Chapter: 05

Atomic Structure

Objective

1. The charge on proton is:
   (A) $1.6022 \times 10^{+19}$C (B) 1.6022×10^{-19}C (C) 1.6022×10^{-11}C (D) 1.6022×10^{-12}C
2. The maximum number of unpaired electrons are present in:
   (A) Cr = 24 (B) Na = 11 (C) Ni = 28 (D) Fe = 26
3. Quantum number values for '3d' orbitals will be:
   (A) n = 3, l = 3 (B) n = 3, l = 0 (C) n = 3, l = 1 (D) n = 3, l = 2
4. The value of quantum number is n = 1,2,3,4,5 .... for:
   (A) azimuthal quantum number (B) spin quantum number
   (C) principal quantum number (D) magnetic quantum number
5. Among the given e/m value is maximum for:
   (A) Nitrogen (B) Helium (C) Hydrogen (D) Oxygen
6. Brackett series lie in the region:
   (A) X-Ray (B) I.R (C) U.V (D) Visible
7. The total number of Fundamental particles in an atom of Carbon - 14 is:
   (A) 20 (B) 16 (C) 14 (D) 8
8. Total number of electrons in f − orbital is:
   (A) 2 (B) 8 (C) 10 (D) 14
9. Which of the given sub-atomic particle do not show ionization?
   (A) Alpha ray (B) Electron (C) Neutron (D) Proton
10. The value of charge on electron is:
    (A) $1.602 \times 10^{+19}$C (B) 1.6023×10^{-19}C (C) 2.602×10^{19}C (D) 1.6022×10^{19}Kg
11. Quantum number value for 2S orbitals are:
    (A) n = 1, l = 0 (B) n = 2, l = 0 (C) n = 1, l = 2 (D) n = 2, l = 1
12. How many subatomic particles are thought to exist in an atom?
    (A) 100 (B) 75 (C) 50 (D) 25
13. (n + l) value for 5S orbital will be:
    (A) 3 (B) 7 (C) 10 (D) 5
14. The velocity of photon is:
    (A) Depends on its wave length (B) Independent of its wave length
    (C) Depends on its source (D) Equal to square of its amplitude
15. Neutron was discovered by:
    (A) Goldstein (B) Chadwick (C) C.D Anderson (D) Rutherford
16. Mass of electron is:

(A) 9.1095×10^{31}kg (B) 9.1095×10^{-31}kg (C) 9.1095×10^{27}kg (D) 9.1095×10^{-27}kg

17. Positive rays were discovered by:
(A) William Crooks (B) JJ. Thomson (C) Rutherford (D) E.Goldstein

18. $^{66}_{29}Cu \longrightarrow {}^{66}_{30}Zn +$ X where X is:
(A) Neutron (B) Proton (C) Electron (D) Positron

19. The e/m value for the positive rays in maximum for:
(A) Hydrogen (B) Nitrogen (C) Helium (D) Oxygen

20. The positive particle produced in the discharge tube from hydrogen gas was named proton by:
(A) Chadwick (B) Millikan (C) Goldstein (D) Rutherford

21. The nature of the positive rays depends on:
(A) The nature of the discharge tube (B) The nature of the cathode
(C) The nature of the anode (D) The nature of the residual gas

22. When α −particles strike on the nucleus of $^{9}_{4}Be$ then the emitted particle is:
(A) γ −radiations (B) Neutrino (C) Neutron (D) Proton

23. Cathode rays cause a chemical change because they have .... effect.
(A) Diffusing (B) Reducing (C) Conducting (D) Oxidizing

24. The mass of a proton is how much times more than that of an electron:
(A) 1836 (B) 8136 (C) 6138 (D) 1386

25. The velocity of photon is:
(A) equal to square of its amplitude (B) depends on its source
(C) depends on its wavelength (D) independent of its wavelength

26. Bohr's model is contradicted by:
(A) Dual nature of matter (B) Compton effect
(C) Heisenberg's uncertainty principle (D) Planck's quantum theory

27. When fast neutron carry nuclear reaction with nitrogen it ejects particles:
(A) δ (B) γ (C) β (D) α

28. The electrons in a sub shell are filled according to formula:
(A) (2l +1) (B) $2n^2$ (C) 2(2l +1) (D) None of these

29. Cathode rays can be generated at the pressure of:
(A) 0.001 torr (B) 0.01 torr (C) 0.1 torr (D) 1 torr

30. When 6d orbital is complete the entering electron goes into:
(A) 7d (B) 7s (C) 7p (D) 7d

31. Rutherford's model of atom failed because:
(A) There is actually no space between nucleus and electrons.
(B) It did not account for the stability of the atom
(C) It did not account for the attraction between proton and neutron
(D) The atom did not have a nucleus and electron

32. After filling of 4f. the entering electron goes into:
   (A) 6s (B) 5d (C) 4d (D) 6p

33. When one beta (β) particle is emitted from the nucleus of an atom is:
   (A) atomic number increases by 1 (B) atomic mass decreases by 1
   (C) atomic number decreases by 1 (D) action mass decreases by 1

34. When 5d orbital is completed then entering electron goes into:
   (A) 6p (B) 6s (C) 6f (D) 6d

35. Name the electron is given by:
   (A) Chadwick (B) William Crooks (C) Stoney (D) J.J. Thomson

36. Orbitals having equal energy are called:
   (A) Degenerate orbital (B) d-orbital (C) Molecular orbital (D) Valence orbital

37. Balmer series in hydrogen spectrum lies in the region:
   (A) Microwave (B) visible (C) Infra-red (D) Ultraviolet

38. Lyman series lies in:
   (A) U.V region (B) I.R region (C) Microwave region (D) Visible region

39. Maximum number of electrons in an orbital is:
   (A) 14 (B) 2 (C) 10 (D) 7

40. Cathode rays strike alumina and produce a colour:
   (A) Red (B) Green (C) Blue (D) Yellow

41. Bombardment of α −particles on Berylium (Be) atoms emits neutron and this process is called:
   (A) Hund's rule (B) Pauli exclusion principle
   (C) Artificial radioactivity (D) Natural radioactivity

42. The wave number of light emitted by certain source is $2 \times 10^6 m^{-1}$. The wavelength of this light will be:
   (A) 5×10^6m (B) 500nm (C) 500m (D) 200nm

43. The element which has maximum number of unpaired electron is:
   (A) Cr_{24} (B) Cu_{29} (C) Ca_{20} (D) Fe_{26}

44. In the ground state of an atom, the electron is present:
   (A) Nearest to the nucleus (B) farthest from the nucleus
   (C) in the second shell (D) In the nucleus

45. Splitting of spectral lines when atom are subjected to strong electric field is called:
   (A) photoelectric effect (B) Compton effect (C) Zeeman effect (D) Stark effect

46. De.Broglie equation is represented by:
   (A) $m = \frac{h}{\lambda v}$ (B) $m = \frac{\lambda}{hv}$ (C) $\lambda = \frac{h}{mv}$ (D) $h = \frac{\lambda}{mv}$

47. The quantum number values of 2p orbital are:
   (A) $n = 1, l = 1$ (B) $n = 2, l = 1$ (C) $n = 1, l = 2$ (D) $n = 1, l = 0$

48. (n + l) value of 6d orbital is:

Ⓐ 08 Ⓑ 11 Ⓒ 10 Ⓓ 06

49. When the azimuthal quantum number is 3 then 'm' can have:

Ⓐ 2 values Ⓑ 3 values Ⓒ 5 values Ⓓ 7 values

50. ${}^{65}_{29}Cu + {}^{1}_{0}n \longrightarrow {}^{66}_{30}Cu + X$:

Ⓐ B-rays Ⓑ hv/ γ −rays Ⓒ Electron Ⓓ Proton

Fill in the blanks

Q1: β − particles are nothing but .... moving with a very high speed.

Q2: The charge on one mole of electrons is .... coulombs.

Q3: The mass of hydrogen atom is .... grams.

Q4: The mass of one mole of electron is ....

Q5: Energy is .... when electron jumps higher to a lower orbit.

Q6: The ionization energy of hydrogen atom can be given by formula ....

Q7: For d-sub-shell, the azimuthal quantum number has a value of ....

Q8: The number of electrons is a given sub - shell is given by formula ....

Q9: The electronic configuration of H^- is ....

Answers

1.	Electrons	2.	96500 C	3.	1.66×10^{-24} g	4.	0.55 mg
5.	emitted	6.	Bohr	7.	2	8.	2 (2I + 1)
9.	$1S^2$						

Chapter : 05 Atomic Structure

Subjective

Q1: Cathode rays are negatively charged? Explain it with diagram.

Ans: *Cathode rays are negatively charged. It was proved in 1895, when J Perrin showed that when the cathode rays passed between the poles of the magnet, the path of the negatively charged particles was curved downward by magnetic field.*

In 1897, J. Thomson established their electric charge by the application of electric field, the cathode ray particle were deflected upward. As shown in figure given below.

