DPP No. # A1 (JEE-MAIN)

Total Marks: 45 **Max. Time: 33 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.12 (3 marks, 2 min.) [36, 24]
Numerical Value Questions ('0' negative marking) Q.13 to Q.15 (3 marks, 3 min.) [09, 09]

1. 1 mole by definition represents same number of particles as :
(A) Number of atoms present in exactly 8 g of $^{16}_{8}O$ isotope.
(B) Number of molecules in exactly 2 g of H_2 gas.
(C) Number of atoms present in exactly 16 g of $^{16}_{8}O$ isotope.
(D) Number of atoms present in exactly 12 g of $^{12}_{6}C$ isotope.

2. The weight of a molecule of the compound $C_6H_{12}O_6$ is about :
(A) 180 g (B) 3×10^{-22} g (C) 22×10^{-23} g (D) 132 g

3. 39.4 kg of gold was recovered from a smuggler. The number of atoms of gold recovered are :
(A) 200 (B) 1.2044×10^{25} (C) 6.022×10^{25} (D) 1.2044×10^{26}

4. The charge on 1 gram of Al^{3+} ions is : (e = magnitude of electronic charge)
(A) $\frac{1}{27} N_A e$ coulomb (B) $\frac{1}{3} N_A e$ coulomb (C) $\frac{1}{9} N_A e$ coulomb (D) $3 N_A e$ coulomb

5. The number of atoms present in 0.5 g atoms of nitrogen is same as the atoms in :
(A) 24g of Mg (B) 8g of Oxygen gas (C) 32g of S (D) 12g of C

6. In which of the following pairs, do 1 g of each have an equal number of molecules ?
(A) N_2O and CO (B) N_2 and CO (C) N_2O and CO_2 (D) Both (B) and (C)

7. Total number of neutrons present in 4 g of heavy water (D_2O) is : (Where N_A represents Avogadro's number)
(A) $2.4\ N_A$ (B) $4\ N_A$ (C) $1.2\ N_A$ (D) $2\ N_A$

8. In which of the following options, the molecules are correctly matched with their atomicity?

(1)	P_4	(p)	7
(2)	HNO_3	(q)	6
(3)	N_2H_4	(r)	5
(4)	H_2SO_4	(s)	4

(A) (1 – s), (2 – r), (3 – p), (4 – q) (B) (1 – q), (2 – s), (3 – p), (4 – r)
(C) (1 – q), (2 – s), (3 – r), (4 – p) (D) (1 – s), (2 – r), (3 – q), (4 – p)

9. 124 g of P_4 will contain which of the following :
(1) 4 atoms of Phosphorus (2) $4N_A$ atoms of Phosphorus
(3) N_A molecules of Phosphorus (4) 1 molecule of Phosphorus
(A) 1 and 4 (B) 2 and 3 (C) 1 and 3 (D) 2 and 4

10. Among the following samples, select the sample which contains maximum number of atoms.
(A) 4 gm of oxygen (B) 32 gm of sulphur
(C) 108 gm of silver (D) 2 gm atoms of nitrogen

11. Which of the following has least mass?
(A) 2 gram-atom of Nitrogen (B) 3×10^{23} atoms of Carbon
(C) 1 mole of Sulphur atoms (D) 7 g of Silver

12. The number of F^- ions in 2.1g AlF_3 is $X \times 10^{23}$. Determine X ($N_A = 6 \times 10^{23}$)
(A) 1.5×10^{22} (B) 6×10^{22} (C) 3×10^{22} (D) 4.5×10^{22}

13. The mass of half mole of electrons in milligram will be: (Given: Mass of electron = 9.1×10^{-28} g)

14. The number of atoms in 4.25 g of NH_3 is $X \times 10^{23}$. Determine X? ($N_A = 6 \times 10^{23}$)

15. A gaseous mixture contains oxygen and sulphur dioxide in the ratio of 1 : 4 by mass. Therefore, the ratio of their respective number of molecules is :

DPP No. # A2 (JEE-ADVANCED)

Total Marks: 46 **Max. Time: 34 min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.4	**(3 marks, 2 min.)**	**[12, 08]**
Multiple choice objective ('–1' negative marking) Q.5 to Q.6	**(4 marks, 2 min.)**	**[08, 04]**
Comprehension ('–1' negative marking) Q.7 to Q.8	**(3 marks, 2 min.)**	**[06, 04]**
Numerical Value Questions ('0' negative marking) Q.9 to Q.11	**(3 marks, 3 min.)**	**[12, 12]**
Match the Following (no negative marking) Q.12	**(8 marks, 6 min.)**	**[08, 06]**

1. A gaseous mixture contains SO_2 & CO_2, average molecular mass of mixture may be :
(A) 64 (B) 44 (C) 54 (D) 70

2. An element is found in nature in two isotopic forms with mass numbers (A–1) and (A+3). If the average atomic mass of the element is found to be A, then the relative abundance of the heavier isotope in the nature will be :
(A) 66.6% (B) 75% (C) 25% (D) 33.3%

3. A hypothetical element Z exists in nature as two isotopes ^{65}Z and ^{67}Z with their relative abundances 25% and 75% respectively. Then, the average atomic mass (in u) of element Z is :
(A) 65.5 (B) 66 (C) 66.25 (D) 66.5

4. What is the ratio of weights of O_2 and SO_2, the mixture of which contains equal number of molecules of each gas?
(A) 1 : 8 (B) 8 : 1 (C) 1 : 2 (D) 2 : 1

5. 360 amu of Glucose ($C_6H_{12}O_6$) contains :
(A) 2 moles of glucose molecules (B) 24 hydrogen atoms
(C) 12 moles of carbon atoms (D) 2 glucose molecules

6. If 42 g of an unknown gas X occupies a volume of 125 L at 0.3 bar pressure and 300 K temperature, then the gas X could be :
(A) N_2 (B) CO_2 (C) CO (D) NO_2

Comprehension #

Consider a sample containing $(NH_4)_2Cr_2O_7$

7. Mass of nitrogen present in sample if mass of oxygen present is 11.2 g.
(A) 1.4 g (B) 2.8 g (C) 28 g (D) 14 g

8. Number of gm molecules of $(NH_4)_2Cr_2O_7$ present in the sample if mass of hydrogen obtained from the sample is 2g.
(A) 0.25 N_A (B) 0.25 (C) 0.125 N_A (D) 0.125

9. Calculate mass of carbon in 0.01 mole of $K_4[Fe(CN)_6]$. Report your answer after dividing by 0.08.

10. What is the number of gram atoms of oxygen in 6.023×10^{24} CO-molecule?

11. A gaseous mixture is composed of equal number of moles of CH_4, C_2H_6 and C_2H_2. Determine the average molecular mass of mixture (in amu).

