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**Q1.** What is photoelectric effect?

**Q2.** According to $n + l$ rule of Aufbau principle the energy of 3*d*-orbital. But in case of Cu, the valence shell electronic configuration is $3d^{10} 4s^1$ explain why?

**Q3.** Give exception of Aufbau principle.

**Q4.** What you understand by aufbau principle?

**Q5.** What you understand pouli's exclusion principle?

**Q6.** What is the isotones?

**Q7.** What you understand by isobars?

**Q8.** What you understand by isotopes?

**Q9.** Write the complete atomic symbol for each of the given atomic number (Z) and mass number (*A*).

(a) Z = 4, A = 9 (b) Z = 92, A = 233 (c) Z = 17, A = 35

**Q10.** Calculate the number of protons and neutrons in $^{88}_{38}Sr$.

**Q11.** Caculate the number of unpaired electrons in $Fe^{2+}$ and $Fe^{3+}$ (atomic no. is 26)

**Q12.** Write the special name of the charge carried by one mole of electrons.

**Q13.** What you understand by Heisenberg's uncertainty principle.

**Q14.** The Br atom possesses 35 electrons. It contains 6 electrons in 2*P* orbitals, and 6 electrons in 3*P* orbitals and 5 electrons in 4*P* orbitals, which of the following expence the lowest effective nuclear charge?

**Q15.** Write the units of various terms in equation

$$E_n = 2\pi^2 m\, k^2 Z^2 e^4 / n^2 h^2$$

and deduce the unit of energy

**Q16.** Which of the following are isoelectronics?

$$Na^+, K^+, Mg^{2+}, Ca^{2+}, S^{2-}, Ar$$

**Q17.** What is the maximum number of emission lines when the excited electron of an H-atom in the energy state of n = 6 falls to the ground state?

**Q18.** Calculate the number of protons and number of neutrons in the following:

$$^{17}_{8}O,\ ^{19}_{9}F,\ ^{56}_{26}Fe,\ ^{88}_{38}Sr$$

**Q19.** What is difference between orbit and orbital

**Q20.** Give difference between the atomic orbital ($\Psi$) and probability distribution $\Psi^2$.

**Q21.** The mass number of an element *X* is 81. Write its atomic notation if its nucleus contains 31.7 % more neutrons than the number of protons.

**Q22.** The energy of the principal energy state of hydrogen and hydrogen like atoms is given by the equation

$$E_n = -\frac{2\pi^2 m k^2 Z^2 e^4}{n^2 h^2}$$

(i) What is the significance of the negative sign in the expression?

(ii) Write the name of each symbol in the expression.

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**S1.** When a beam of light of proper frequency (thershold frequency $\nu_0$) falls on a clean surface of alkali metals in vaccum the metal emits electrons this effect is called photoelectric effect.

The ejected electrons are called photoelectrons.

**S2.** It is true that for 4*s*-orbital $n + l = 4$ to = 4 and 3*d*-orbital $n + l = 3 + 2 = 5$; But in $3d^{10}4s^1$ configuration the exchange energy is larger than that $3d^9 4s^2$ configuration this larger value of exchange energy make the system more stable.

**S3.** Half filled and full filled *d*-orbital is more stable than other configuration of *d*-orbital.

For example $d^5$ is more stable than $d^4$ and $d^{10}$ is more stable than $d^9$.

Hence, in $_{24}$Cr electron transfer from 4*s* to 3*d* and configuration of Cr is $4s^1 3d^5$.

**S4.** According to Aufbau principle electrons enter in the sub-shells of an atom in the increasing order of energy.

*I.e.*, Electron filled in first lower level than in higher level.

**S5.** According to pauli's exclusion principle no, two electrons in the same atom can have the same values for all the four quantum numbers.