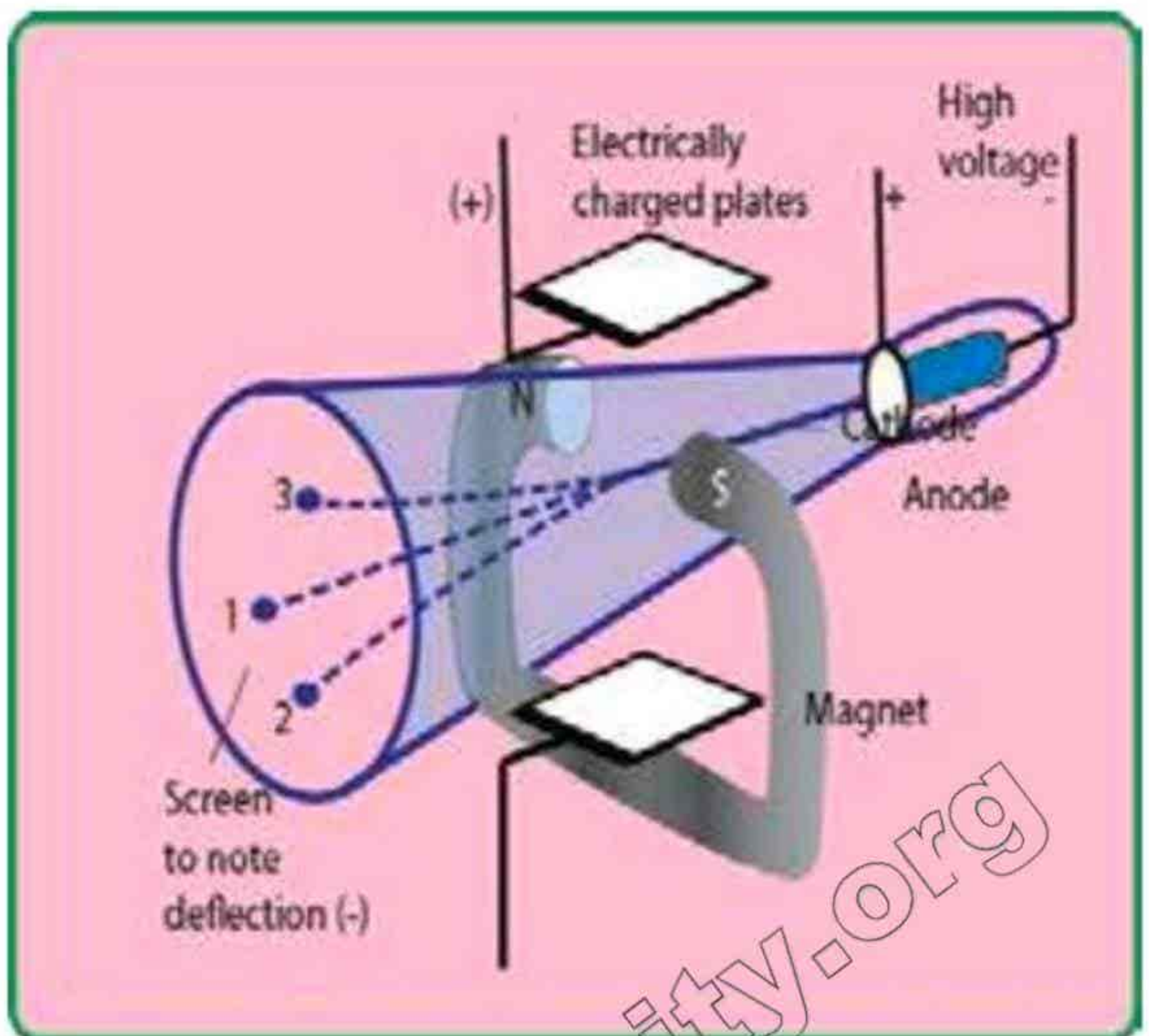


Fig Deflection of cathode rays in electric and magnetic fields

Q2: Justify that e/m value of H gas is maximum.

Ans: *Lighter the gas used in discharge tube, large the value of e/m. The positive particle obtained from hydrogen has smallest mass among all gases, so it has maximum e/m value. This particle is called proton.*

Q3: Justify that e/m value of positive rays for different gases are different but those for cathode rays, the e/m values are same.

Ans: *An e/m value of cathode rays or electrons is independent of gas of discharge tube and voltage. It means every type of substance has same type of electrons. Positive rays are produced by ionization of gas molecules.*

Different gases have different values of e/m of anode rays. The e/m ratio of anode rays depends upon the mass of the gas. Lighter gases have high e/m values for anode rays.

Q4: Cathode rays can cause a chemical change. Justify.

Ans: *Cathode rays can ionize the gases. The ionized gas molecules unite to form new substances. Thus, cathode rays can cause a chemical change.*

Q5: The e/m values of positive rays obtained from hydrogen gas is 1836 times less than that of cathode rays. Justify.

Ans: *When we use hydrogen gas in the discharge tube, the positive rays produced which consist of only one proton. The proton is 1836 times heavier than that of electron. So its e/m value is 1836 times smaller than e/m value of electron.*

Q6: How will you prove that Cathode Rays travel in Straight Lines?

Ans: *Cathode rays cast a shadow when an object is placed in their path. This proves that they travel in a straight line perpendicular to the surface of cathode.*

Q7: ***Why e/m of cathode rays is equal to that of electrons?*** **OR**
Why cathode rays are also called as electron?

Ans: *The e/m value of cathode rays shows that they are simply electrons J.J. Thomson Concluded from his experiments that cathode rays consist of stream of negatively charged particles. Stony name these particles electrons, Thomson also determined the charge to mass ratio (e/m) of electrons.*

He found that the e/m value remained the same no matter which gas was used in the discharged tube.

Q8: ***Write four properties of positive rays.***

Ans: *The four properties of positive rays are:*

- *They produce flashes on striking ZnS plate.*
- *The charge to mass ratio (e/m) for these rays is always smaller than for electrons.*
- *The e/m ratio is highest when hydrogen is present.*
- *These rays travel in a straight line in a direction opposite to the cathode rays.*

Q9: ***Whatever gas is used in the discharge tube the nature of the cathode rays remains the same, why?***

Ans: *Cathode rays are actually the electrons and electrons are fundamental particles of each type of matter. Moreover, cathode rays are emitted from surface of cathode not from gas enclosed. So it is independent of nature of gas.*

Q10: ***Why is it necessary to decrease the pressure in discharge tube to get cathode rays?***

Ans: *At ordinary pressure the number of particles of a gas is greater hence greater chances of collisions of cathode rays with them. These cannot reach the anode and conduction does not take place.*

When pressure is reduced, the number of gas particles becomes smaller collision decreases and conduction take place.

Q11: ***The positive rays are also called canal rays. Explain.*** **OR**
What are canal rays?

Ans: *Goldstein used perorated cathode in his discharge tube. These perforations are called canals. Since positive rays can pass through these canal. Hence the rays are called canal rays.*

Q12: ***Give reason for the production of positive rays.***

Ans: *Positive rays are produced by the ionization of gas inside the discharge tube. Different gases have different e/m ratio. Highest e/m ratio obtained by hydrogen gas. When high velocity electrons strike with gas molecules it split up into cation and electrons. Electron move towards anode and cation move towards cathode.*

This diagram is just for information.

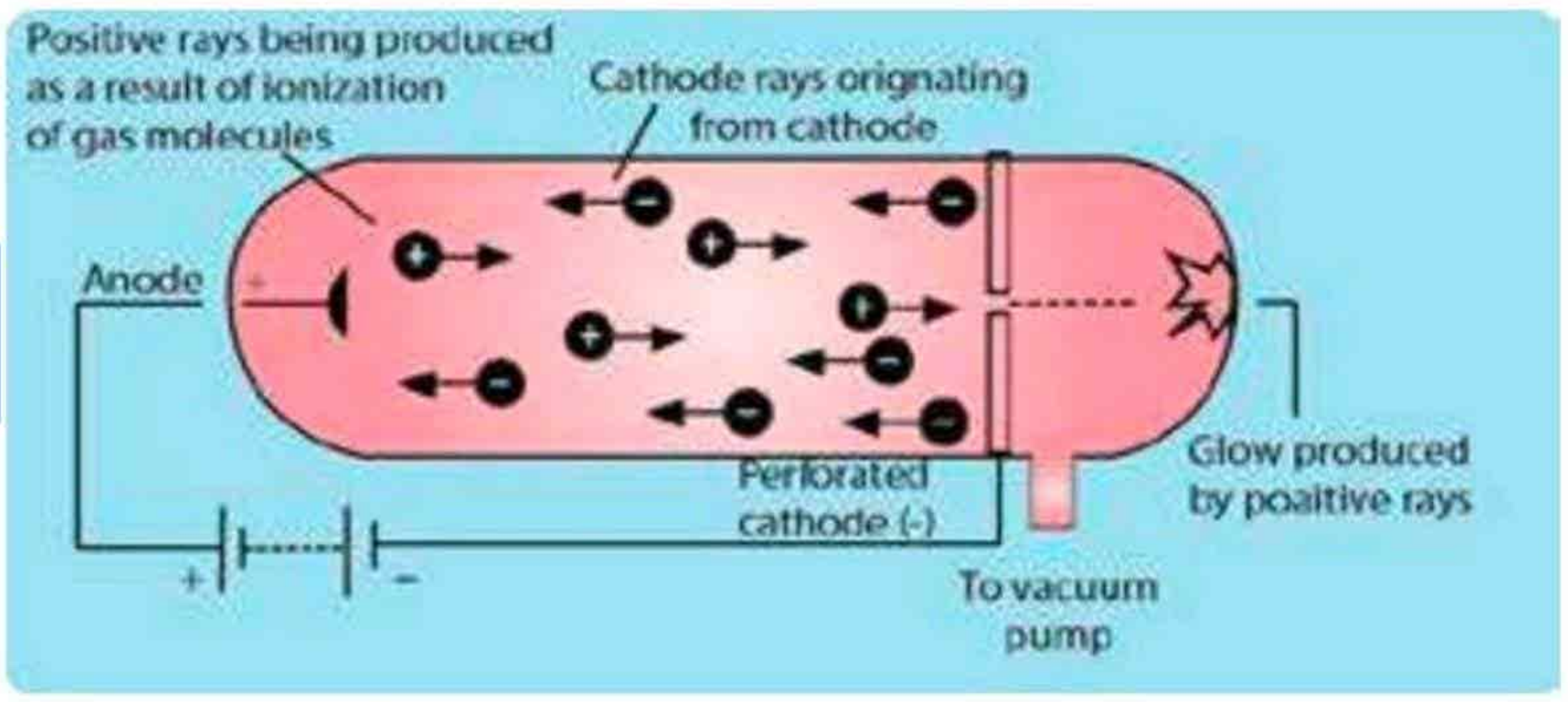


Fig Production of positive rays

Q13: *e/m value of cathode ray is just equal to that of electrons. Justify.*

Ans: *Cathode rays are actually the electrons. Therefore their e/m value is equal to electrons.*

Q14: *Evaluate the mass of an electron.* ***OR***

Calculate the mass of an electron $e/m = 1.7588 \times 10^{11}$ ***Columbs*** Kg^{-1}.

Ans: *Charge on electron* $= e = 1.6022 \times 10^{-19} C$

Charge to mass ratio $= e/m = 1.7588 \times 10^{11} C\ Kg^{-1}$

$$\frac{1.6022 \times 10^{-19} C}{\text{Mass of electron}} = 1.7588 \times 10^{11} C\ Kg^{-1}$$

$$\text{Mass of electron} = \frac{1.6022 \times 10^{-19} C}{1.7588 \times 10^{11} C\ Kg^{-1}}$$

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

Q15: *Cathode rays are charged particles.* ***OR***

How the bending of cathode rays in the electric and magnetic fields shows that they are negatively charged?