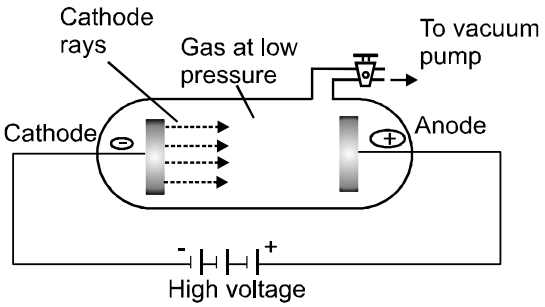
12. Match the column :

	Column-I		Column-II
A	1 mole $(NH_4)_2CO_3$	p	moles of carbon atom is less than 1
B	0.5 mole NH_2CONH_2	q	Mass of oxygen is greater than 16g in sample
C	1 mole C_6H_5N	r	at least two elements have same number of atoms in given sample
D	1 mole C_9N_6	s	Number of neutron and protons are not same.
		t	moles of nitrogen atom is greater than 1.

ChemINFO — Atomic Structure

Daily Self-Study Dosage for mastering Chemistry **I. Cathode Rays-Discovery of Electron**

In 1859, **Julius Plucker** started the study of conduction of electricity through gases at low pressure (10^{-4}atm) in a discharge tube. When a high voltage of the order of 10,000 volts or more was applied across the electrodes, some sort of invisible rays moved from the negative electrode to the positive electrode. These rays are called cathode rays.



Properties:

(i) Path of travelling is straight with a very high velocity as it produces shadow of an object placed in their path.

(ii) Cathode rays produce mechanical effects. If small light paddle wheel is placed between the electrodes, it rotates. This indicates that the cathode rays consist of material particles.

(iii) When electric and magnetic fields are applied, the rays are deflected thus establishing that they consist of charged particles. The direction of deflection showed that cathode rays consist of negatively charged particles called **electrons**. Electrons were discovered by J.J. Thomson.

(iv) They produce a green glow when strike the glass wall beyond the anode. Light is emitted when they strike the zinc sulphide screen.

(v) Cathode rays penetrate through thin sheets of aluminium and other metals, affect the photographic plates and produce heating effect when they collide with a metal objective.

(vii) Specific charge i.e. charge/mass is same (1.76×10^{11} C/kg) for all cathode rays irrespective of the gas used in the tube or the material of cathode. Thus, electrons were considered fundamental particles of matter.

Read this unseen theory & Learn it. It is not expected that this will be covered in class. Read it, understand it & then answer the following questions (1–4):

(i). Which is not true with respect to cathode rays :
(A) Cathode rays consist of fast moving electrons.
(B) For production of Cathode rays in a discharge tube, the gas filled should be at a low pressure.
(C) For production of Cathode rays in a discharge tube, the voltage applied across the electrodes should be high.
(D) None of these

(ii). Select the correct statement :
(A) Cathode rays have charge only, no mass.
(B) Cathode move with same speed as that of light.
(C) The magnitude of e/m ratio for Cathode rays is 1.76×10^{11} C/g.
(D) Cathode rays are deflected by electric and magnetic field.

(iii). The e/m ratio for cathode rays :
(A) varies with the element forming the cathode in the discharge tube.
(B) varies with the gas in the discharge tube.
(C) is constant.
(D) has the smallest value when the discharge tube is filled with hydrogen.

(iv). Cathode rays _____ penetrate through thin metal sheets and produce _____ effect when they collide with a metal object :
(A) can, cooling (B) can, heating (C) cannot, heating (D) cannot, cooling

ANSWER KEY

(i). (D) **(ii).** (D) **(iii).** (C) **(iv).** (B)

DPP No. # A3 (JEE-MAIN)

Total Marks: 45 **Max. Time: 33 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.12 (3 marks, 2 min.) [36, 24]
Numerical Value Questions ('0' negative marking) Q.13 to Q.15 (3 marks, 3 min.) [09, 09]

1. Match the following:

	Column-I		**Column-II**
	Sub-atomic particles		**Persons responsible for discovery**
(1)	Electron	(p)	James Chadwick
(2)	Anode rays	(q)	J.J. Thomson
(3)	Neutron	(r)	Rutherford
(4)	Nucleus	(s)	Goldstein

(A) (1 - q, 2 - s, 3 - r, 4 - p) (B) (1 - p, 2 - p, 3 - q, 4 - s)
(C) (1 - r, 2 - s, 3 - p, 4 - q) (D) (1 - q, 2 - s, 3 - p, 4 - r)

2. Which of the following is an arrangement of increasing value of e/m (wrt magnitude only) :
(A) $n < \alpha < p < e$ (B) $e < p < \alpha < n$ (C) $n < p < e < \alpha$ (D) $n < p < \alpha < e$

3. The ratio of the e/m values of a proton and an α-particle is.
(A) 2 : 1 (B) 1 : 1 (C) 1 : 2 (4) 1 : 4

4. Which has highest specific charge?
(A) Na^{+} (mass no. = 23) (B) Mg^{+2} (mass no. = 24)
(C) Al^{+3} (mass no. = 27) (D) Si^{+4} (mass no. = 28)

5. Rutherford's experiment, which established the nuclear model of the atom, used a beam of :
(A) β-particles, which impinged on a metal foil & got absorbed.
(B) γ-rays, which impinged on a metal foil & ejected electrons.
(C) helium atoms, which impinged on a metal foil & got scattered.
(D) helium nuclei, which impinged on a metal foil & got scattered.