**S6.** Atom of different elements having the same number of neutrons are known as isotones

$^{14}_{6}C$ $^{15}_{7}N$ and $^{16}_{8}O$

**S7.** Atoms having different atomic numbers and same mass number are known as isobars.

$^{40}_{18}Ar$ and $^{40}_{20}Ca$

**S8.** Atoms having same atomic number and different mass number called isotopes.

E.g. Hydrogen has three isotopes

$^{1}_{1}H$ (Protonium) mass no. = 1

$^{2}_{1}H$ (Deuterium) mass no. = 2

$^{3}_{1}H$ (Tritium) mass no. = 3

**S9.** (a) $^{9}_{4}Be$ (b) $^{233}_{92}U$ (c) $^{35}_{17}Cl$

**S10.** $^{88}_{38}Sr$ : Number of protons = $Z$ = 38 = atomic number

Number of neutrons = $A - Z = 88 - 38 = 50$

**S11.** The electronic configuration will tell the number of unpaired electrons.

$Fe^{2+} = 1s^2\, 2s^2\, 2p^6\, 3s^6\, 3d^6$ (Four unpaired electron) in $3d^6$ = ↑↓↑↑↑↑

$Fe^{3+} = 1s^2\, 2s^2\, 2p^6\, 3s^2\, 3d^6\, 3d^5$ (Four unpaired electron) in $3d^5$ = ↑↑↑↑↑

**S12.** The charge carried by 1 mole of electrons is called faraday constant. Its value is accepted to be 96500 C $mol^{-1}$ for practical works.

**S13.** According to Heisenberg's uncertainty principle. It is impossible to determine simultaneously and occurately the exact position and the exact momentum of the moving particle.

Mathmetically,

$$(\Delta x) \times (\Delta P) \geq \frac{h}{4\pi}$$

where, $\Delta P$ – uncertainty in momentum.

$\Delta x$ = uncertainty in position.

**S14.** $4P$ has highest energy level *i.e.*, highest number of $n$ means farest away from nucleus *i.e.*, $4P$ electrons having lowest effective nuclear charge.

**S15.**

$$E_n = -\frac{2\pi^2 m k^2 Z^2 e^4}{n^2 h^2}$$

$$\text{Units} = \frac{(\text{kg})(\text{N m}^2 C^{-2})^2 (C)^4}{(\text{kg m}^2 \text{s}^{-1})^2} = \frac{N^2}{\text{kg}\, s^{-2}}$$

$$= \text{kg m}^2\text{s}^{-2} = \text{N m} = \text{J} \qquad \because N = \text{kg m s}^{-2}$$

The unit of energy is joule (J).

**S16.** isoelectronics have equal number of electrons. Thus

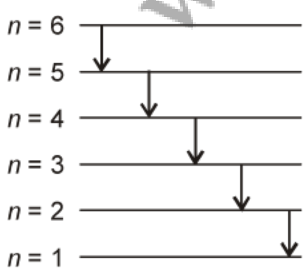
(a) $Na^+$ and $Mg^{2+}$ are isoelectronics.

**Reason:** Because each on has 10 electrons.

(b) $K^+$, $Ca^{2+}$, $S^{2-}$ and Ar are isoelectronics.

**Reason:** Because each one has 18 electrons.

**S17.** Let us suposse that the electron falls from $n = 6$ orbit (excited state) to $n = 1$ orbit (ground state) in steps as $6 \rightarrow 5 \rightarrow 4 \rightarrow 3 \rightarrow 2 \rightarrow 1$.



There are possible transitions. Now each transition will correspond to an emission line. Thus, the maximum number of possible emission lines in the spectrum of H-atom is 5, when the electron falls from $n$ = 6 orbit to the ground state.

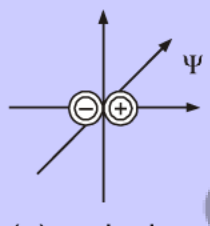
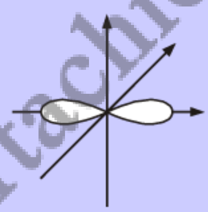
**S18.**

| Species | $A$ | $Z = P$ | $n = A - Z$ |
|---|---|---|---|
| $^{17}_{8}O$ | 17 | 8 | 17 – 8 = 9 |
| $^{19}_{9}F$ | 19 | 9 | 19 – 9 = 10 |
| $^{56}_{26}Fe$ | 56 | 26 | 56 – 26 = 30 |
| $^{88}_{38}Sr$ | 88 | 38 | 88 – 38 = 50 |

