CHEMISTRY

WORKSHEET-11

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-11

(A. Physical Chemistry)

Atomic Structure

Q.1 The nucleus of an atom contains:

A) Always neutrons

B) Always protons and neutrons

C) Always protons only

D) Usually protons and neutrons

Q.2 In the modern periodic table elements are arranged in order of increasing their:

A) Mass number C) Proton number

B) Reactivity D) Density

Q.3 An atom with proton number of 19 and mass number of 40 is/has:

A) Found in the Group - IIA

B) Found in the third period

C) Same number of protons and electrons

D) Same number of protons and neutrons

Q.4 The neutron particle has:

A) A mass of 1 gram

B) A mass approximately equal to that of proton

C) A charge equal but opposite to that of electron

D) It is present in all the atoms

Q.5 Proton numbers of certain elements are given. Which represents an element which would not be in the same period as rest of the elements?

A) 3 C) 9

B) 10 D) 12

Q.6 Which of the following particles contains 20 neutrons 19 protons and 18-electrons?

A) $^{39}_{19}K^{+}$ C) $^{39}_{19}K$

B) $^{40}_{18}Ar$ D) $^{39}_{20}Ca$

Q.7 Which of the following statements is incorrect?

A) Metals have 1 – 3 valence electrons

B) Non-metals have 4 – 7 valence electrons

C) Noble gases have 2 or 8 valence electrons

D) All the elements of IIIA group are metals

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Q.8 All of the following statements are correct EXCEPT:

A) Group number is based on valence electrons

B) Period is based on number of shells involved in the electronic configuration

C) Electrons present in the inner shells are called valence electrons

D) Block of the elements in the modern Periodic table is based on partially filled atomic orbitals

Q.9 Which of the following species has maximum number of unpaired electrons?

A) Fe^{+3} C) Zn

B) Ni^{+2} D) Cu^{+}

Q.10 The lowest principal quantum number that an electron can have is:

A) 0 C) 1

B) 2 D) 3

Q.11 The relative energy of 4s, 4p and 3d orbitals are in the order of:

A) 3d < 4p < 4s C) 4s < 4p < 3d

B) 4s < 3d < 4p D) 4p < 3d < 4s

Q.12 With the increase of value of principal quantum number (n), the shape of the s-orbitals remain same although their sizes:

A) Increase

B) Decrease

C) Remain the same

D) May or may remain the same

Q.13 All of the following are applications of quantum numbers EXCEPT:

A) To find group of elements

B) To find block of elements

C) To find period of elements

D) To determine 1st ionization energy of elements

Q.14 In a multi-electron atoms, the energy of the electrons in a particular orbital is determined by:

A) n C) n + *l*

B) n + *l*, m D) n, *l*, m, s

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Q.15 **The fact that the two electrons in an atomic orbital must have opposite spin as deduced from:**

A) Hund's Rule

B) Pauli's Exclusion Principle

C) Aufbau Rule

D) Heisenberg's Uncertainty Principle

Q.16 **An atomic orbital may never be occupied by:**

A) 1 electron C) 2 electrons

B) 3 electrons D) Zero electron

Q.17 **Where in a periodic series do you find strong based formers?**

A) Inert gases C) Right

B) Middle D) Left

Q.18 **Which of the following is proper order of characteristic features of quantum numbers?**

A) Size, Shape, Orientation C) Shape, Size, Orientation

B) Orientation, Size, Shape D) Shape, Orientation, Size

Q.19 **Which of the following formula is used to determine number of electrons in a sub-shell?**

A) $2n^2$ C) $2(2l + 1)$

B) $l = n - 1$ D) $m = 2l + 1$

Q.20 **Which of the following ions have more electrons than protons and more protons than neutrons?**

A) D^{-1} C) OD^-

B) He^+ D) OH^-

Q.21 **Which of the following is correct electronic configuration of Copper (atomic number of Cu = 29)?**

A) [Ar] $3d^9, 4s^2$ C) [Kr] $3d^9, 4s^2$

B) [Ar] $3d^{10}, 4s^1$ D) [Kr] $3d^{10}, 4s^1$

Q.22 **Correct electronic configuration of potassium (atomic number K=19) is:**

A) [Ar] $4s^1$ C) [Kr] $4s^2$

B) [Ne] $4s^2$ D) [Kr] $4s^1$

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Q.23 **Which of the following atoms represent isotones?**