6. The mass of an electron in amu is :
(A) 5.48×10^{-3} amu (B) 9.109×10^{-28} amu (C) 5.48×10^{-4} amu (D) 9.109×10^{-31} amu

7. How many moles of protons will have total charge equal to about 4825 Coulombs:
(A) 0.02 mole (B) 0.5 mole (C) 0.05 mole (D) 0.2 mole

8. Which of the following samples does not contain a total of 1.8066×10^{24} atoms :
(A) 0.375 mole of S_8 (B) 45 g of NO
(C) 24 g of Oxygen (D) 0.5 gram-molecule of ethene (C_2H_4)

9. Total number of H_2 molecules that can be obtained from all hydrogen atoms of 10 formula units of CH_3COONH_4 is :
(A) 35 N_A (B) 140 (C) 140 N_A (D) 35

10. The number of neutrons present in 7 gm of phosphonium (PH_4^+) ion is $\left|{}^{31}_{15}P, {}^{1}_{1}H\right|$:
(A) 8 N_A (B) 3.2 N_A (C) 4 N_A (D) 5 N_A

11. Total number of ions in 17.1 g $Al_2(SO_4)_3$ is [$N_A = 6 \times 10^{23}$]
(A) 1.5×10^{23} (B) 4.5×10^{23} (C) 3×10^{23} (D) 6×10^{22}

12. If 36 grams of ozone gas is replaced by an another unknown gas 'X' keeping all other parameters same and the gas 'X' weighs 24 g, then the unknown gas may be :
(A) SO_2 (B) O_2 (C) CH_4 (D) None of these

13. Cinnabar (HgS) is a prominent ore of mercury. How many grams of mercury are present in 464g of pure HgS?

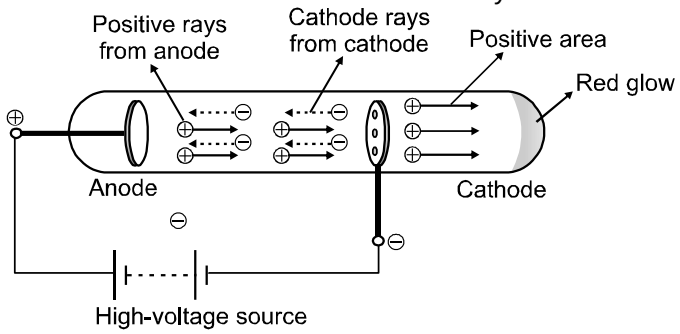
14. Sulphur exist in different allotropic forms like S_2, S_6 and S_8 etc. If equal moles of these three forms are taken in separate containers, then the simplest ratio of number of atoms present in them respectively is X, Y & Z. Find X + Y + Z ?

15. A gaseous mixture contains $SO_3(g)$ and $CH_4(g)$ in 25 : 1 ratio by mass. What is ratio of total number of atoms present in $SO_3(g)$ to total number of atoms present in $CH_4(g)$ in the mixture.

ChemINFO — Atomic Structure

Daily Self-Study Dosage for mastering Chemistry — **II. Anode Rays-Discovery of Proton**

Goldstein (1886) repeated the cathode ray experiment with a discharge tube filled with a perforated cathode and found that new type of rays came out through the hole in the cathode. When this experiment is conducted, a faint red glow is observed on the wall behind the cathode. These rays are called anode rays.



Properties :

- Anode rays travel along straight paths and hence they cast shadows of object placed in their path.
- They rotate a light paddle wheel placed in their path. This shows that anode rays are made up of material particles.
- They are deflected in magnetic field as well as towards the negative plate of an electric field. This shows that these rays are positively charged.
- For different gases used in the discharge tube, the specic charge of the positive particles constituting the positive rays is different. When hydrogen gas is taken in the discharge tube, the q/m value obtained for the positive rays is found to be maximum. Since the value of charge (q) on the positive particle obtained from different gases is the same, the value of m must be minimum for the positive particles obtained from hydrogen gas. Thus, the positive particle obtained from hydrogen gas is the lightest among all the positive particles obtained from different gases. This particle is called the proton (H^+) and is also considered a fundamental particle of matter.

Read this unseen theory & Learn it. It is not expected that this will be covered in class. Read it, understand it & then answer the following questions (5–8):

(i). Which of the following statements is/are INCORRECT regarding anode rays :
(A) Anode rays consist of fast moving protons.
(B) Anode rays are produced by the ejection of protons from the anode material.
(C) Both (A) & (B)
(D) None of these.

(ii). Select the correct statement(s) :
(A) Anode rays have charge as well as mass.
(B) Anode rays are deflected by electric and magnetic field.
(C) Anode rays are also known as Positive rays or Canal rays.
(D) All of these.

(iii). The e/m ratio for Anode rays :
(A) varies with the element forming the anode in the discharge tube.
(B) varies with the gas in the discharge tube.
(C) is constant.
(D) Both (A) & (B).

(iv). The highest value for e/m for anode rays has been observed when the discharge tube is filled with _____ gas:
(A) nitrogen (B) oxygen (C) hydrogen (D) helium

ANSWER KEY

(i). (C) **(ii).** (D) **(iii).** (B) **(iv).** (C)

DPP No. # A4 (JEE-ADVANCED)

Total Marks: 41 **Max. Time: 30 min.**

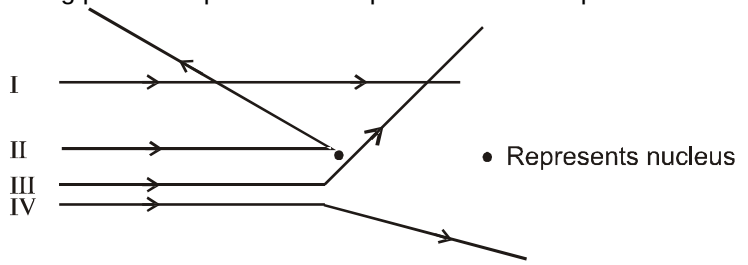
Single choice Objective ('–1' negative marking) Q.1	**(3 marks, 2 min.)**	**[03, 02]**
Multiple choice objective ('–1' negative marking) Q.2 to Q.4	**(4 marks, 2 min.)**	**[12, 06]**
Comprehension ('–1' negative marking) Q.5 to Q.6	**(3 marks, 2 min.)**	**[06, 04]**
Numerical Value Questions ('0' negative marking) Q.7 to Q.10	**(3 marks, 3 min.)**	**[12, 12]**
Match the Following (no negative marking) Q.11	**(8 marks, 6 min.)**	**[08, 06]**

1. α-particles are projected towards the following metals, with the same kinetic energy. Towards which metal, the distance of closest approach is minimum?
(A) Cu(Z = 29) (B) Ag(Z = 47) (C) Au(Z = 79) (D) Ca(Z = 20)