**S19.**

| Orbit | Orbital |
|---|---|
| – An orbit is a fixed circular path of electron motion around the nucleus of atom. | – An orbital is the region of space around the nucleus in which the probability of the finding the electron in maximum. |
| – The orbit is stationary state of definite energy | – The orbit is a wave function Ψ which represents the solution of schrodinger wave equation for an electron |

**S20.**

| Atomic orbital (Ψ) | Probability density distribbution (Ψ)$^2$ |
|---|---|
| – It is Ψ function | – It is (Ψ$^2$) |
| – The surface of the plot of Ψ function for a. $p$-orbital has the shape in which two spheres are in contact<br> | – The surface of probability density distribution (Ψ$^2$) has the dumb-bell shape.<br> |
| – The plus (+) and minus (–) signs are associated with the values of Ψ functions and have only mathematical meaning. These (+) and (–) signs do not mean the electric charge | – The (+) and (–) signs donot appear with (Ψ$^2$) because (Ψ$^2$)is positive whether Ψ is positive or negative. |
| – These shapes are useful to describe the orbital overlap in the formotion of chemical bond between atoms. | – These are useful to interept the maximum probability distribution of electrons. |

**S21.** It is given that

$$n = p + (31.7/100)p = p(1.317)$$

$$A = n + p = p(1.317) + p = (2.317)p$$

$$p = \frac{A}{2.317} = \frac{81}{2.317} = 34.958 = 35 = Z$$

Atomic notation = ${}^{A}_{Z}X = {}^{81}_{35}Br$

**S22.** (i) In the given equation for energy the negative sign suggests that:

(a) The energy of the electron in the atom is less than the energy of a free electron and thus the hydrogen atom is a stable entity.

(b) The electron is attracted by the nucleus of the atom.

(c) If the electron is to be removed from the orbit, the energy must be supplied from outside.

(ii) Name of the symbols in the expression $E_n = -\frac{2\pi^2 m k^2 Z^2 e^4}{n^2 h^2}$

$E_n$ = Energy of the electron in $n$th energy state

$\pi$ = Constant = 22/7

$m$ = Mass of an electron = $9.1 \times 10^{-31}$kg

$Z$ = Nuclear charge = 1 for hydrogen atom = atomic number

$e$ = Charge on the electron = $1.602 \times 10^{-19}$ C

$k$ = Constant = $8.99 \times 10^9$ N $m^2C^{-2}$ = 1/4 $\pi\in_0$

$n$ = Principal quantum number

$h$ = Planck's constant = $6.626 \times 10^{-34}$ kg $m^2s^{-1}$

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**Q1.** What is the lowest value of the principal quantum number ($n$) for which the g subshells (or g-orbitals) may be possible?

**Q2.** Give the possible values of $n$, $l$ and $m$ for an electron which is present in one of the 3$d$ orbitals.

**Q3.** Write the azimuthal and magnetic numbers ($l$ and $m$) for the electrons for 3$d$-orbitals.

**Q4.** For atomic orbitals with $n = 3$, calculate the possible values of $l$ and $m$.

**Q5.** Calculate the number of electrons in an atom which have the quantum number $n = 3$, $l = 0$.

**Q6.** How many electrons in an atom may have the atomic number $n = 4$, $s = -1/2$?

**Q7.** Write the azimuthal quantum number ($l$) and magnetic and spin quantum numbers of electrons of 3$d$ orbital.

**Q8.** What is the correct set of quantum number of the unpaired electron of chorine atom? At. no of Cl is 17.

**Q9.** Write the electronic configuration of elements of atomic numbers 25 and 37. Electronic configuration

**Q10.** The ground state configuration of nitrogen (at no. 7) is not written as $1s^2\ 2s^2\ 2p_x^2\ 2p_y^1\ 2p_z^0$ Explain why?