Ans: *In 1895, J Perrin showed that when the cathode rays passed between the poles of the magnet, the path of the particles was curved downward by the magnetic field.*

In 1897, J. Thomson established their electric charge by the application of electric field and the particles were deflected upwards (towards the positive plate).

The above mentioned two experiments showed that the cathode rays are negatively charged particles.

Q16: *Describe behavior of cathode rays in magnetic field.*

Ans: *Cathode rays are negatively charged. Perrin showed that cathode rays are deflected in a magnetic field perpendicular to the lines joining the two poles.*

Q17: *How it was inferred that cathode rays are material particles?*

Ans: *Cathode rays can drive a small paddle wheel placed in their path. This shows that these rays possess momentum. From this observation, it is inferred that cathode rays are not rays but material particles having a definite mass and velocity. Cathode rays are material particles and have mass* $9.1 \times 10^{-31} kg$.

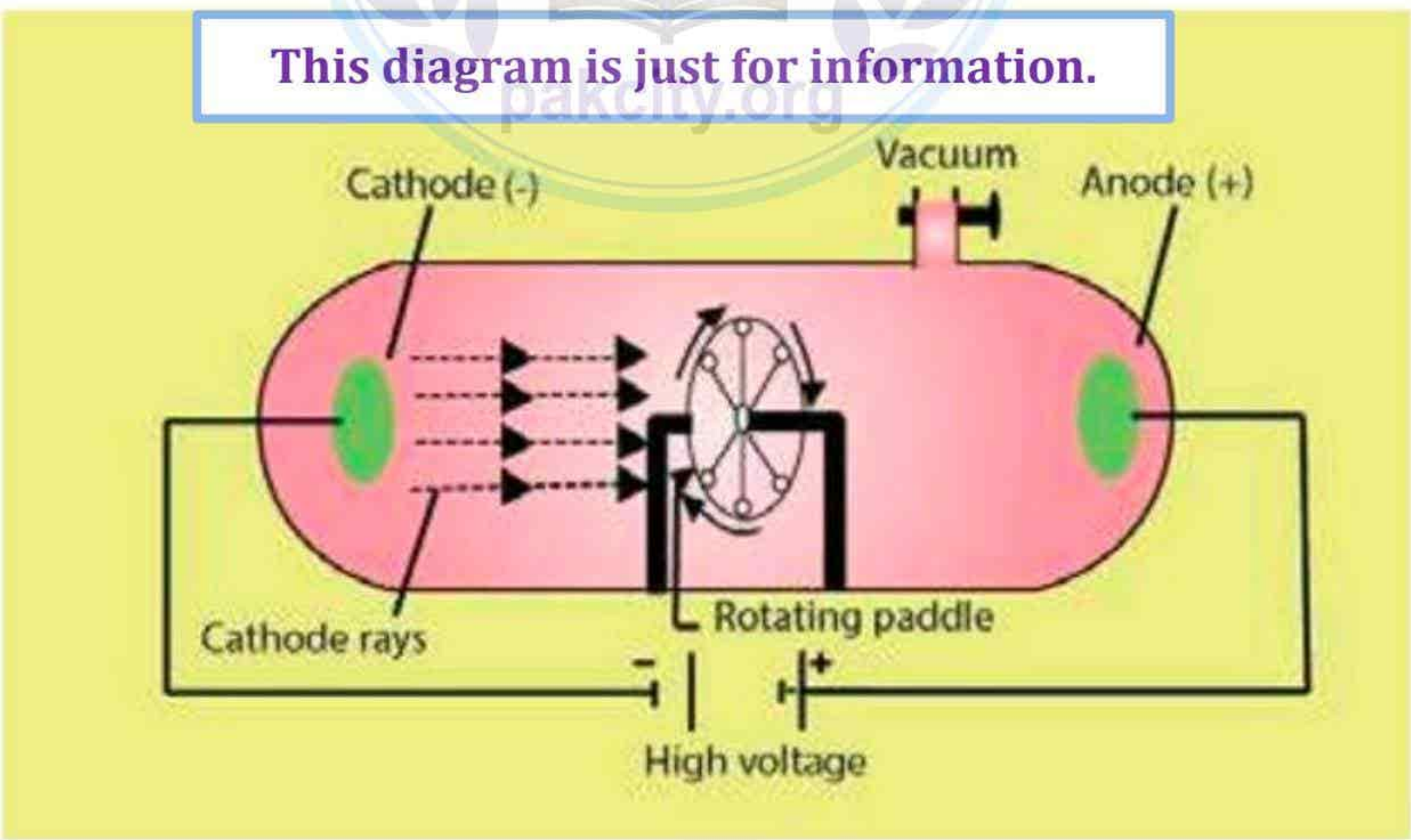


Fig cathode rays derive a sman paddle wheel

Q18: *What happens when free neutron decay?* ***OR***

Which particles are formed by the decay of free neutrons?

Ans: *Free neutron decay into proton, electron and neutrino. Neutrino has no charge and no mass.*

$$^{1}_{0}n \longrightarrow {}^{0}_{-1}e + {}^{1}_{+1}P + {}^{0}_{0}n$$

Q19: *Give any two properties of cathode rays.*

Ans: Cathode rays have following properties:

- *They produce a greenish fluorescence on striking the walls of the glass tube. These rays also produce fluorescence in rare earths and minerals. When placed in the path of these rays, alumina glows red and tin stone yellow.*
- *Cathode rays cast a shadow when an opaque object is placed in their path. This proves that they travel in straight line perpendicular to the surface of cathode.*

This diagram is just for information.

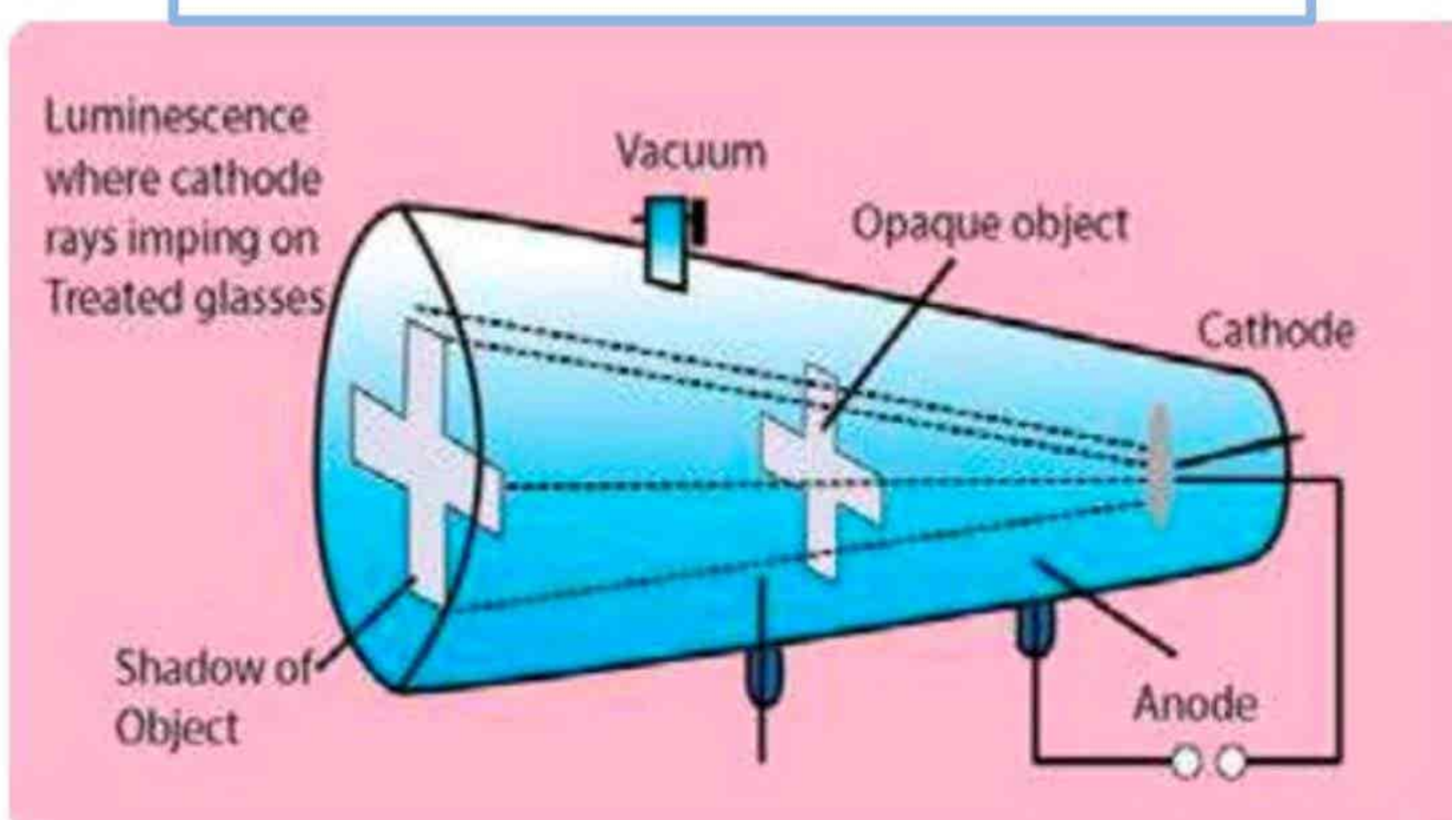


Fig Cathode rays cast a shadow of an opaque object

Q20: *Give two properties of neutrons.*

Ans: Two properties of neutrons are:

- *Neutrons cannot ionize gases.*
- *Neutrons are highly penetrating particles.*

Q21: *What are Nuclear Reactions? Write equation for a Nuclear Reaction for the production of Neutron.*

Ans: The chemical reactions involves nucleus are called nuclear reactions.

Equation for a Nuclear Reaction:

$$^{9}_{4}\text{Be} + {}^{4}_{2}\text{He} \longrightarrow {}^{12}_{6}\text{C} + {}^{1}_{0}\text{n}$$

This diagram is just for understanding.