A) $^{12}_{6}C$, $^{13}_{6}C$, $^{14}_{6}C$

B) $^{40}_{18}Ar$, $^{40}_{20}Ca$, $^{41}_{21}Sc$

C) $^{40}_{18}Ar$, $^{42}_{20}Ca$, $^{43}_{21}Sc$

D) $^{14}_{7}N$, $^{16}_{8}O$, $^{18}_{9}F$

Q.24 **Mark the incorrect statement:**

A) Number of protons in the nucleus of an atom is called proton number and it is shown by Z

B) Sum of protons and neutrons in the nucleus of an atom is called nucleon number (mass number) and is shown by A

C) Number of neutrons = A – Z

D) Number of protons and electrons in a cation are equal

Q.25 **Properties of three fundamental particles are given in the tabular form:**

	Particles	Charge	Relative charge	Mass (kg)	Deflection under electric field
I	Proton	+1.6022 x 10^{-19}	+1	1.6726 x 10^{-27}	Deflects toward negative pole
II	Neutron	0	0	1.6705 x 10^{-27}	Undeflected
III	Electron	-1.6022 x 10^{-19}	-1	9.1095 x 10^{-31}	Deflects towards positive pole

Identify which one is not correctly matched:

A) I

B) II

C) III

D) I and II

Q.26 **Bohr's hydrogen atomic model of atom is contradicted by:**

A) Planck's quantum theory

B) Heisenberg's uncertainty principle

C) Photoelectric effect

D) Dual nature of electrons

Q.27 **Bohr's hydrogen atomic model theory is applicable for all of the following species EXCEPT:**

A) H

B) He^{+1}

C) Li^{+2}

D) Be^{+2}

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Q.28 **Which of the following statements about Bohr's hydrogen atomic model is incorrect?**

A) $r_2 - r_1 < r_3 - r_2 < r_4 - r_3$

B) $E_2 - E_1 > E_3 - E_2 > E_4 - E_3$

C) Energy of electron is directly proportional to n^2 (n = shell number)

D) According to him electrons not only revolve round the nucleus in circular orbit but also in elliptic orbit

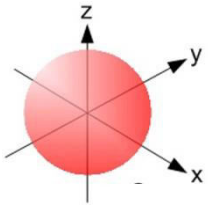
Q.29 **e/m ratio of cathode rays is _____ than that of positive rays:**

A) Greater C) Same

B) Smaller D) Greater or smaller

Q.30 **Consider the shape of orbitals:**

I.



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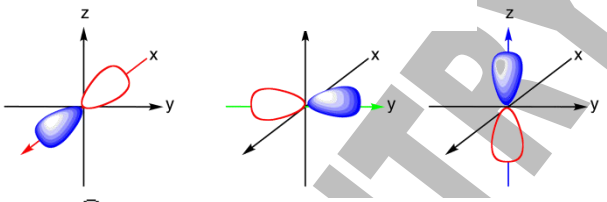

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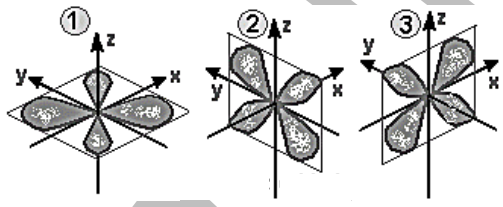

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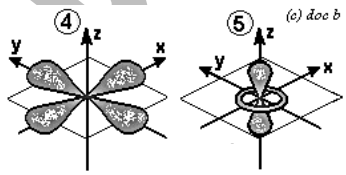

Which of the above atomic orbital has p-shaped structure?

A) I C) III

B) II D) IV

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Q.31 Which of the following statements are does not matched correctly about cathode rays and positive rays?

Opt.	Cathode rays	Positive rays
A)	They produce green fluorescence when strike with the walls of glass tube.	They produce red fluorescence when strike with the walls of glass tube.
B)	Their e/m ratio is independent from nature of gas	Their e/m ratio is depends from nature of gas
C)	On applying electric field they are deflected toward positive pole so they are negatively charged	On applying electric filed they are deflected toward negative pole so they are positively charged
D)	They cannot ionize gases	They can ionize gases

Q.32 Which of the following statement is incorrect about principal quantum number (n) it tells us about?

A) Atomic radius (r_n)
B) Energy of electron (E_n)
C) No of electrons in a shell ($2n^2$)
D) n is related with group of the periodic table

Q.33 Which of the following is correct electronic configuration of ^{20}Ca?

A) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1$
B) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$
C) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6$
D) $1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 5s^2$

Q.34 Gaseous particle X has a proton (atomic) number n and a charge of +1.
Gaseous particle Y has a proton (atomic) number of (n + 1) and is isoelectronic with (has the same number of electrons as) X.
Which of the following statements correctly describe X and Y?

A) X has a larger radius than Y
B) X requires more energy than Y when a further electron is removed from each particle
C) X releases more energy than Y when an electron is added to each particle
D) Both A and B

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Q.35 Which of the following ions contains an unpaired electron?

A) Ca^{+2} C) Zn^{+2}

B) Cu^{+2} D) K^{+}

Q.36 The electronic configuration of four elements are gives. Which of these elements has the highest first ionization energy?

A) $1s^2, 2s^2, 2p^3$

B) $1s^2, 2s^2, 2p^4$

C) $1s^2, 2s^2, 2p^6, 3s^1$

D) $1s^2, 2s^2, 2p^6, 3s^2, 3p^3$

Q.37 Which of the following formulae represents a particle with the composition 1 proton, 1 neutron and 2 electrons? (D represents deuterium, ^2H).

A) D C) H^-

B) D^- D) He

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ANSWER KEY (Worksheet-11)							
1	D	11	B	21	B	31	D
2	C	12	A	22	A	32	D
3	C	13	D	23	C	33	B
4	B	14	C	24	D	34	A
5	D	15	B	25	B	35	B
6	A	16	C	26	B	36	A
7	D	17	D	27	D	37	B
8	C	18	A	28	D		
9	A	19	C	29	A		
10	C	20	D	30	B		

ANSWERS EXPLAINED

Q.1 (D) The nucleus of an atom usually contains protons and neutrons **except hydrogen (protium)** which **does not have neutrons.** All the other elements have protons and neutrons.

Q.2 (C) In the modern periodic table elements are arranged in order of increasing proton number which is shown by Z.

Q.3 (C) The element with **proton number 19** and **mass number 20** is isotope of K. It has same number of protons and electrons.

Q.4 (B) **Neutron particle** has a mass approximately equal to that of proton as shown below.

- **Mass of neutrons = 1.6750×10^{-27} kg**
- **Mass of protons = 1.6726×10^{-27} kg**

{By comparison it is clear that mass of neutron is almost equal to that of proton}

Q.5 (D) The element having **atomic number 12** belongs to **third period** because it involves three shells in its electronic configuration such as **2, 8, 2 (K, L, M) i.e three shells.**

Q.6 (A) It has been explained in the tabular form **i.e.**

Specie	Protons	Electrons	Neutrons
$^{39}_{19}K^{+}$	19	18	20

Q.7 (D) In fact all the elements of **IIIA group** are metals **(except Boron)** which is **non-metal.**

Q.8 (C) Electrons present in the inner shells are called core electrons which are responsible for shielding effect (screening effect). This effect is responsible for the decrease in force of attraction of the nucleus for the electrons present in the valence shell.

Q.9 (A) $^{26}Fe^{+3}_{(23e^-)} = 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 3d^5.$

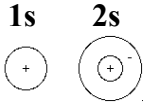
From the electronic configuration of a Fe^{+3}, it shows that there are five unpaired electrons in 3d-sub shell and it has the maximum number of unpaired electrons while others species has less number of unpaired electrons.

Q.10 (C) **Principal quantum number is shown by n. Its possible values are 1,2,3,4,5,6,7 so it is clear that it cannot be zero.**

Q.11 (B)

Name of sub-shell	n	ℓ	$n+\ell$	Order of filling of sub-shell
4s	4	0	4+0=4	4s < 3d < 4p
4p	4	1	4+1=5	
3d	3	2	3+2=5	

Q.12 (A) **With the increase n value (principal quantum number), the size of s-orbital increases whereas the shape remains the same. e.g. the size of 2s-orbital is greater than 1s-orbital**



Q.13 (D) e.g. it can be explained on the basis of electronic configuration as in nitrogen element $_7N$:

- w.r.t… n value two shells (2,5) are involved (distribution of electron in shells), it shows that N belongs to 2nd period and VA group.
- w.r.t… n + ℓ rule ($1s^2$, $2s^2$, $2p^3$) it shows that nitrogen is p-block element
- By applying Hund's rule $\left(1s^2,\ 2s^2,\ 2\overset{\uparrow}{p}_x,\ 2\overset{\uparrow}{p}_y,\ 2\overset{\uparrow}{p}_z\right)$ valency of **N = 3**
- It is clear that quantum numbers help us to determine **period, group, block, and valency** of the element but quantum numbers have no concern with ionization energy

Q.14 (C) In a multi-electron atoms, the energy of the electrons in a particular orbital is determined by n + ℓ rule, which is in accordance to Aufbau principle **which states that the electrons should be filled in the energy sub-shells in order of increasing energy values.** It can be explained with the help of following example.