2. Which of the following pairs has different values of e/m :
(A) A proton and a neutron (B) A proton and a Deuterium nucleus
(C) A Deuterium nucleus and an α-particle (D) An electron and α-particle

3. As an electron (at rest) is brought towards a proton from infinity, its :
(A) Potential energy increases (B) Potential energy decreases
(C) Kinetic energy increases (D) Total energy remains constant

4. Which of the following path of α–particle is/are possible in the α -particle scattering experiment ?

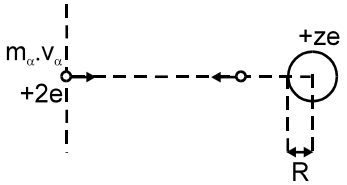


(A) I (B) II (C) III (D) IV

Comprehension

Rutherford model :

The approximate size of the nucleus can be calculated by using energy conservation theorem in Rutherford's α-scattering experiment. If an α-particle is projected from infinity with speed v, towards the nucleus having Z protons, then the α-particle which is reflected back or which is deflected by 180^0 must have approached closest to the nucleus. It can be approximated that α-particle collides with the nucleus and gets back. Now, if we apply the energy conservation equation at initial point and collision point, then :



$(\text{Total Energy})_{\text{initial}} = (\text{Total Energy})_{\text{final}}$

$(K.E.)_i + (P.E.)_i = (K.E.)_f + (P.E.)_f$

$(P.E.)_i = 0$, since P.E. of two charge system separated by infinite distance is zero. Finally the particle stops and then starts coming back.

$$\frac{1}{2}m_\alpha v_\alpha^2 + 0 = 0 + \frac{Kq_1q_2}{R} \quad \Rightarrow \quad \frac{1}{2}m_\alpha v_\alpha^2 = K\frac{2e \times Ze}{R} \quad \Rightarrow \quad R = \frac{4KZe^2}{m_\alpha v_\alpha^{\,2}}$$

Thus the radius of nucleus can be calculated using above equation. The nucleus is so small a particle that we can't define a sharp boundary for it.

5. An α-particle with initial speed v_0 is projected from infinity and it approaches up to r_0 distance from a nuclie. Then, the initial speed of α-particle, which approaches upto $2r_0$ distance from the nucleus, is:

(A) $\sqrt{2}\,v_0$ (B) $\frac{v_0}{\sqrt{2}}$ (C) $2v_0$ (D) $\frac{v_0}{2}$

6. Radius of a particular nucleus is calculated by the projection of α-particle from infinity at a particular speed. Let this radius is the true radius. If the radius calculation for the same nucleus is made by another α-particle with half of the earlier speed, then the percentage error involved in the radius calculation is :
(A) 75% (B) 100% (C) 300% (D) 400%

7. If the diameter of two different nuclei are in the ratio 2 : 1,then calculate the ratio of their mass number :

8. For a broadcasted electromagnetic wave having frequency of 1200 KHz, calculate number of waves that will be formed in 2 km distance.

9. Calculate the ratio of the energy of a photon of wavelength 3000 Å to that of a photon of wavelength 6000Å respectively.

10. If the frequency of violet radiation is 7.5×10^{14} Hz, then the value of wavenumber in m^{-1} for it is $p \times 10^5$. Give the value of p?

11. **Match the column:**

	Column-I		**Column-II**
(A)	44 g of CO_2	(p)	6.02×10^{23} atoms of carbon
(B)	3.01×10^{23} molecules of N_2O	(q)	1 gm atoms of nitrogen
(C)	1 gm molecule of NO_2	(r)	32 g of oxygen
(D)	22.4 L of C_2H_4 at 1 atm 546 K	(s)	18.06×10^{23} total atoms
		(t)	Total number of protons & neutrons is same

DPP No. # A5 (JEE-ADVANCED)

Total Marks: 44 **Max. Time: 30 min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.6	**(3 marks, 2 min.)**	**[18, 12]**
Multiple choice objective ('–1' negative marking) Q.7 to Q.9	**(4 marks, 2 min.)**	**[12, 06]**
Numerical Value Questions ('0' negative marking) Q.10 to Q.11	**(3 marks, 3 min.)**	**[06, 06]**
Match the Following (no negative marking) Q.12	**(8 marks, 6 min.)**	**[08, 06]**

1. Volume at STP of 0.22 g of CO_2 is same as that of :
(A) 0.01 g of hydrogen (B) 0.085 g of NH_3
(C) 320 mg of gaseous SO_2 (D) All the above

2. Which of the following is incorrect about a sample of 11.2L CH_4 gas at STP :
(A) Number of molecules in the sample are 3.01×10^{23}
(B) Weight of 11.2L of CH_4(g) at STP is 8 g.
(C) Number of atoms in the sample are 15.05×10^{22}
(D) None of these

3. Boron has two isotopes, B–10 and B–11. The average atomic mass of boron is found to be 10.80 u. Predict the percentage of abundance of these elements respectively.
(A) B–10 = 80% ; B–11 = 20% (B) B–10 = 40% ; B–11 = 60%
(C) B–10 = 20% ; B–11 = 80% (D) B–10 = 70% ; B–11 = 30%

4. Rutherford's experiment, which established the nuclear model of the atom, used a beam of :
(A) β-particles, which impinged on a metal foil & got absorbed.
(B) γ-rays, which impinged on a metal foil & ejected electrons.
(C) helium atoms, which impinged on a metal foil & got scattered.
(D) helium nuclei, which impinged on a metal foil & got scattered.

5. Four different containers contain four different gases with following parameters:

Container	Volume	Pressure	Temperature	Gas	Molar Mass
A	44.8 L	101325 N/m^2	273 K	W	10
B	22.4L	1 bar	546 K	X	20
C	11.2 L	1520 mm Hg	0°C	Y	40
D	5.6 L	1 bar	–136.5°C	Z	60

Now they are mixed in a single container, then which of following option is correct.
(A) Mole % of gas X and gas Z are same. (B) Average molar mass of final mixture is 25.
(C) Mole ratio of gas W and gas Z is 4 : 1 (D) All are correct.