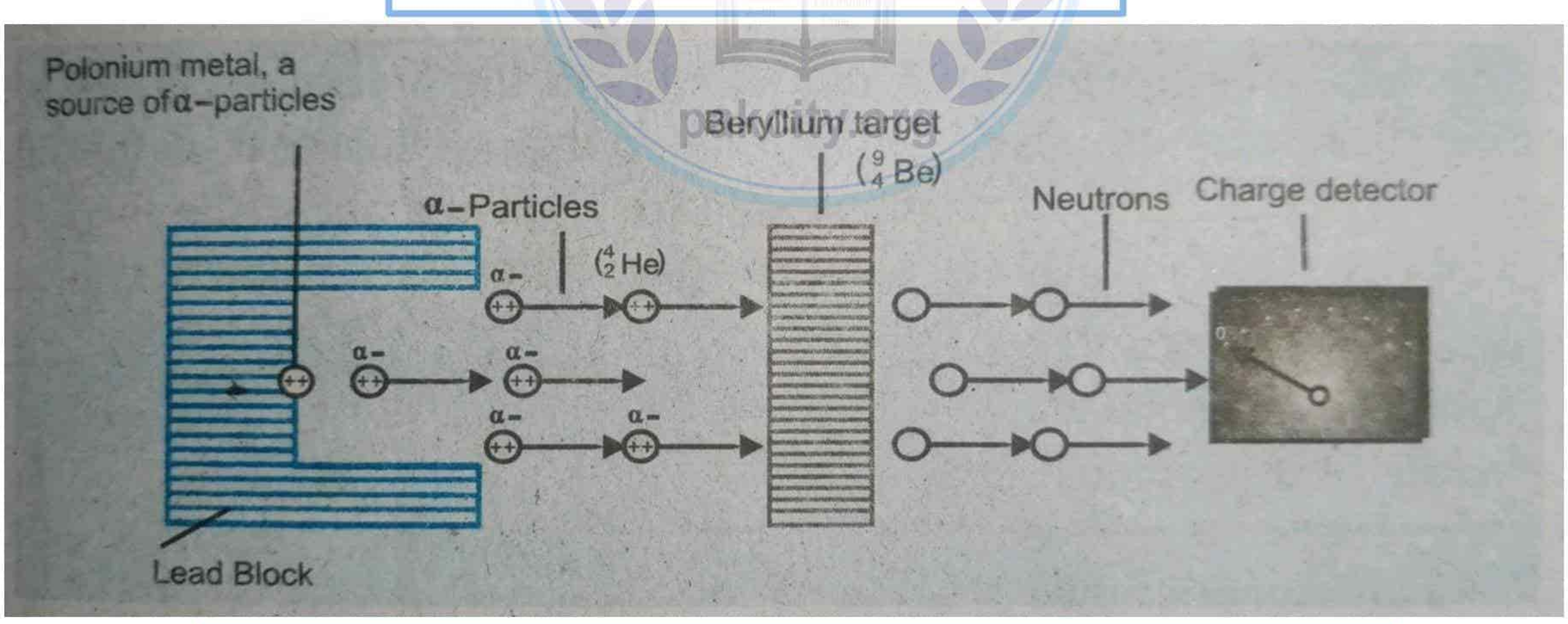


Fig. Bombardment of Be with α –particles and discovery of neutron

Q22: *How neutrons were discovered by Chadwick? Give the equation of nuclear reaction involved?*

Ans: Chadwick discovered neutron in 1932 and was awarded Nobel Prize in Physics in 1935.

A stream of α–particles produced from a polonium source was directed at beryllium $^{9}_{4}$Be target. It was noticed that some penetrating radiation were produced. These radiations were called neutrons because the charge detector showed them to be neutral.

The nuclear reaction is as follows:

$$^{9}_{4}Be + ^{4}_{2}He \longrightarrow ^{12}_{6}C + ^{1}_{0}n$$

Q23: ***Give nuclear reactions to show the radioactive decay when a slow moving neutron hits the copper metal.*** ***OR***

How $^{65}_{29}Cu$ can be converted into $^{65}_{30}Zn$?

Ans:
$$^{65}_{29}Cu + ^{1}_{0}n \longrightarrow ^{66}_{29}Cu + \gamma \text{ (radiation)}$$

$$^{66}_{29}Cu + ^{4}_{2}He \longrightarrow ^{65}_{30}Zn + ^{0}_{-1}e$$

Q24: ***How $^{14}_{7}Cu$ is converted to $^{11}_{5}B$ and give equation?***

Ans: *A fast neutron ejects α −particles from nucleus of N − atom and boron is produced.*

$$^{14}_{7}Na + ^{1}_{0}n \longrightarrow ^{11}_{5}B + ^{4}_{2}He$$

Q25: ***How neutrons are used in treatment of cancer?***

Ans: *Neutrons are highly penetrating particles. Because of their intense biological effect they are being used in treatment of cancer.*

Q26: ***Differentiated between slow and fast neutron.***

Ans: *When neutrons travel with energy* 1.2 MeV, *they are called fast neutrons but with energy below* 1eV *are called slow neutrons. Slow neutrons are usually more effective than fast ones for the fission purposes.*

Q27: ***Differentiate between frequency and wave number.***

Ans: *The difference between frequency and wave number is:*

Frequency	***Wave Number***
➢ *The number of waves which passes through a given point in one second.* ➢ *It is denoted by* v *and units* Hz.	➢ *It is the number of waves per unit distance.* ➢ *It is denoted by* $\bar{V}$. *Its units are* m^{-1} *or* cm^{-1}.

Q28: ***Prove that $E = hc\bar{V}$.***

Ans: *According to Planks Quantum theory:*

$$E \propto v$$

$$E = hv \longrightarrow (i)$$

Where
$$v = \frac{c}{\lambda} \longrightarrow (ii)$$

Putting the value of "v" in equation (i)

$$E = \frac{hc}{\lambda} \longrightarrow (iii)$$

Where
$$\bar{v} = \frac{1}{\lambda}$$

Putting the value of $\bar{v}$ *in equation (iii)*

$$E = hc\bar{v}$$

Q29: ***Give two postulates of plank's quantum theory.***

Ans: *These are the two postulates of plank's quantum theory:*

- *Energy is not emitted or absorbed continuously. Rather, it is emitted or absorbed in a discontinuous manner and in the form of wave packets. Each wave packet or quantum is associated with a definite amount of energy. In case of light the quantum of energy it often called photon.*
- *The amount of energy associated with a quantum of radiation is proportional to the frequency* (v) *of the radiation. Frequency is the number of waves passing through a point per second.*

$$E \propto v$$

$$E = hv$$

Where "h" is a constant known as Planck's constant and its value is 6.626×10^{-34}Js. *It is infect the ratio of energy and the frequency of a photon.*

Q30: *Why does the size of* He^+ *is much smaller than* H *−atom although both* H *−atom and* He^+ *ion are mono-electronic systems?*

Ans: It is because the atomic number (number of protons) is higher in Helium nad lesser in hydrogen. Radius or size of atom or ion depends inversely on its atomic number as follows;

$$r = \frac{n^2h^2\varepsilon_\circ}{\pi m Ze^2}$$

Q31: *How do you come to know that the velocities of electrons in higher orbits are less than those of lower orbits?*

Ans: As we known,

$$r = \left(\frac{Ze^2}{4\pi\varepsilon_\circ m}\right)\frac{1}{V^2}$$

Where $r = \left(\frac{Ze^2}{4\pi\varepsilon_\circ m}\right)\frac{1}{V^2}$ *is Constant*

So, $r \propto \frac{1}{V^2}$

Radius is inversely proportional to square of velocity. It means that if radius is increased than velocity is decreased and vice versa.

Q32: *The radius of first orbit of hydrogen atom is* 0.529A°. *Calculate the radius of* 3rd *orbit of hydrogen atom.*

Ans:

$$r = \frac{\varepsilon_\circ h^2}{\pi me^2} \times \frac{n^2}{Z}$$

$$Z = 1$$

$$r = 0.529A^\circ \times n^2$$

So, $r \propto n^2$

For third orbit $n = 3$

$$r = 0.529A^\circ \times (3)^2$$

$$r = 4.75A^\circ$$

Q33: *Justify that the distance gaps between different orbits go on increasing from lower to higher orbits.*

Ans: According to Bohr's model:

$$r = \frac{\varepsilon_\circ h^2}{\pi m e^2} \times \frac{n^2}{Z}$$

For H-atom $Z = 1$

$$r = 0.529 A^\circ (n)^2$$

$$r_1 = 0.529 A^\circ$$

$$r_2 = 0.529 A^\circ (2)^2 = 0.529 A^\circ (4) = 2.4 A^\circ$$

$$r_3 = 0.529 A^\circ (3)^2 = 0.529 A^\circ (9) = 4.8 A^\circ$$

$$r_4 = 0.529 A^\circ (4)^2 = 0.529 A^\circ (16) = 8.4 A^\circ$$

The orders of difference between adjacent orbits are

$$r_2 - r_1 < r_3 - r_2 < r_4 - r_3 \ldots\ldots$$

Q34: ***Why the potential energy of bonded electron has negative value?***

Ans:

$$E_{(potential)} = \frac{-Ze^2}{4\pi\varepsilon_\circ r}$$

The minus sign indicates that the potential energy of electron decreases, when it is brought from infinity to a point at a distance 'r' form the nucleus. At infinity electron is not being attracted by anything and the potential energy of the system is zero.

Q35: ***Give two defects in Rutherford's atomic model.*** **OR**
Why Rutherford's model fails?

Ans: Rutherford's model fails due to the following reasons:

- *If electron emits energy continuously, then a continuous spectrum should be formed. Actually atoms form line spectrum.*
- *A revolving electron must emit energy continuously. As a result electron will move in a spiral path and will fall into the nucleus. However it never happened.*

Q36: ***Write two postulates of Bohr's atomic model.***

Ans: Postulates of Bohr's atomic model:

- *Electrons revolve in one of the circular orbits outside the nucleus. Each orbit has fixed energy and quantum number is assigned to it.*
- *Electrons present in a particular orbit do not radiate energy. The energy is emitted or absorbed only, when an electron jumps from one orbit to another.*

Q37: ***Give two defects in Bohr's atomic model.***

Ans: These are the following defects in Bohr's atomic model:

- *The model can explain the spectrum of hydrogen and hydrogen like ions such as* He^+, Li^+, Be^{+3}, *etc. It cannot explain the spectrum of multi electron system.*
- *According to Bohr's model orbits are planar whereas motion of electrons takes place in three dimensional spaces.*
- *This theory cannot explain Zeeman and Stark Effect.*

Q38: ***Justify that angular momentum of an electron is quantized.***

Ans: According to Bohr's atomic model, electron can revolve only in those orbits with fixed value of angular momentum (mvr). *It is integral multiple of factor* $\frac{h}{2\pi}, \frac{2h}{2\pi}, \frac{3h}{2\pi}, \ldots\ldots$

The electron is bound to move in one of these orbits. So angular momentum of electron is quantized.