**Q11.** Write the four quantum numbers of the outermost two electrons in the atom of Ca (atomic number 20).

**Q12.** Write the all quantum number set of last electron of Cu(29)

**Q13.** Write the all quantum number set of last electron of $3d^6$

**Q14.** Calculate the value of $n + l$ for each 3$p$, 3$d$ and 4$s$ and arrange in sequence

**Q15.** Write the four quantum number of 19th electron in Cr (at. no. 24).

**Q16.** Write the electronic configurations of $Cu^{2+}$ and $Cr^{2+}$ ions. The atomic numbers of Cu and Cr and 29 and 24 respectively.

**Q17.** Why is the electronic configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^4$ not correct for chromium? What is its correct configuration? (Atomic number of Cr is 24).

**Q18.** Write the electronic configuration of an element with number 29.

**Q19.** According to $n + l$ rule of aufbau principle the energy of 4s orbital is lower than than the energy of 3$d$ orbital. But in case of Cu the valence shell electronic configuration is $3d^{10}\ 4s^1$. Explain why?

**Q20.** Calculate the atomic number of an element whose outermost orbital has the configuration $3s^1$.

**Q21.** What is the maximum number of electrons in
(a) a principal shell (b) an orbital

**Q22.** List the quantum numbers *n*, $\ell$ and *m* of electrons in 4*f*-orbitals.

**Q23.** Name two atom/ions having electronic configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}$.

**Q24.** An electron is in one of the 3*d*-orbitals. Give the possible value of *n*, *l* and *m* for this electrons.

**Q25.** What is lowest value of *n* that allows of orbital to exists?

**Q26.** Write the electronic configuration of *S* in exited state if all electrons of last *y*-shell are unpair (*S* = 16).

**Q27.** Write the electronic configuration od $s^{2-}$ and $s^{2+}$ (*s* = 16).

**Q28.** How many sub-shells and orbitals of Cr-24

**Q29.** How many electrons in an atom of neon (*z* = 10) have clockwise spin?

**Q30.** Desigine the orbital

If (a) $n = 3$, $l = 2$, $m = +2$

(b) $n = 3$, $l = 1$, $m = 0$

**Q31.** Arrange the following orbitals in the increasing order of energy

3*d*, 4*d*, 4*f*, 4*s*, 5*d*

**Q32.** Write the notations of subshells for the following set of quantum numbers

(i) $n = 4, l = 0$ (ii) $n = 5, l = 0$ (iii) $n = 2, l = 1$ (iv) $n = 3, l = 2$.

**Q33.** Arrange the following orbitals in decreasing order of energy. Write the name of orbital also.

(i) $n = 3, l = 0, m = 0$ (i) $n = 4, l = 0, m = 0$ (iii) $n = 3, l = 1, m = 0$ (vi) $n = 3, l = 2, m = 1$

**Q34.** Which of the 2*s*, 2*p*, 1*p*, 3*p* orbitals are possible?

**Q35.** Write the atomic number and name of the elements whose outermost orbitals have the configurations.

(a) $2p^3$ (b) $3d^6$ (c) $3s^2$

**Q36.** Name the elements which have the following condensed electronic electronic configurations.

(a) $[He]2s^1$ (b) $[Ne]3s^2 3p^3$ (c) $[Ar]4s^2\ 3d^1$.

**Q37.** For the M-shell (n = 3) of an atom calculate the total number of orbitals.

**Q38.** State which sets of quantum numbers are possible, and which are not possible.

(a) $n = 1,\ l = 0,\ m = 0,\ s = \pm 1/2$

(b) $n = 0,\ l = 0,\ m = 0,\ s = \pm 1/2$

(c) $n = 1,\ l = 1,\ m = 0,\ s = \pm 1/2$

(d) $n = 1,\ l = 0,\ m = +1,\ s = \pm 1/2$

(e) $n = 1,\ l = 1,\ m = 0,\ s = \pm 1/2$

(f) $n = 2,\ l = 2,\ m = -1,\ s = \pm 1/2$

(g) $n = 2,\ l = 1,\ m = 0,\ s = \pm 1/2$

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**S1.** The g-orbitals correspond to $l = 4$. But the highest value of $l = n - 1$. Therefore, the lowest value of $n = l + 1 = 4 + 1 = 5$.