Rule	3d	4s
n + ℓ	n = 3, ℓ = 2	n = 4, ℓ = 0
	n + ℓ = 3 + 2 = 5	n + ℓ = 4 + 0 = 4

Conclusion:

n + ℓ rule shows that energy of 4s sub-shell is less than that of 3d. So 4s sub-shell is preferentially filled first than that of 3d.

Q.15 (B) This principle can be stated as follows. It is impossible for two elections residing in the same atomic orbital of a poly-electrons atom to have the same values of four quantum numbers or two electrons in the same atomic orbital should have opposite spins (↑↓).

Q.16 (C) An atomic orbital may never be occupied by 3 electrons.

Q.17 (D) Strong base former are present on the left side of the periodic table i.e. Na is present in IA group on the left side and it forms stronger based former. For example, NaOH.

Q.18 (A)

n	ℓ	m
It tells about **size** of atomic orbitals	It shows **shape** of atomic orbital	It tells about **orientation** of atomic orbitals
Conclusion: So three quantum numbers n, ℓ, m depicts **size, shape and orientation.**		

Q.19 (C) This formula helps us to determine number of electrons in a sub-shell e.g.

Formula	Example
$2(2\ell+1)$	ℓ value of d-sub shell = 2 so d-sub shell has number of electrons = 2 (2 x 2 +1) =10 Electrons

Q.20 (D) It can be explained with the help of table.

Ions	Protons	Electrons	Neutrons
D^-	1	2	1
He^+	2	1	2
OD^-	9	10	9
OH^-	**9**	**10**	**8**

Q.21 (B) In 3d-series Cr and Cu show abnormal electronic configuration. General configuration of **Cr** should be **(Ar) $3d^4$, $4s^2$,** since **3d sub**-shell is near to half filled, so that is why 3d orbital snatches one electron from 4s and shows electronic configuration **(Ar) $3d^5$, $4s^1$.**

- **Similarly** general electronic configuration of **Cu** should be **(Ar) $3d^9$, $4s^2$,** since **3d sub-shell** is near to complete filled, so that is why 3d orbital snatches one electron from 4s and shows electronic configuration **(Ar) $3d^{10}$, $4s^1$. This detail is shown in tabular form**.

Elements	Electronic configuration
$_{24}Cr$	(Ar) $3d^5$, $4s^1$
$_{29}Cu$	(Ar) $3d^{10}$, $4s^1$

Q.22 (A) Detail electronic configuration of $_{19}K$ is shown as $\left(\frac{1s^2,2s^2,2p^6,3s^2,3p^6}{Ar\,(core)},4s^1\right)$ so overall shortly it can be shown as **[Ar] $4s^1$.**

Q.23 (C) $^{40}_{18}Ar, ^{42}_{20}Ca, ^{43}_{21}Sc$ are **isotones as shown in the tabular form for comparison.** $^{14}_{6}C$ **and** $^{16}_{8}O$ **are also known as isotones, because they have same number of neutrons.**

Nuclide	Protons (Z)	Mass number (A)	Neutrons (A-Z)
$^{40}_{18}Ar$	18	40	22
$^{42}_{20}Ca$	20	42	22
$^{43}_{21}Sc$	21	43	22

Q.24 (D) In any cation number of electrons is always less than that of protons. The number of protons in a neutral atom or its cation is always same.

- In a chemical reaction there is always exchange of electrons. In a cation number of electrons decreases than that of protons, because in a cation formation there is loss of electron.
- In anion the number of electrons exceeds than that of protons, because in this case atom gains electrons.

Q.25 (B) The mass of a neutron is always greater than that of a proton as shown by the value. The mass of proton is (1.6726×10^{-27}kg) and that of neutron is (1.6750×10^{-27}kg) as shown in the table.