Q39: Differentiate between Zeeman and Stark effect.

Ans: The difference between Zeeman and Stark effect is:

Zeeman Effect	Stark Effect
The splitting of spectral lines of excited hydrogen atom into closely spaced lines in strong magnetic field is called Zeeman Effect.	The splitting of spectral line of excited hydrogen atom into closely spaced lines in an electric field is called Stark Effect.

Q40: What is Lyman series?

Ans: Lyman series:

When an electron jumps from higher orbit to n 1 Lyman series are obtained. It lies in ultraviolet region of spectrum.

Q41: Differentiate between line spectrum and continuous spectrum.

Ans: The difference between line spectrum and continuous spectrum is:

Line spectrum	Continuous spectrum
➢ It consists of dark or bright lines separated by bright or dark bands.	➢ In this spectrum, colores are diffused into each other and they are not separated.
➢ There is a sharp boundary between the colours.	➢ There is no sharp boundary between the colours.
➢ Example: Hydrogen spectrum	➢ Example: Rainbow

Q42: What is continuous spectrum? Explain with example.

Ans: Continuous spectrum:

In this type of spectrum, the boundary line between the colours cannot be marked. The colours diffuse into each other. One colour merges into another without any dark space.

Example:

The best example of continuous spectrum is rainbow.
It is obtained from the light emitted by the Sun or incandescent (electric light) solids. It is the characteristic of matter in bulk.

Q43: What is discontinuous spectrum? Explain with example.

Ans: Discontinuous spectrum:

When an element or its compound is volatilized on a flame and the light emitted is seen through a spectrometer, we see distinct lines separated by dark spaces. This type of spectrum is called line spectrum or discontinuous spectrum.

Example:

Hydrogen spectrum

Fig Atomic spectrum of hydrogen

Q44: Differentiate between atomic emission and atomic absorption spectrum.

Ans: The difference between atomic emission and atomic absorption spectrum is:

Atomic emission spectrum	Atomic absorption spectrum
➢ *In this emission bright lines are separated by dark bands.* ➢ *It is formed when the substance is in excited state.* ➢ *During its formation electrons jumps from higher to lower level.*	➢ *In this emission dark lines are separated by bright band.* ➢ *It is formed when the substance is in unexcited state.* ➢ *During its formation electrons jumps from lower to higher level.*

Q45: ***What is H_α –line in hydrogen spectrum? Which effects explain these lines?***

Ans: H_α *–line in Balmer series consists of five component lines. This is called fine structure or multiple line structure of spectrum.*

Bohr's theory cannot explain this fine structure. Splitting of lines shows that only one quantum number is not sufficient to explain the origin of spectral lines.

Q46: ***Write names of spectral series of hydrogen spectrum.***

Ans: *The spectrum series of hydrogen spectrum can be classified into five groups.*

- ➢ *Lyman series (U.V region)*
- ➢ *Balmer series (visible region)*
- ➢ *Paschen series (I.R region)*
- ➢ *Brackett series (I.R region)*
- ➢ *Pfund series (I.R region)*

Just for information.

Table Wave numbers (m^{-1}) of various series of hydrogen spectrum.

Lyman series (U.V. region)	Balmer series (Visible region)	Paschen series (I.R. region)	Brackett series (I.R. region)	Pfund series (I.R. region)
82.20×10^5	15.21×10^5 (H$_{\text{à}}$ line)	5.30×10^5	2.46×10^5	1.34×10^5
97.20×10^5	20.60×10^5 (H$_{\text{â}}$ line)	7.80×10^5	3.80×10^5	2.14×10^5
102.20×10^5	23.5×10^5 (H$_{\text{à}}$ line)	9.12×10^5	4.61×10^5	
105.20×10^5	24.35×10^5 (H$_{\text{ä}}$ line)	9.95×10^5		
106.20×10^5	25.18×10^5			
107.20×10^5				

Q47: ***What is origin of Hydrogen Spectrum?***

Ans: *According to Bohr, electrons in hydrogen atom may revolve in any orbit depending upon its energy. When hydrogen gas is subjected to an electric discharge, its electron move from one of the lower orbit to higher orbit, absorbing particular wavelength of energy.*

When it comes back, the same energy is released. This energy is observed as radiation in certain region of the emission spectrum of hydrogen gas.

Q48: ***What is electromagnetic spectrum?***

Ans: *The electromagnetic spectrum comprises the span of all electromagnetic radiation and consists of many sub-ranges, commonly referred to as portions, in addition to the visible region of the spectrum, there are seven other regions.*

Ultraviolet, X-rays, y-rays and cosmic rays are towards the lower wavelength end of the spectrum and they possess the photons with greater energies. On the other side of the visible region, there lie infrared, microwave and radio frequency regions.

Q49: ***What is atomic absorption spectrum?***

Ans: When a beam of white light is passed through a gaseous sample of an element, the element absorbs certain wavelengths while the rest of wavelengths pass through it. The spectrum of this radiation is called an atomic absorption spectrum.

The wavelengths of the radiation that have been absorbed by the element appear as dark lines and the background is bright.

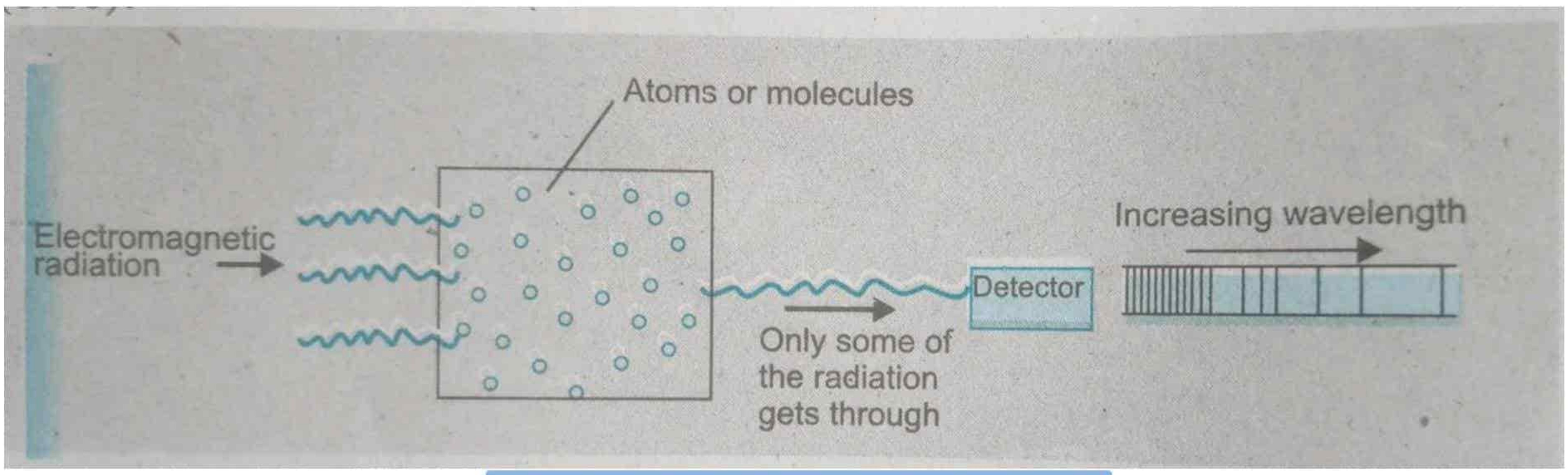


Fig. Atomic absorption spectrum

Q50: ***Describe atomic emission spectrum.***

Ans: When solids are volatilized or elements in their gaseous states are heated to high temperature or subjected to an electrical discharge, radiations of certain wavelengths are emitted. The spectrum of this radiation contained bright lines against a dark background. This is called atomic emission spectrum.

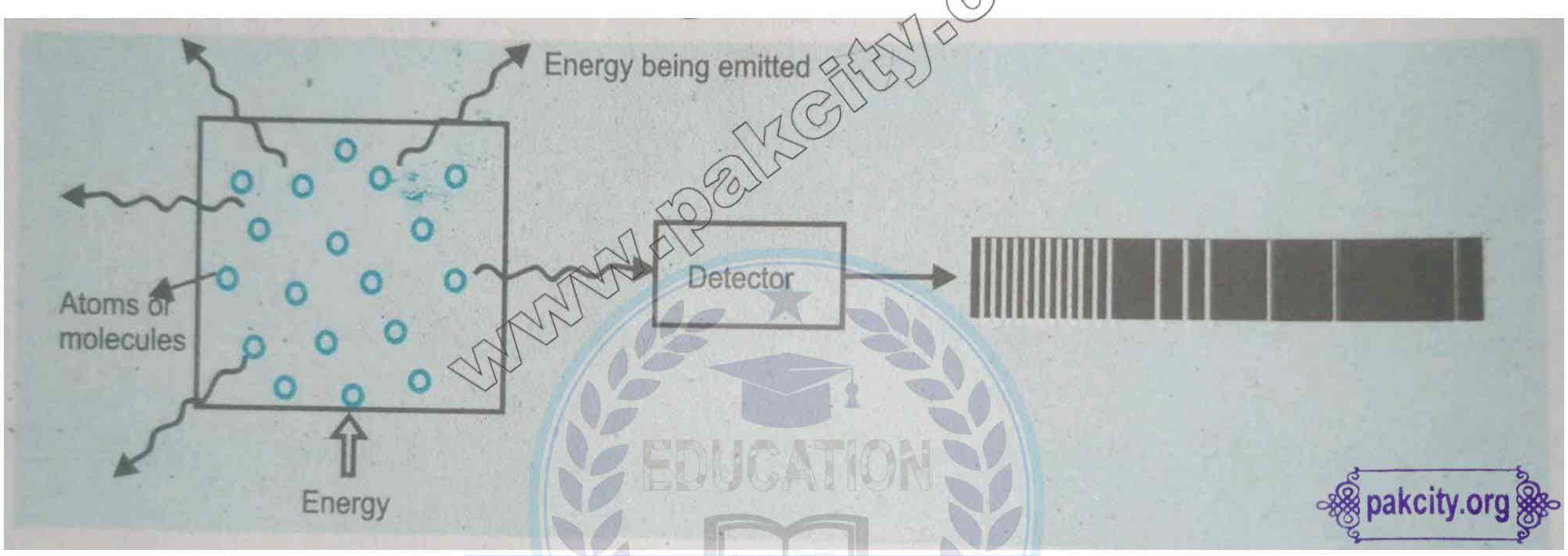


Fig. Atomic emission spectrum

Q51: ***What are X-rays? How are they produced?***

Ans: X-rays are a form of electromagnetic radiation with much shorter wavelengths and extra ordinary penetration power. When fast moving electrons strike a heavy metal anode surface in a discharge tube some highly energetic rays are produced. These are called X-rays.