6. A photon of 300 nm is absorbed by a gas and then, it re-emits two photons and attains the same initial energy level. One re-emitted photon has wavelength 500 nm. Calculate the wavelength of other photon re-emitted out:
(A) 450 nm (B) 800 nm (C) 200 nm (D) 750 nm

7. Three different containers contain three different gases with following parameter.
Container 1 of 67.2 L containing gas X at 0^0C and 1.01325 bar
Container 2 of 44.8 L contaning gas Y at 546 K & 760 mm of Hg
Container 3 of 89.6 L containing Z gas at 101325 N/m^2 & 0^0C.
Now they are mixed in single container. If gram molecular mass of X, Y & Z are 10 g/mol, 20 g/mol and 40 g/mol respectively. Then which of the following statements are correct
(A) Mole percent of gas Z in final mixture is 50%
(B) Average molecular mass of final mixture is 26.25 amu.
(C) Mole ratio of gas X and gas Z is 3 : 4
(D) Number of molecules present in final mixture is equal to number of atoms in 320 g Ca.

8. Identify the correct statement(s) :
(A) Cathode rays produce heating effect when they collide with a metal object.
(B) Anode rays consist of fast moving protons.
(C) For production of Cathode rays in a discharge tube, the gas filled should be at a very high pressure.
(D) The magnitude of e/m ratio for Cathode rays is 1.76×10^{11} C/Kg.

9. Select the correct statement:
(A) Orthosilicate ion (SiO_4^{4-}) and Perchlorate ion (ClO_4^-) are isoelectronic species.
(B) According to Rutherford formula, volume of a nucleus is directly proportional to mass number of nucleus.
(C) Isotopes have different number of nucleons in them.
(D) All atoms of Ar, K and Ca are isobars of each other.

10. What change in molar energy (in J) would be associated with an atomic transition giving rise to a radiation of 1 Hz frequency: ($h = 6.6 \times 10^{-34}$ Js). Report your answer after multiplying by 10^{10}.

11. For a wave, frequency is 10 Hz and wavelength is 2.5 m. How much linear distance (in km) will it travel in 40 seconds?

12. Match the following: (Mass numbers: H = 1, C = 12, N = 14, O = 16)

	Column-I		**Column-II**
(A)	CH_4	(p)	Species contain a total of 10 electrons.
(B)	NO^+	(q)	Total number of protons is greater than or equal to 13.
(C)	CN^-	(r)	Total number of neutrons is less than or equal to 9.
(D)	H_2O	(s)	Species is isoelectronic with CO.

ChemINFO — Atomic Structure

Daily Self-Study Dosage for mastering Chemistry **III. Rutherford scattering formula**

The scattering of alpha particles from nuclei can be modeled from the coulomb force and treated as an orbit. The scattering process can be treated statistically in terms of the cross section for interaction with a nucleus, which is considered to be a point charge Ze. For a detector at specific angle with respect to the incident beam, the number of particles per unit area striking the detector N(θ) is given by the Rutherford formula :

$$N(\theta) = \frac{N_i n t Z^2 k^2 e^4}{4r^2 K E^2 \sin^4(\theta/2)}$$

N_i = Number of incident alpha particles
n = Atoms per unit volume, in target
t = Thickness of target
Z = Atomic number of target
e = Electronic charge
K = Coulomb's constant
r = Target-to-detector distance
KE = Kinetic energy of alpha particle
θ = Scattering angle

PE = Potential energy

In general, $N(\theta) \propto \frac{1}{\sin^4\frac{\theta}{2}} \propto \text{cosec}^4\frac{\theta}{2}$

$N(\theta) \propto t$

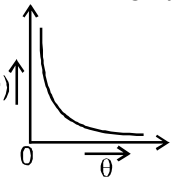
$N(\theta) \propto \frac{1}{KE^2}$

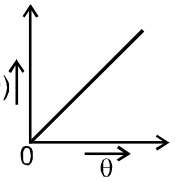
Ex. In Rutherford formula, the number of α-particles showing scattering is minimum when θ is :
(A) 90º (B) 45º (C) 60º (D) 180º

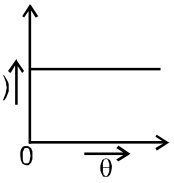
Sol. $N(\theta) \propto \frac{1}{\sin^4\frac{\theta}{2}} \propto \text{cosec}^4\frac{\theta}{2}$

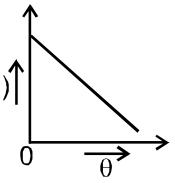
Read & understand this theory as soon as you get the DPP. Then answer the following questions using above theory. You don't need to memorize the above theory.

(i). Select the correct graph :

(A) 

(B) 

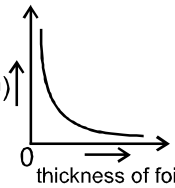
(C) 

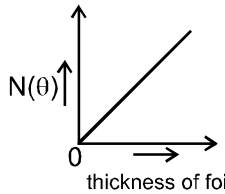
(D) 

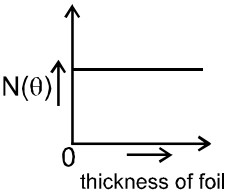
(ii). In Rutherford experiment, minimum number of α-particles will be deflected on using the thin foil of same thickness of which of the following metals?
(A) Ag (B) Au (C) Pt (D) Al

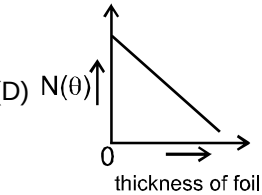
(iii). In Rutherford formula, maximum number of α-particles deflecting is for which among the following angles θ :
(A) 30º (B) 45º (C) 60º (D) 90º

(iv). Select the correct graph :

(A) 

(B) 

(C) 

(D) 

ANSWER KEY

(i). (A) **(ii).** (D) **(iii).** (A) **(iv).** (B)

DPP No. # A6 (JEE-MAIN)

Total Marks: 45 **Max. Time: 33 min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.12	**(3 marks, 2 min.)**	**[36, 24]**
Numerical Value Questions ('0' negative marking) Q.13 to Q.15	**(3 marks, 3 min.)**	**[09, 09]**

1. Which of the following is correct statement?
(A) The ratio of e/m value for H^+ & He^+ is 1 : 2. (B) The ratio of e/m value for He^+ & Li^{2+} is 7 : 8.
(C) The ratio of e/m value for Li^{2+} & Be^{3+} is 9 : 8. (D) The ratio of e/m value for ${}_1^1H^+$ & ${}_1^2H^+$ is 1 : 2.

