energy of n = 1 for H-atom

$E_1 = -13.6$ eV

Energy of n = 2 for H-atom

$$E_2 = -\frac{13.6}{4} \text{ eV}$$

Energy of n = 6 for H-atom

$$E_6 = -\frac{13.6}{36} \text{ eV}$$

So, $E_2 - E_1 = 13.6 - \dfrac{13.6}{4} = 13.6 \times \dfrac{3}{4}$

$$E_6 - E_2 = \frac{13.6}{4} - \frac{13.6}{36} = 13.6\left(\frac{1}{4} - \frac{1}{36}\right) = 13.6 \times \frac{2}{9}$$

$E_2 - E_1 > E_6 - E_2$

(25) **(d)** The correct answer is (d).

(26) **(c)** The elliptical orbits of electron in the atom were proposed by Sommerfield.

(27) **(d)** All statements are correct.

(28) **(d)** Isobars are the atoms of different elements having same mass number but different atomic number, S-1 is correct but S-2 is false because atomic mass is sum of number of neutrons and protons which should be same for isobars.

(29) **(c)** We know that the line in Balmer series of hydrogen spectrum the highest wavelength or lowest energy is between $n_1 = 2$ and $n_2 = 3$. And for Balmer series of hydrogen spectrum, the value of $n_1 = 2$ and $n_2 = 3, 4, 5$. Therefore the S-1 is false but the S-2 is true.

(30) **(b)** Both statements are true, but S-2 is not the correct explanation of S-1. The difference between the energies of adjacent energy levels decreases as we move always far from the nucleus. Thus in H atom $E_2 - E_1 > E_3 - E_2 > E_4 - E_3$ ......