If $n$ is less than 5, then $l$ is less than 4 and thus the g-subshell is not allowed.

**S2.** For an electron in 3$d$ orbital

$n = 3$, $l = 2$ and $m$ may have any one value of – 2, –1, 0, 1, 2,

**S3.** For the five 3$d$-orbital

$n = 3$, $l = 2$ and $m = -2, -1, 0, 1, 2$

**S4.** For $n = 3$

| $l$ | 0 | 1 | 2 |
|---|---|---|---|
| $m$ | 0 | – 1, 0, 1 | – 2, – 1, 0, 1, 2 |

**S5.** The quantum number $n = 3$, $l = 0$ corresponds to 3$s$ orbital. This orbital will have two electrons.]

**S6.** The one half of the total number of electrons of $n = 4$ shell will have the spin quantum number s = – 1/2 (and other half will have spin quantum number $s = + 1/2$). Thus :

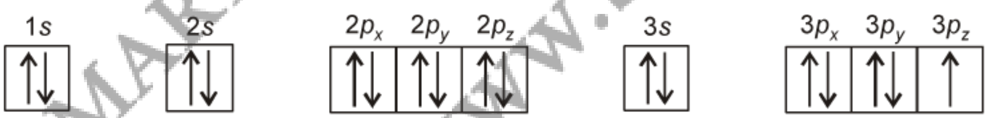
Number of electrons each with –1/2 spin quantum number

$$= \frac{1}{2}(2n^2) = n^2 = 4^2 = 16$$

**S7.** For 3$d$ orbitals, $l = 2, -1, 0, 1, 2$

$s = \pm 1/2, \pm 1/2, \pm 1/2, \pm 1/2, \pm 1/2$

**S8.** The electronic configuration of Cl atom is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p_x^{\ 2}\ 3p_y^{\ 2}\ 3p_z^{\ 1}$. In terms of box diagram it is shown as




Therefore, quantum numbers of unpaired in 3$p_z$ orbital are

$$n = 3,\ \ i = 1,\ \ m = 0,\ s = +\frac{1}{2} \text{ or } -\frac{1}{2}.$$

**S9.** (a) $Z = 25 = 1s^2\ 2s^2\ 2p^6\ 3s^2\ 4s^1\ 3d^5$

(b) $Z = 37 = 1s^2\ 2s^2\ 2p^6\ 3s^6\ 3p^6\ 4s^2\ 3d^{10}\ 4p^6\ 5s^1$

**S10.** The configuration $1s^2\,2s^2\,2p_x^{\,2}2p_y^{\,1}\,2p_z^{\,0}$ is incorrect in this case pairing of electron spin shown before each degenerate orbital is singly occupied ($2p_x$ contains two electrons while $2p_z$ is unoccupied). This is against Hund's rule of maximum multiplicity. The correct electronic configuration of *N* atom is $1s^2\,2s^2\,2p_x^{\,1}\,2p_y^{\,1}\,2p_z^{\,1}$.

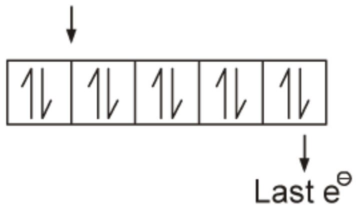
**S11.**

$$\text{Ca (20)} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,4s^2$$

In this configuration the outermost electrons are in 4s orbital with opposite spins. Therefore, their quantum numbers respectively are :

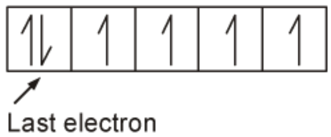
$$n = 4,\ l = 0,\ m = 0,\ s = +\frac{1}{2} \text{ and } n = 4,\ l = 0,\ m = 0,\ s = -\frac{1}{2}$$

**S12.** $_{29}$Cu, $1s^2\ \ 2s^2\ \ 2p^6\ \ 3s^2\ \ 3p^6\ \ 4s^1\ \ 3d^{10}$




$n = 3$, $l = 2$, $m = 2$, $s \pm 1/2$.