2. Photon of which light has minimum energy :
(A) green (B) blue (C) violet (D) red

3. Visible spectrum contains light of following colours "Violet - Indigo - Blue - Green - Yellow - Orange - Red" (VIBGYOR).
Its frequency ranges from Violet (7.5×10^{14} Hz) to Red (4×10^{14} Hz). Find out the maximum wavelength in this range :
(A) 400 Å (B) 750 Å (C) 4000 Å (D) 7500 Å

4. The work function for a metal is 4 eV. To eject a photoelectron of zero velocity from the surface of the metal, the wavelength of incident light should be below :
(A) 310 Å (B) 1550 Å (C) 155 Å (D) 3100 Å

5. The energies E_1 and E_2 of two electronic radiations are 25 eV per electron and 50 eV per electron respectively. The relation between their de-broglie wavelengths i.e. λ_1 and λ_2 will be :
(A) $\lambda_1 = \sqrt{2}\,\lambda_2$ (B) $\lambda_1 = 2\lambda_2$ (C) $\lambda_1 = 4\lambda_2$ (D) $\lambda_1 = \frac{1}{2}\,\lambda_2$

6. Which of the following statements is correct :
(A) Observations like Photoelectric effect and Blackbody radiations could not be explained by particle nature of electromagnetic radiations.
(B) UV rays and IR rays have the same frequency.
(C) Bohr's model is not valid for Li^+ ion.
(D) None of these

7. For which of the following species, Bohr model is not valid :
(A) He^+ (B) H (C) Li^{2+} (D) H^+

8. If radius of third stationary orbit (in Bohr's atom) is R. Then radius of fourth orbit will be:
(A) R/5 (B) 9R (C) 9R/16 (D) 16R/9

9. If the radius of the first Bohr orbit of the H atom is r, then for Li^{2+} ion, it will be :
(A) 3r (B) 9r (C) r/3 (D) r/9

10. The value of R will be maximum for which of the following gases :
(A) H_2 (B) N_2
(C) O_2 (D) It has the same value for all gases.

11. Volume occupied by an ideal gas at one atmospheric pressure and 0°C is V ml. Its volume at 273 K will be:
(A) V ml (B) V/2 ml (C) 2V (D) None of these

12. Select the correct option:
(A) In Photoelectric effect, all the ejected electrons have maximum possible K.E.
(B) Work function is independent of the nature of the metal on which light falls.
(C) Thomson assumed the mass of the atom to be uniformly distributed throughout the atom.
(D) Rutherford's model explained the line spectrum of H atom.

13. If the volume of nucleus of an atom V is related to its mass number A as $V \propto A^n$ according to Rutherford's formula, find the value of n :

14. Assume that 10^{-17} J of light energy is needed by the interior of the human eye to see an object. How many minimum photons of green light (λ = 310 nm) are needed to generate this energy:

15. If the mass of 10^{22} molecules of a hydorcarbon is about 1.2 g, then the molecular mass of hydrocarbon in gram is:

DPP No. # A7 (JEE-MAIN)

Total Marks: 45 **Max. Time: 33 min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.12 **(3 marks, 2 min.)** **[36, 24]**
Numerical Value Questions ('0' negative marking) Q.13 to Q.15 **(3 marks, 3 min.)** **[09, 09]**

1. 11.2 litre of a gas at STP weighs 14 g. The gas could not be :
(A) N_2 (B) CO (C) C_2H_4 (D) N_2O

2. The triad of nuclei which is isotonic will be:
(A) ${}_6C^{14}$, ${}_7N^{15}$, ${}_9F^{17}$ (B) ${}_6C^{12}$, ${}_7N^{14}$, ${}_9F^{19}$
(C) ${}_6C^{14}$, ${}_7N^{14}$, ${}_9F^{17}$ (D) ${}_6C^{14}$, ${}_7N^{14}$, ${}_9F^{19}$

3. Select the correct statement :
(A) Cathode rays are electromagnetic waves, but anode rays are not.
(B) Electromagnetic waves need a material medium for their propagation.
(C) Electromagnetic waves may have different frequencies.
(D) Electromagnetic waves consist of some material particles travelling with the speed of light.

4. A wavelength of 400 nm of electromagnetic radiation corresponds to :
(A) frequency (ν) = 7.5×10^{14} Hz (B) wave number($\bar{\nu}$) = 2.5×10^{6} m^{-1}.
(C) momentum of photon = 1.66×10^{-27} kg ms^{-1} (D) all are correct values.

5. 0.2 moles of an unknown compound weigh 5.6 g. The unknown compound is :
(A) N_2 (B) CO_2 (C) CO (D) N_2O

6. Which of the following statements about the electromagnetic radiation is incorrect.
(A) IR radiations have larger wavelength than X-rays
(B) The frequency of visible region is less than that of UV region
(C) Gamma rays have larger wave number than micro wave
(D) The velocity of γ rays is more than that of IR radiations

7. When an electron drops from a higher energy level to a low energy level, then :
(A) energy is absorbed (B) energy is emitted
(C) atomic number increases (D) atomic number decreases

8. In a certain electronic transition in the Hydrogen atom from an initial state i to a final state f, the difference in the orbit radius ($r_i - r_f$) is seven times the first Bohr radius. Identify the transition:
(A) $4 \rightarrow 1$ (B) $4 \rightarrow 2$ (C) $4 \rightarrow 3$ (D) $3 \rightarrow 1$

9. The energy of an excited H-atom is –1.51 eV. Angular momentum of e^- in the given orbit will be
(A) $3h/\pi$ (B) $3h/2\pi$ (C) $2h/\pi$ (D) h/π

10. The ratio of radius of two different orbits in a H-atom is 4 : 9. Then, the ratio of the frequency of revolution of electron in these orbits is :
(A) 2 : 3 (B) 27 : 8 (C) 3 : 2 (D) 8 : 27

11. Kinetic energy of electron which is moving in the orbit that has its radius, four times the radius of second Bohr orbit for H–atom will be:
(A) 0.85 eV (B) -0.85 eV (C) 0.54 eV (D) –0.54 eV

12. What is the ratio of speeds of electrons in Ist orbit of H-atom to IVth orbit of He^+ ion.
(A) 2 (B) 8 (C) 3 (D) 27

13. Find the average molar mass of a gaseous mixture in g/mole, which contains 1.2046×10^{23} atoms of an unknown gas and 0.2 mole of H_2 gas. The weight of mixture is 22g.