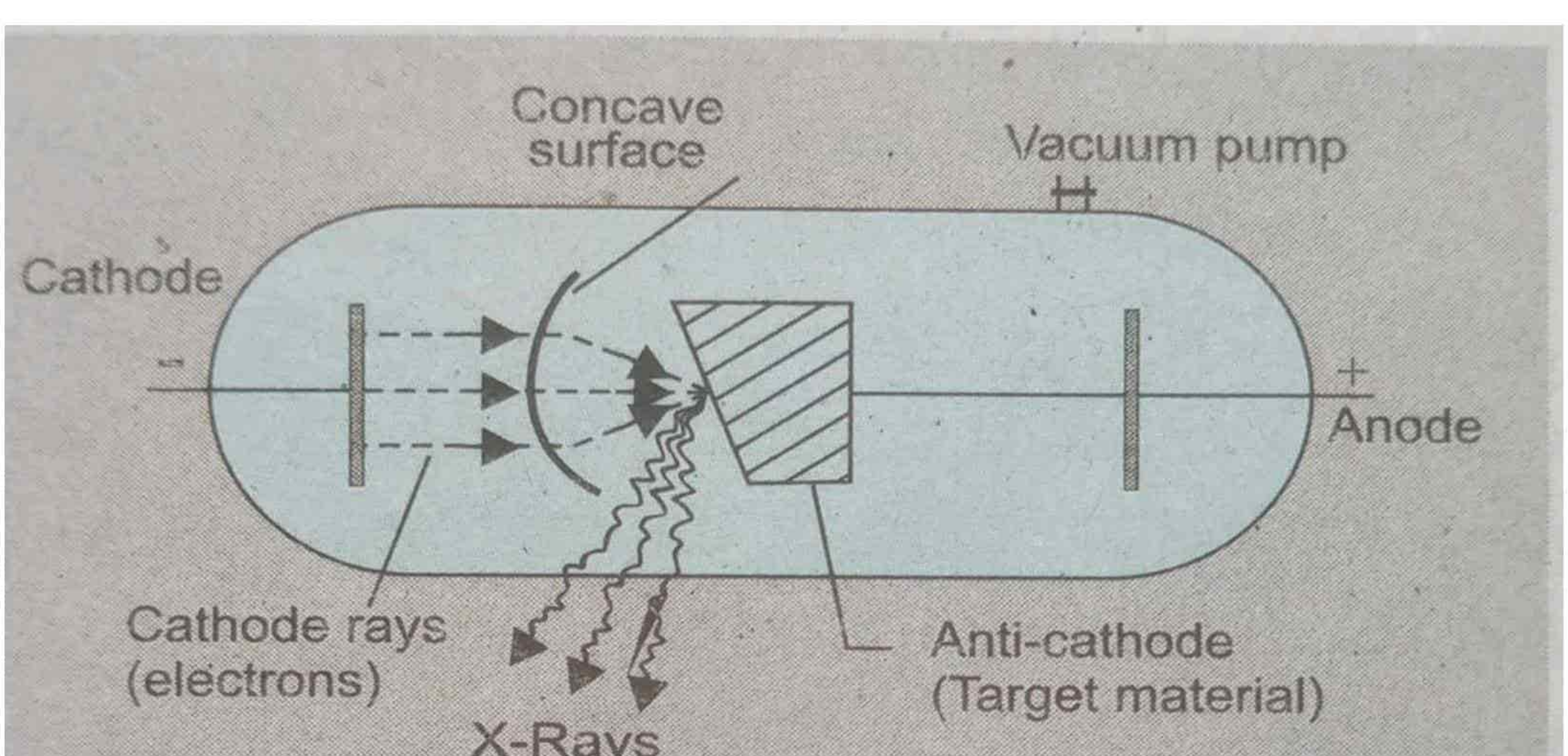


Fig. Production of X-rays

Q52: How X- rays are produced?

Ans: X-rays are produced when rapidly moving electrons collide with heavy metals anode in the discharge tube. Energy is released in the form of electromagnetic waves when the electrons are suddenly stopped.

Q53: State Moseley's law with its mathematical form and give its importance.

Ans: Moseley's law:

The frequency of a spectral line in X-ray spectrum varies as the square of atomic number of the element emitting it.

$$\sqrt{V} = a(2 - b)$$

This linear equation is called Moseley's law. 'a' is proportionality constant and 'b' is screening constant.

Importance:

Mosely arranged K and A_r, Ni and Co in a proper way in Mendeleev's periodic Table.

Q54: How the K-series, L-series and M-series of X-rays spectrum are produced?

Ans: When X-rays are passed through a slit and then through aluminum window. These are then thrown on a crystal of $K_4[Fe(CN)_6]$ which analyze the X-rays. These are diffracted from the crystal and a line spectrum of X-rays is obtained.

This is taken on photographic plate. This X-rays spectrum is characteristic of target material. This spectrum has discrete spectral lines. These lines are grouped into K-series, L-series, and M-series. Each series has various lines as $K_\alpha, K_\beta, L_\alpha, L_\beta$, …….. etc.

Q55: How Davisson and Germer proved dual nature of matter?

Ans: Two scientists Davisson and Germer proved dual nature of electrons experimentally. Electrons were produced from heated tungsten filament and accelerated by applying the potential difference through charged plates. Davisson and germer proved that the accelerated electrons undergo diffraction, like waves, when they fall on a nickel crystal. In-this ways, wave nature of electron got verified.

Q56: Derive de-Broglie's equation.

Ans: According to Planck's equation:

$$E \propto v$$

$$E = hv \longrightarrow (i)$$

According to Einstein's mass energy relationship

$$E = mc^2 \longrightarrow (ii)$$

Where 'm' is the mass of the material particle which has to convert itself into a photon, 'and c' is the velocity of photon.

Equation one values of energy;

$$hv = mc^2 \longrightarrow (iii)$$

Since $$v = \frac{c}{\lambda} \longrightarrow (iv)$$

Putting the value of "v" in equation (iii)

$$\frac{hc}{\lambda} = mc^2$$

Where $$\lambda = \frac{hc}{mc^2}$$

$$\lambda = \frac{h}{mc} \longrightarrow (v)$$

According to equation (vi), *the wavelength of photon is inversely proportional to the momentum of photon. Considering that nature is symmetrical, we apply this equation* (vi) *to the moving electron of mass 'm' and velocity V.*

So, $$\lambda = \frac{h}{mv}$$

λ = *De-Broglie's wavelength,*
m = *Mass of the particle*
v = *Velocity of electron*

Q57: *Calculate wavelength of electron moving with velocity* $2.188\times 10^{6}ms^{-1}$.

Ans: *An electron which is moving with a velocity of* $2.188\times 10^{6}ms^{-1}$ *in the first orbit of Bohr's model of hydrogen atom. Then, wavelength associating with it, can be calculated with the help of equation,*

$$\lambda = \frac{h}{mv} \longrightarrow (i)$$

As we know that,

$$h = 6.626 \times 10^{-34} JS$$
$$m_e = 9.108 \times 10^{-31} Kg$$

Putting this value in equation (i), we get

$$\lambda = \frac{6.626 \times 10^{-34} JS}{9.108 \times 10^{-31} Kg \times 2.188 \times 10^{6} ms^{-1}}$$

Since (J= kg m^2s^{-2})

$$\lambda = 0.33 \times 10^{-9} m \qquad (10^{-9}m) = 1nm$$

$$\lambda = 0.33\ nm$$

Thus $\lambda = 0.33$ nm *is the wavelength of electron moving with velocity* $2.188\times 10^{6}ms^{-1}$.

Q58: *Define frequency. Give its relationship with wavelength.*

Ans: *Frequency:*

Frequency is defined as, 'the number of waves passing through a point per second' and it is related with wavelength as,

$$v = \frac{c}{\lambda}$$

Q59: *Electron has dual nature, justify.*

Ans: *According to de-Broglie wave particle concept all matter particles like electron, proton etc in motion possess the characteristics of both the particle and a wave. This is called dual natural of matter.*

Equation:

$$\lambda = \frac{h}{mv}$$

λ *is wave length and* mv *is momentum of moving matter particle.*

Q60: *Define Heisenberg's principle of uncertainty and give its mathematical expression.*

Ans: *Heisenberg's uncertainty principle:*

It is impossible to determine simultaneously and precisely both position and momentum of a small fast moving particle e.g. electron.

$$\Delta x.\Delta p \geq \frac{h}{4\pi}$$

Q61: Define Quantum numbers.

Ans: *Schrodinger wave equation has been solved for hydrogen atom. It may have different solutions. Quantum numbers are the sets of numerical values which give the acceptable solutions to Schrodinger wave equation for hydrogen atom. An electron in an atom is completely described by its four quantum numbers.*

Q62: Compare orbit and orbital.

Ans: *The comparison of orbit with orbital is:*

Orbit	Orbital
➢ It is the circular path on which electrons revolve around the nucleus.	➢ It is the region in space in which probability of finding electron is maximum.
➢ It is two dimensional.	➢ It is three dimensional.

Q63: Calculate number of electrons in s, p, d and f orbitals according to formula.

Ans: *Number of electrons can be calculated by the formula* $2(2l+1)$, *where* l *is Azimuthal Quantum number.*

$l = 0$ *S-subshell* $2(2 \times 0 + 1) = 2$ *electrons*

$l = 1$ *P-subshell* $2(2 \times 1 + 1) = 6$ *electrons*

$l = 2$ *d-subshell* $2(2 \times 2 + 1) = 10$ *electrons*

$l = 3$ *f-subshell* $2(2 \times 3 + 1) = 14$ *electrons*

Q64: What is function of principle quantum number?

Ans: *It tells us the distance of electrons from nucleus, greater the value of "n" greater will be the distance of electron from nucleus.*
It also tells about the energy of electron in a shell.

Q65: Define azimuthal quantum number and give its importance.

Ans: *Azimuthal quantum number:*

A spectrometer of high resolving power shows that an individual line in a line spectrum of an atom is actually further divided into several fine lines. It means that a shell is further divided into sub-shells. It is denoted by (l).