Particles	Mass (kg)	Mass (amu)
Proton	**1.6726×10^{-27}**	**1.0073**
Neutron	**1.6750×10^{-27}**	**1.0087**

Q.26 (B) According to Bohr's theory, an electron is a material particle and its position as well as momentum can be determined with great accuracy. But with the advent of the concept of wave nature of electron, it has not been possible for us to measure simultaneously the exact position and velocity of electron. This was **suggested by Heisenberg, in 1927.** Due to above mentioned reason, Bohr's H-atomic model is contradicted by Heisenberg's uncertainty principle.

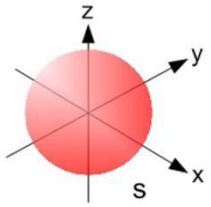
Q.27 (D) **Bohr's hydrogen atomic model theory is applicable only for single electron system. But Be^{+2} has two electrons, so for Be^{+2} ion it is not applicable.**

Q.28 (D) This was stated by **Sommerfeld in 1915** but **not** by Bohr. **Sommerfeld** suggested the moving electrons might describe in addition to the circular orbits elliptic orbits as well wherein the nucleus lies at one of the focii of the ellipse.

Q.29 (A) **e/m ratio of cathode rays is <u>greater</u> than that of positive rays.**

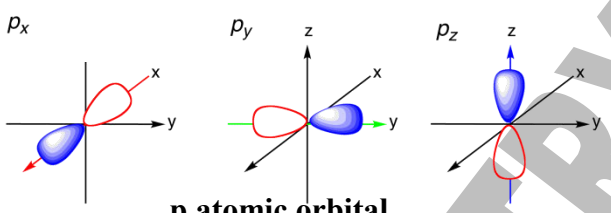
Q.30 (B) **Following are the shape of s, p and d orbitals with their shapes**

I.



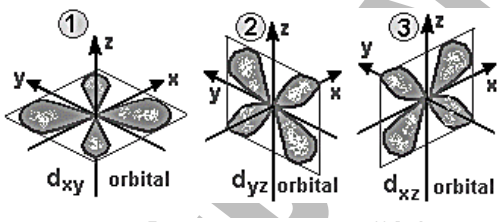
s atomic orbital

II.



p atomic orbital

III.



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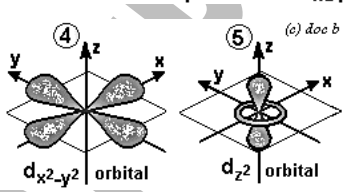

d atomic orbital

Q.31 (D) **It is incorrect statement. The correct statement is as follow:**

Opt.	Cathode rays	Positive rays
D)	They can ionize gases	They cannot ionize gases

Q.32 (D) **It is incorrect statement. The correct statement is as follow:**

n is related with period of the periodic table.

Q.33 (B) **The correct electronic configuration of ^{20}Ca is:**

$$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2$$

Q.34 (A) **Let X be $_nM^+$ (It has n – 1 number of electrons). Then Y will be $_{n+1}N^{2+}$, so that it also has n -1, number of electron.**

- **Since X has a lower nuclear charge, the electrons are more loosely bound and hence it has a larger radius.**
- **X requires less energy because it is larger and it has a lower positive cationic charge.**
- **Y releases more energy because it has a stronger attraction for electron than does X due to its smaller radius and higher cationic charge.**

Q.35 (B)

Options	Ions	Configuration
A)	Ca^{+2}	[Ar]
B)	Cu^{+2}	[Ar] $3d^9$
C)	Zn^{+2}	[Ar] $3d^{10}$
D)	K^+	[Ar]

Q.36 (A) **The first ionization energy is the highest if the atom is small and has high nuclear charge.**

- **C has the lowest $I.E_1$, because it is Group I element.**
- **Comparing A and D (both in Group V), D has a lower $I.E_1$, because it is larger with greater screening effect.**
- **Comparing A and B (both in Period 2), although B is expected to have a higher**

$I.E_1$, due to its higher nuclear charge, it has a lower $I.E_1$ than A. This is because in B, the presence of a paired electrons in one of the 2 p-orbitals creates electronic repulsion and this makes its removal easier.

Q.37 (B) The presence of only 1 proton means that the species is hydrogen (H or D). With 1 neutron, it is D. An excess of 1 electron over the proton indicates that it is D^-.

Species	Protons	Neutrons	Electrons
D	1	1	1
D^-	1	1	2
H^-	1	0	2
He	2	2	2

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