14. "A^{+2}" is isoelectronic with N_2O and has (Z + 1) neutron (Z is atomic number of A) then mass number of A is:

15. In hydrogen atom, energy of second state is –3.4 eV. Then, KE of electron in same orbit of hydrogen atom in eV is :

DPP No. # A8 (JEE-ADVANCED)

Total Marks: 44 **Max. Time: 34 min.**

Multiple choice objective ('–1' negative marking) Q.1 to Q.3	**(4 marks, 2 min.)**	**[12, 06]**
Comprehension ('–1' negative marking) Q.4 to Q.5	**(3 marks, 2 min.)**	**[06, 04]**
Numerical Value Questions ('0' negative marking) Q.6 to Q.11	**(3 marks, 3 min.)**	**[18, 18]**
Match the Following (no negative marking) Q.12	**(8 marks, 6 min.)**	**[08, 06]**

1. Which of the following charge(s) can exist on an oil drop (in Millikan's oil drop experiment)
(A) 3.2×10^{-19} C (B) 8.3×10^{-19} C (C) 4.8×10^{-19} C (D) 9.6×10^{-19} C

2. Which of the following statement is(are) true in the context of photoelectric effect:
(A) The maximum possible kinetic energy of ejected electrons is independent of the intensity of radiation at a given frequency.
(B) The threshold frequency is same for all metals.
(C) The number of photoelectrons ejected depends on the frequency of the incident radiation
(D) The maximum possible kinetic energy of the emitted electrons depends on the frequency of the incident radiation

3. A single electron orbits around a stationary nucleus of charge +Ze where Z is atomic number and 'e' is the magnitude of the electric charge. The hydrogen like species required 47.2 eV to excite the electron from the second Bohr orbit to the third Bohr orbit. Which of the following is/are correct.
(A) Atomic number of species is 5 (B) The kinetic energy in first excited state is 85 eV
(C) the potential energy in second state is –170eV (D) First excitation potential of species is 255 V

Comprehension

Niles Bohr a Danish physicist received his Ph.D from the University of Copenhagen in 1911. He then spent a year with J.J. Thomson and Ernest Rutherford in England. In 1913, he returned to Copenhagen whrere he remained for the rest of his life. In 1920 he was named Director of the Institute of theoritical Physics. After first World War, Bohr worked energetiocally for peaceful uses of atomic energy. He recieved the first Atoms for Peace award in 1957. Bohr was awarded the Nobel Prize in Physics in 1922.

(a) The Angular momentum of an electron in a given stationery state can be expressed as $m_e vr = n.\frac{h}{2\pi}$ where n = 1, 2, 3... Thus an electron can move only in those orbits for which its angular momentum is intergal multiple of $h/2\pi$ that is why only certain fixed orbits are alowed.

(b) The radii of the stationary states are expressed as $r_n = n^2 a_0$ where $a_0 = 52.9$ pm. Thus the radius of the first stationary state, called the **Bohr radius**, is 52.9 pm. Normally the electron in the hydrogen atom is found in this orbit (that is n = 1). As n increases the value of r will increase.

(c) The most important property associated with the electron, is the energy of its stationary state. It is given by the expression. $E_n = -2.18 \times 10^{-18}\left(\frac{Z^2}{n^2}\right)$ J n = 1,2,3....

(d) It is also possible to calculate the velocities of electrons moving in these orbits by using $v_n = 2.18 \times 10^6 \times \frac{Z}{n}$ m/sec . Qualitatively the magnitude of velocity of electron increases with increase of positive charge on the nucleus and decreases with increase the value of n

(e) Bohr's theory can also be applied to the ions containing only one electron, similar to that present in hydrogen atom. For example, He^+ Li^{2+}, Be^{3+} and so on.

4. Choose the correct statement:

(A) The order of velocity is $v_1 < v_2 < v_3 < v_4$ (v_n : where n is orbit number for a given atom)

(B) The order of total energy is $E_1 > E_2 > E_3 > E_4$ (E_n : where n is orbit number for a given atom)

(C) The order of velocity of electron in H, He^+, Li^+, Be^{3+} species in second Bohr orbit is $Be^{3+} < Li^{+2} < He^+ < H$

(D) The order of Bohr radius is $r_1 < r_2 < r_3 < r_4$ (r_n : where n is orbit number for a given atom)

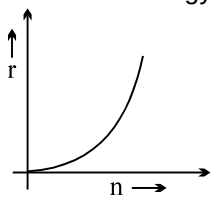
5. Select the incorrect curve:

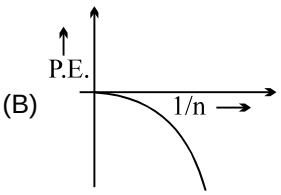
If **v** = velocity of electron in Bohr's orbit

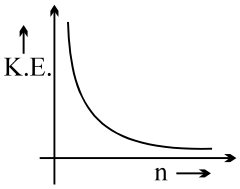
r = Radius of electron in Bohr's orbit

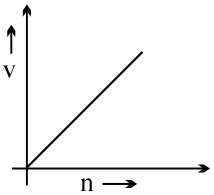
P.E. = Potential energy of electron in Bohr's orbit

K.E. = Kinetic energy of electron in Bohr's orbit.

(A) 

(B) 

(C) 

(D) 

6. Infrared lamps are used in restaurants to keep the food warm. The infrared radiation is strongly absorbed by water, raising its temperature and that of the food. If the wavelength of infrared radiation is assumed to be 1500 nm, then the number of photons per second of infrared radiation produced by an infrared lamp that consumes energy at the rate of 100 W and is 12% efficient only is y x 10^{19}. Find the value of y.

7. The number of revolutions/sec made by an electron in IInd orbit is 8 times of the number of revolutions/sec made by an electron in n^{th} orbit. Give the value of "n".

8. What is the ratio of the wave lengths of last lines of Balmer and Lyman series.

9. Calculate maximum number of possible spectral lines which may be emitted in brackett series in H atom, if electrons present in 9^{th} excited level return upto ground level in a sample of H-like species.