**S13.**




$n = 3$ $m = -2$

$l = 2$ $s = \pm 1/2$

**S14.**

$3p = 3 + 1 = 4$

$3d = 3 + 2 = 5$

$4s = 4 + 0 = 4$

According to $n + l = 3p, 4s, 3d$.

**S15.** A correct electronic configuration of Cr atom is

$$\text{Cr (24)} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^1\,4s^1\,3d^5$$

From energy consideration sequence of filling the electrons in various energy states tells that 19th electron is $4s^1$ in Cr atom. Therefore, its four quantum numbers are : $n = 4$, $l = 0$, $m = 0$, $s = +\frac{1}{2}$.

**S16.** In Cu atom there are 29 electrons but in $Cu^{2+}$ ions there are 27 electrons:

$$Cu^{2+} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^9$$

In Cr atom there are 24 electrons but $Cr^{2+}$ has only 22 electrons.

$$Cr^{2+} = 1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^4$$

**S17.** The electronic configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6 4s^2\ 3d^4$ is not correct for chromium because the exchange energy in $4s^2\ 3d^4$ configuration is low hence it is unsable. The stable configuration gives maximum possible multiplicity and large exchange energy (Hund's rule). Therefore, a correct electronic configuration of chromium atom is $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$.

**S18.** $Z = 29 = 1s^2\ 2s^2\ 2p^6\ 3p^6\ 4s^1\ 3d^{10}$

According to $n + l$ rule the configuration should be $4s^2\ 3d^9$, but according to principle of maximum exchange energy and spectroscopic studies $4s^1\ 3d^{10}$ configuration leads to stability.

**S19.** It is true that for $s$ orbital $n + l = 4 + 0 = 4$ and for $3d$ orbital $n + l = 3 + 2 = 5$. But in $3d^{10}\ 4s^1$ configuration. the exchange energy is larger than that in $3d^9\ 4s^2$ configuration. This larger value of exchange energy makes the system more stable.

**S20.** In the given atom the outermost $3s$ orbital belongs to the third shell (M-shell). Now before the M-shell there are K-shell and L-shell which are filled as $1s^2\ 2s^2\ 2p^6$. Thus the total number of electrons = $1s^2 + 2s^2 + 2p^6 + 3s^1 = 11$ = atomic number of Na.

**S21.** (a) No. of electron in principal shell is $2n^2$

*E.g.*, $n = 1$, no. of electron = 2

$n = 2$, no. of electron = 8

(b) In an orbital no. of electron = 2.

**S22.** $n = 4$, $l = 3$, $m$, $-3$, $-2$, $-1$, $0$, $1$, $2$, $3$

**S23.** $Cu^{\oplus}$, $Zn^{2+}$

**S24.** For $3d$, $n = 3$ $l = 2$

$m = +2\ \ +1\ \ 0\ \ -1\ \ -2$

**S25.**

| | | $l$ |
|---|---|---|
| $s$ | – | 0 |
| $p$ | – | 1 |
| $d$ | – | 2 |
| $f$ | – | 3 |
| $g$ | – | 4 |

For $g$, $l$ is 4 and
$l = n - 1$. *i.e.*,
$4 = n - 1$, $n = 5$

**S26.** $_{16}S$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4\ 3d^0$ (Ground state)

$_{16}S$ $1s^1\ 2px^1\ 3py^1\ 3pz^1\ 3p^4\ 3dxy^1\ 3dyz^1$ (excited state)

**S27.** $_{16}s^{2-}$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6$ (18 electrons)

$_{16}s^{2+}$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^2$ (14 electrons)

**S28.** $_{24}Cr$ $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1\ 3d^5$

Sub-shell = 7

Orbitals = 15

**S29.**

| | $1s^2$ | $2s^2$ | $2p^6$ |
|---|---|---|---|
| Ne | ↿⇂ | ↿⇂ | ↿⇂ ↿⇂ ↿⇂ |

5 electrons are in clockwise spin

**S30.** (a) $3dz^2$ (b) $3pz$

**S31.**

$$(n + \ell) = 3d = 3 + 2 = 5$$
$$4d = 4 + 2 = 6$$
$$4f = 4 + 3 = 7$$
$$4s = 4 + 0 = 4$$
$$5d = 5 + 2 = 7$$

*I.e.,* $4s < 3d < 4d < 4f < 5d$.