Importance:

- *It determined shape of orbitals.*
- *It determined total number of sub-shells in a shell.*

Q66: What is $(n + l)$ rule for distribution of electrons?

Ans: *This is the sum of the principal quantum number and azimuthal quantum number. According to this rule, the electrons are filled in energy sub-shells in the increasing order of* $(n + l)$ *value. When two or more than two subshells have the same* $(n + l)$ *value, then that one is placed first whose n value is smaller.*
According to this rule arrangement of subshells in ascending order of their energy is 1s, 2s, 2p, 3s, 3p, 4s, 3d, *and so on.*

Q67: Define Azimuthal quantum number. Justify concept of s, p, d, and f subshells from it.

Ans: *The quantum number which is used to represent subshells is called azimuthal quantum number. It is represented by* 'l'.

A subshell may have different shapes depending upon the value of 'l'. It may be spherical, dumb bell, or some other complicated shapes.

The value of 'l' is related to the shape of the subshell as follows:

$l = 0$	*S-subshell*	*spherical*
$l = 1$	*P-subshell*	*dumb-bell*
$l = 2$	*d-subshell*	*complicated shape*
$l = 3$	*f-subshell*	*complicated shape*

Q68: ***For Azimuthal quantum number, $l = 2$ and $l = 3$. Calculate the total values of magnetic quantum number (m).***

Ans: *For a given value of* 'l' *the total values of* 'm' *are* $(2l + 1)$.

$l = 2$ *d-subshell* $m = 0, \pm1, \pm2$ *(d-subshell has five degenerate orbitals)*

$l = 3$ *f-subshell* $m = 0, \pm1, \pm2, \pm3$ *(f-subshell has seven degenerate orbitals)*

Q69: ***What is magnetic quantum number? Give its value.***

Ans: *It tells us the number of different ways in which a given s, p, d or f-subshell can be arranged along x, y and z-axes in the presence of a magnetic field. Thus, different values of 'm' for a given value of 'l' represent the total number of different space orientations for a subshell.*

For a given value of 'l' *the total values of* 'm' *are* $(2l + 1)$.

When $l = 0$ *S-subshell* $m = 0$

$l = 1$ *P-subshell* $m = 0, \pm1$ *(p-subshell has three degenerate orbitals)*

$l = 2$ *d-subshell* $m = 0, \pm1, \pm2$ *(d-subshell has five degenerate orbitals)*

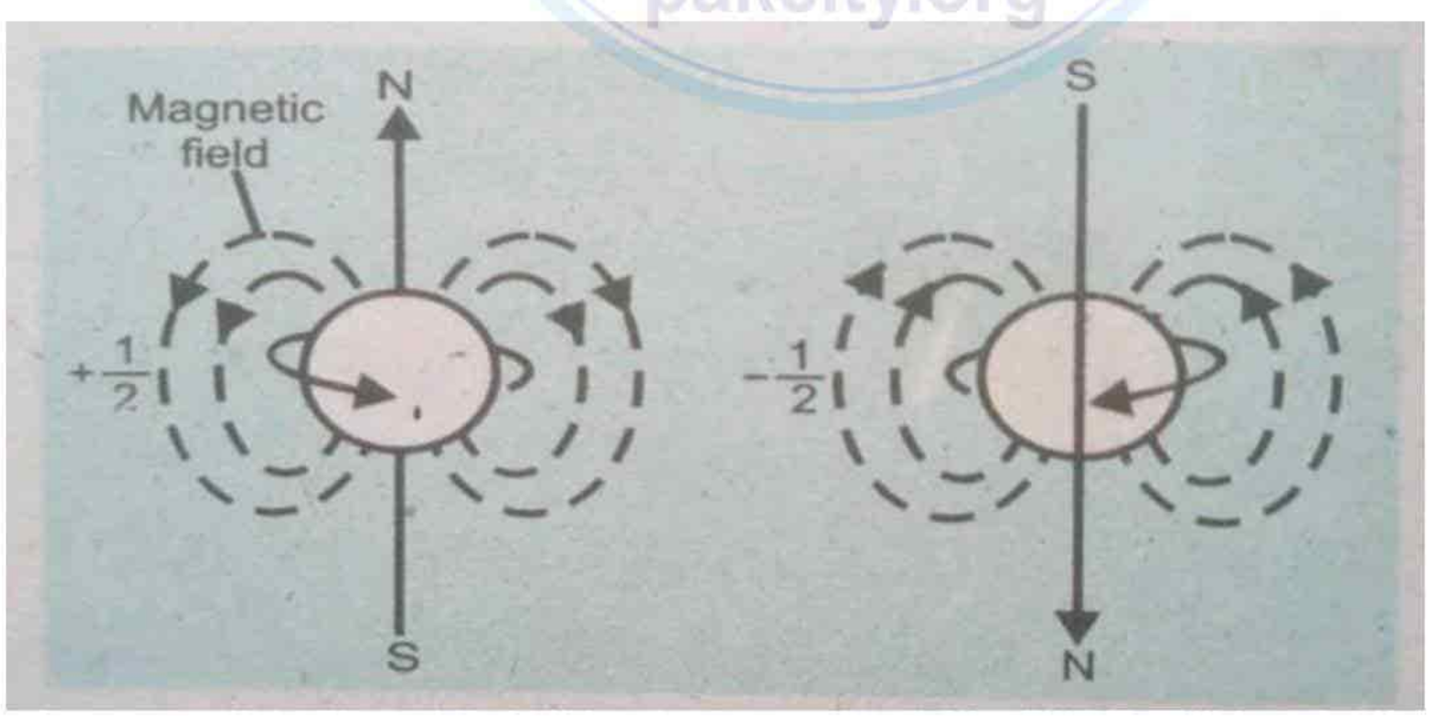
$l = 3$ *f-subshell* $m = 0, \pm1, \pm2, \pm3$ *(f-subshell has seven degenerate orbitals)*

Q70: ***What is spin quantum number? Give its two values.***

Ans: *The Spin quantum number describes the angular momentum of an electron. Electrons spin around an axis and have both angular momentum and orbital momentum. It is a fourth quantum number which describes the spin (rotation) of electron in space.*

Values:

Spin quantum number have two values i.e $+\frac{1}{2}$ *and* $-\frac{1}{2}$.



Q71: ***What is orbital?***

Ans: *Orbital:*

The electrons are moving with specific velocities in orbits of specified radi, are called orbitals.

The volume of space in which there is 95% chances of finding an electron is called atomic orbital.

The orbital can be regarded as a spread of charge surrounding the nucleus. This is often called the electron cloud.

Q72: ***The distance gaps between different orbits go on increasing from the lower to the higher orbits. Give reason.***

Ans: *The distance between the orbits goes on increasing as we move from 1st orbit to higher. Because the force of attraction between nucleus and electrons decreases as we move towards higher orbits.*

Q73: ***What is orbital? Draw the shape of p −orbital.***

Ans: *The volume of space in which there is 95% chance of finding electron is called atomic orbital.*

There are three values of magnetic quantum number for p-subshell. So, p −subshell has three orientations in space i.e. along x, y and z −axis. All the three p −orbitals namely p_x, p_y, and p_z, have dumb-bell shapes those which attain the activation energy after collision.

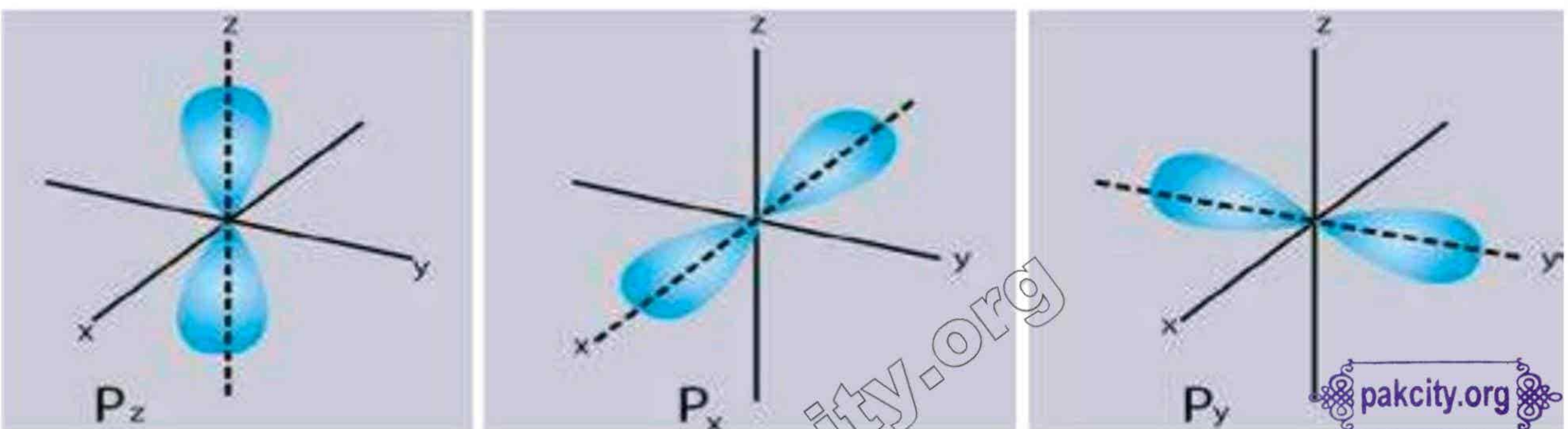


Fig Shapes of p-orbitals

Q74: ***Define Hund's Rule and Pauli Exclusion Principle.***

Ans: *Hund's Rule:*

If degenerated orbitals are available and more than one electron are to be placed in them, they should be placed in separate orbitals with the same spin rather than putting them in the same orbital with opposite spin.

Pauli Exclusion Principle:

It is impossible for two electrons residing in the same orbital of a poly-electron atom to have the same values of four quantum numbers. Or two electrons in the same orbital should have opposite spin.

Q75: ***Define: (i) Pauli-exclusion principle. (ii) Wavelength.***

Ans: *Paul-exclusion principle:*

The electrons in an orbital have opposite spin or no two electrons in the same orbital nave same set of four quantum numbers.

Wavelength:

The distance between two adjacent crests or troughs is called wavelength (λ).

Q76: ***State Hund's rule.***

Ans: *Hund's Rule:*

If degenerate orbitals are available and more than one electron are to be placed in them, they should be placed in separate orbital with same spin rather to put them in same orbital with opposite spin.

For example:

N =7 $1s^2, 2s^2, 2px^{\uparrow}, 2py^{\uparrow}, 2pz^{\uparrow}$

Q77: *State Aufbau principle. Write electronic configuration of Na − 11 according to this principle.*

Ans: *Aufbau's Principle:*

The electrons should be filled in energy subshells in order of increasing energy values. The electrons are first placed in 1s, 2s, 2p and so on.

For example:

Sadium ($_{11}Na$)

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

Q78: *Write electronic configuration for an element with atomic number Z=29.*

Ans: Z = 29:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$

Q79: *Distribution the electrons in orbitals of Cu_{29} and Br_{35}.*

Ans: Cu_{29}:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$

Br_{35}:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^5$

Q80: *Write the electronic configuration of Ca_{20}.*

Ans: Ca_{20}:

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

Q81: *Write electronic configuration of an element with atomics number Z = 24, Z = 37.*

Ans: Z = 24:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 4s^{\uparrow}, 3dxy^{\uparrow}, 3dyz^{\uparrow}, 3dzx^{\uparrow}, 3dx^2y^{2\uparrow}, 3dz^{2\uparrow}$

Z = 37:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^2, 3d^{10}, 4p^6, 5s^{\uparrow}$

Q82: *Give electronic distribution of $^{31}_{15}P$ and $^{66}_{29}Cu$.*

Ans: P = 15:

$1s^2, 2s^2, 2p^6, 3s^2, 3p_x^{\uparrow}, 3p_y^{\uparrow}, 3p_z^{\uparrow}$

Cu = 29:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$

Q83: *Distribute the electrons in orbitals of Cu_{29} and Fe_{26}.*

Ans: Cu = 29:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$

Fe = 26:

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

Q84: *Distribute electrons in the orbitals of Cu_{29} and Cr_{24}. / $\left[\frac{AP}{13}\right]$*

Ans: Cu = 29:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1, 3d^{10}$

Fe = 26:

$1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^{\uparrow}, 3dxy^{\uparrow}, 3dyz^{\uparrow}, 3dzx^{\uparrow}, 3dx^2y^{2\uparrow}, 3dz^{2\uparrow}$

Q85: *Write down electronic configuration of Mg_{12}.*

Ans: Mg_{12}:

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

Q86: ***Distribute electrons in the orbitals of*** **Cs_{55}**.

Ans: Cs_{55}:

$1s^2, 2s^2, 2s^6, 3s^2, 3p^6, 3d^{10}, 4s^2, 4p^6, 4d^{10}, 5s^2, 5p^6, 6s^1$

Q87: ***Give electronic configuration of*** **Cr_{24}**.

Ans: $Cr = 24$:

$1s^2, 2s^2, 2p^6k, 3s^2, 3p^6, 4s^1, 3d^5$

These tables are important for MCQs and Short question.

Table Arrangement of orbitals according to (n+1) rule

	n	ℓ	n + ℓ
1s	1	0	1 + 0 = 1
2s	2	0	2 + 0 = 2
2p	2	1	2 + 1 = 3
3s	3	0	3 + 0 = 3
3p	3	1	3 + 1 = 4
3d	3	2	3 + 2 = 5
4s	4	0	4 + 0 = 4
4p	4	1	4 + 1 = 5
4d	4	2	4 + 2 = 6
4f	4	3	4 + 3 = 7
5s	5	0	5 + 0 = 5
5p	5	1	5 + 1 = 6
5d	5	2	5 + 2 = 7
5f	5	3	5 + 3 = 8
6s	6	0	6 + 0 = 6
6p	6	1	6 + 1 = 7
6d	6	2	6 + 2 = 8
6f	6	3	6 + 3 = 9
7s	7	0	7 + 0 = 7

Table Electron configurations of elements

Element	Atomic number	Electron Configuration Notation
Hydrogen	1	$1\overset{\uparrow}{s}$
Helium	2	$1s^2$
Lithium	3	$1s^2 2\overset{\uparrow}{s}$
Beryllium	4	$1s^2 2s^2$

Element	Atomic number	Electron Configuration Notation
Boron	5	$1s^2 2s^2 \overset{\uparrow}{2p_x}\, \overset{0}{2p_y}\, \overset{0}{2p_z}$
Carbon	6	$1s^2 2s^2 \overset{\uparrow}{2p_x}\, \overset{\uparrow}{2p_y}\, \overset{0}{2p_z}$
Nitrogen	7	$1s^2 2s^2 \overset{\uparrow}{2p_x}\, \overset{\uparrow}{2p_y}\, \overset{\uparrow}{2p_z}$
Oxygen	8	$1s^2 2s^2 2p^2{}_x\, \overset{\uparrow}{2p_y}\, \overset{\uparrow}{2p_z}$
Fluorine	9	$1s^2 2s^2 2p^2{}_x\, 2p^2{}_y\, \overset{\uparrow}{2p_z}$
Neon	10	$1s^2 2s^2 2p^2{}_x\, 2p^2{}_y\, 2p^2{}_z$
Sodium	11	$[Ne]\, \overset{\uparrow}{3s}$
Magnesium	12	$[Ne]\, 3\overset{\uparrow\downarrow}{s}$
Aluminum	13	$[Ne]\, 3s^2\, \overset{\uparrow}{3p_x}\, \overset{0}{3p_y}\, \overset{0}{3p_z}$
Silicon	14	$[Ne]\, 3s^2\, \overset{\uparrow}{3p_x}\, \overset{\uparrow}{3p_y}\, \overset{0}{3p_z}$
Phosphorus	15	$[Ne]\, 3s^2\, \overset{\uparrow}{3p_x}\, \overset{\uparrow}{3p_y}\, \overset{\uparrow}{3p_z}$
Sulphur	16	$[Ne]\, 3s^2\, 3p^2{}_x\, \overset{\uparrow}{3p_y}\, \overset{\uparrow}{3p_z}$
Chlorine	17	$[Ne]\, 3s^2\, 3p^2{}_x\, 3p^2{}_y\, \overset{\uparrow}{3p_z}$
Argon	18	$[Ne]\, 3s^2\, 3p^2{}_x\, 3p^2{}_y\, 3p^2{}_z$
Potassium	19	$[Ar]\, \overset{\uparrow}{4s}$
Calcium	20	$[Ar]\, 4s^2$
Scandium	21	$[Ar]\, 4s^2\, \overset{\uparrow}{3d_{xy}}\, \overset{0}{3d_{yz}}\, \overset{0}{3d_{xz}}\, \overset{0}{3d_{x^2-y^2}}\, \overset{0}{3d_{z^2}}$
Titanium	22	$[Ar]\, 4s^2\, \overset{\uparrow}{3d_{xy}}\, \overset{\uparrow}{3d_{yz}}\, \overset{0}{3d_{xz}}\, \overset{0}{3d_{x^2-y^2}}\, \overset{0}{3d_{z^2}}$
Vanadium	23	$[Ar]\, 4s^2\, \overset{\uparrow}{3d_{xy}}\, \overset{\uparrow}{3d_{yz}}\, \overset{\uparrow}{3d_{xz}}\, \overset{0}{3d_{x^2-y^2}}\, \overset{0}{3d_{z^2}}$
Chromium	24	$[Ar]\, \overset{\uparrow}{4s}\, \overset{\uparrow}{3d_{xy}}\, \overset{\uparrow}{3d_{yz}}\, \overset{\uparrow}{3d_{xz}}\, \overset{\uparrow}{3d_{x^2-y^2}}\, \overset{\uparrow}{3d_{z^2}}$
Manganese	25	$[Ar]\, 4s^2\, 3d^2{}_{xy}\, \overset{\uparrow}{3d_{yz}}\, \overset{\uparrow}{3d_{xz}}\, \overset{\uparrow}{3d_{x^2-y^2}}\, \overset{\uparrow}{3d_{z^2}}$
Iron	26	$[Ar]\, 4s^2\, 3d^2{}_{xy}\, 3d^2{}_{yz}\, \overset{\uparrow}{3d_{xz}}\, \overset{\uparrow}{3d_{x^2-y^2}}\, \overset{\uparrow}{3d_{z^2}}$
Cobalt	27	$[Ar]\, 4s^2\, 3d_{xy}\, 3d_{yz}\, 3d_{xz}\, \overset{\uparrow}{3d_{x^2-y^2}}\, \overset{\uparrow}{3d_{z^2}}$
Nickel	28	$[Ar]\, 4s^2\, 3d_{xy}\, 3d_{yz}\, 3d_{xz}\, 3d_{x^2-y^2}\, \overset{\uparrow}{3d_{z^2}}$
Copper	29	$[Ar]\, \overset{\uparrow}{4s}\, 3d^2{}_{xy}\, 3d^2{}_{yz}\, 3d^2{}_{xz}\, 3d^2{}_{x^2-y^2}\, 3d^2{}_{z^2}$
Zinc	30	$[Ar]\, 4s^2\, 3d^2{}_{xy}\, 3d^2{}_{yz}\, 3d^2{}_{xz}\, 3d^2{}_{x^2-y^2}\, 3d^2{}_{z^2}$

Chapter : 05 Atomic Structure

Long Questions

Q1: *What is neutron? How was it discovered? Give its two properties?*

Q2: *Explain Born-Haber cycle in detail.*

Q3: *Discuss properties of cathode rays.*

Q4: *Describe Millikan's oil drop method for determination of charge of electron.*

Q5: *What is JJ Thomson's experiment for determining e/m value of electron?*

Q6: *Derive the formula for calculating the energy of an electron in nth orbit using Bohr's model.*

Q7: *Write defects in Rutherford's model of atom. How Bohr removed them?* OR
Explain Rutherford's Model of Atom.

Q8: *Derive the equation for radius of nth orbit of hydrogen atom using Bohr's model.* OR
Give defects of Bohr's atomic model. OR
Give postulates of Bohr's atomic model?

Q9: *What is Plank's Quantum Theory? Write its main points?* OR
Explain Planck's quantum theory of radiations and derive the relation $E = hc/\lambda$.

Q10: *Explain Heisenberg uncertainty principle.*

Q11: *What is spectrum? Differentiate between continuous spectrum and line spectrum.* OR

Q12: *Define spectrum. Explain atomic emission and atomic absorption spectrum with diagram.*

Q13: *Define quantum numbers. Explain principal and magnetic quantum numbers.* OR
Discuss magnetic and spin quantum numbers. OR
Discuss principal and Azimuthal Quantum numbers. OR
What are quantum numbers? Give importance of azimuthal quantum number.