**S32.**

| Set No. | *n* | *l* | subshell |
|---|---|---|---|
| (i) | 4 | 0 | $4s$ |
| (ii) | 5 | 0 | $5s$ |
| (iii) | 2 | 1 | $2p$ |
| (iv) | 3 | 2 | $3d$ |

**S33.** Sum of $n + l$ values will decide the energy. Thus

(i) $n = 3,\ l = 0,\ m = 0$ gives $n + l = 3 + 0 = 3$ and orbital is $3s$

(ii) $n = 4,\ l = 0,\ m = 0$ gives $n + l = 4 + 0 = 4$ and orbital is $4s$

(iii) $n = 3,\ l = 1,\ m = 0$ gives $n + l = 3 + 1 = 4$ and orbital is $3p$

(iv) $n = 3,\ l = 2,\ m = 0$ gives $n + l = 3 + 2 = 5$ and orbital is $3d$

Decreasing order of energy $3d > 4s > 3p > 3s$.

**S34.** In the notation of an orbital the number tells the principal quantum number ($n$) and alphabet tells the azimuthal quantum number ($l$). Thus

| Orbital | *n* | *l* | Remarks |
|---|---|---|---|
| $2s$ | 2 | 0 | Possible |
| $2p$ | 2 | 1 | Possible |
| $1p$ | 1 | 1 | Not Possible* |
| $3f$ | 3 | 3 | Not Possible* |

**S35.** (a) $1s^2\ 2s^2\ 2p^3 = 7e^- =$ atomic number of N

(b) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2 = 26\ e^- =$ atomic number of Fe

(c) $1s^2\ 2s^2\ 2p^6\ 3s^2 = 12\ e^- =$ atomic number of Mg.

**S36.** (a) $[He]\ 2s^1 = (2e^- + 1\ e^-) = 3e^- \equiv$ Li(lithium)

(b) [Ne] $3s^2\ 3p^3 = (10e^- + 2e^- + 3e^-) = 15\ e^- \equiv$ P (Phosphorus)

(c) [Ar] $4s^2\ 3d^1 = (18e^- + 2e^- + 1e^-) = 21\ e^- \equiv$ Sc (scandium)

**S37.** Total number of orbitals in M-shell = $n^2 = 3^2 = 3 \times 3 = 9$.

Detailed calculation

For $n = 3$

$l = 0, 1, 2$

subshell $3s\ 3p\ 3d$

There are three subshells designated as $3s$, $3p$, and $3d$

(a) For $n = 3$ and $l = 0$

$m = 0$ and (one orientation of $3s$ orbital)

There is one $3s$ orbital

(b) For $n = 3$ and $l = 1$

$m = -1, 0, 1$ (three orientations of $3p$ orbitals)

(c) For $n = 3$ and $l = 2$

$m = -2, 1, 0, 1, 2$ (five orientations of $3d$ orbitals)

There are five $3d$ orbitals.

(d) Total number of orbitals in $M$-shell = 1 + 3 + 5 = 9.

**S38.** (a) This set of quantum number is possible.

(b) This set of quantum numbers is not possible because the principal quantum number ($n$) cannot be zero.

(c) This set of quantum number is not permitted because

(i) When $n = 1$, the value of $l$ cannot be 1 since highest value assigned to $l$ is $(n - 1)$

(ii) $m = 0$ has no significance

(d) This set of quantum numbers is not permitted because when $l = 0$, the value of $m$ cannot be +1, since m is assigned values from $-l$ to $+l$.

(e) This set of quantum number is not permitted because for $n = 1$, $l$ cannot be 1, because highest value assigned to $l$ is $n - 1$.

(f) This set of quantum numbers is not permitted because for $n = 2$, $l$ cannot be 2, because highest value assigned to $l$ is $n - 1$.

(g) This set of quantum numbers is possible.