10. What minimum number of atoms/ions should be present in a sample of H-like species, so that a maximum of 6 spectral lines can be produced of electronic transition from fifth excited state upto n = 2?

11. In a mixture of sample of H-atoms and He^+ ions, electrons in all the H-atoms and He^+ ions are present in n = 4th state. Then, find maximum number of different spectral lines obtained when all the electrons make transition from n = 4 upto ground state.

12. Match the following :

	Column – I		Column – II
(A)	Binding energy of 2nd excited state of Li^{++} sample	(p)	10.2 eV
(B)	1st excitation energy of H-atom	(q)	3.4 eV
(C)	2nd excitation energy of Li^{2+}	(r)	13.6 eV
(D)	Binding energy of H-atom	(s)	108.8 eV

DPP No. # A9 (JEE-MAIN)

Total Marks: 45 **Max. Time: 33 min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.10 **(3 marks, 2 min.)** **[30, 20]**

Comprehension ('–1' negative marking) Q.11 to Q.12 **(3 marks, 2 min.)** **[06, 04]**

Numerical Value Questions ('0' negative marking) Q.13 to Q.15 **(3 marks, 3 min.)** **[09, 09]**

1. The de-Broglie wavelength of a particle with mass 1 g and velocity 100 m/s is :
(A) 6.63×10^{-33} m (B) 6.63×10^{-34} m (C) 6.63×10^{-35} m (D) 6.65×10^{-36} m

2. If the kinetic energy of a particle is doubled, De-Broglie wavelength becomes:
(A) 2 times (B) 4 times (C) $\sqrt{2}$ times (D) $\frac{1}{\sqrt{2}}$ times

3. Momentum of a photon of wavelength λ is :
(A) $\frac{h}{\lambda}$ (B) zero (C) $\frac{h\lambda}{c^2}$ (D) $\frac{h\lambda}{c}$

4. Li^{3+} and a proton are accelerated by the same potential, their de-Broglie wavelengths have the ratio (assume mass of proton = mass of neutron) :
(A) 1 : 2 (B) 1 : 4 (C) $1 : \sqrt{21}$ (D) $1 : 3\sqrt{3}$

5. If numerical value of mass and velocity are equal for a particle, then its de-Broglie wavelength in terms of K.E. is :
(A) $\frac{mh}{2K.E.}$ (B) $\frac{h}{2mK.E.}$ (C) both are correct (D) none is correct.

6. If the de-Broglie wavelength of an electron revolving in 2nd orbit of H-atom is x, then radius of that orbit is given by :
(A) $\frac{x}{\pi}$ (B) $\frac{2x}{\pi}$ (C) $\frac{x}{2\pi}$ (D) cannot be determined

7. An electron jumps from nth level to the first level.
The correct statement is :
(A) Number of spectral lines = $\frac{n(n-1)}{2}$ (B) Number of spectral lines = $\frac{n(n+1)}{2}$
(C) If n = 4 , number of spectral lines = 6 (D) Both (A) and (C)

8. **Statement-1 :** It is possible to measure simultaneously both the position and momentum of a moving microscopic particle with absolute accuracy.
Statement-2 : In case of moving microscopic particle, if uncertainty in position is reduced, then uncertainty in velocity is very high and vice versa.
(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 True, Statement-2 is False
(D) Statement-1 is False, Statement-2 is True

9. **Given:** The mass of electron is 9.11×10^{-31} kg, planck constant is 6.626×10^{-34} J s, the Uncertainity involved in the measurement of velocity within a distance of 0.1 Å is :
(A) 5.79×10^{8} m s^{-1} (B) 5.79×10^{5} m s^{-1} (C) 5.79×10^{6} m s^{-1} (D) 5.79×10^{7} m s^{-1}

10. Which of the following statements is correct :
(A) Two charged particles having the same mass and accelerated through same potential difference from rest will have same value of de-Broglie wavelength.
(B) Heisenberg's uncertainty principle is more significant for microscopic particles than for macroscopic particles.
(C) When electron jumps from lower energy level to higher energy level it emits energy.
(D) According to de-Broglie, wavelength associated with electron and proton are same. If both have same velocity.

Comprehension

A chemist was performing an experiment to study the effect of varying voltage and de-Broglie wavelength of the electron. In first experiment, the electron was accelerated through a potential difference of 1 kV from rest and in second experiment, it was accelerated through a potential difference of 2 kV from rest.
The wavelength of de-Broglie waves associated with electron is given by :

$$\lambda = \frac{h}{\sqrt{2qVm}}$$

Where , V is the voltage through which an electron is accelerated.
Putting the values of h , m and q , we get

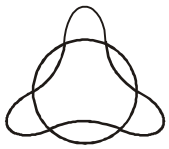
$$\lambda = \frac{12.3}{\sqrt{V}}\text{Å}$$

Answer the following questions

11. The wavelength of electron will be :
(A) 1.4 times in first case than in second case (B) 1.4 times in second case than in first case
(C) double in second case than in first case (D) double in first case than in second case

12. In order to get half velocity of electron than in second case , the applied potential difference from rest will be :
(A) 0.25 kV (B) 2 kV (C) 0.5 kV (D) 0.75 kV

13. The wave motion of an electron in a Bohr's orbit of Hydrogen atom is as shown in diagram. The orbit number is:



14. The uncertainty in momentum of an electron is 1×10^{-5} kg.m/s. The uncertainty in its position is approximate $X \times 10^{-31}$ then X will be: ($h = 6.62 \times 10^{-34}$ kg m^2/s) :

15. The most probable radius (in pm) for finding the electron in He^+ is :

DPP No. # A10 (JEE-ADVANCED)

Total Marks: 43 **Max. Time: 31 min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.3	**(3 marks, 2 min.)**	**[09, 06]**
Multiple choice objective ('–1' negative marking) Q.4 to Q.5	**(4 marks, 2 min.)**	**[08, 04]**
Comprehension ('–1' negative marking) Q.6 to Q.8	**(3 marks, 2 min.)**	**[09, 06]**
Numerical Value Questions ('0' negative marking) Q.9 to Q.11	**(3 marks, 3 min.)**	**[09, 09]**
Match the Following (no negative marking) Q.12	**(8 marks, 6 min.)**	**[08, 06]**

1. A certain dye absorbs light of certain wavelength and then fluorescence light of wavelength 5000 Å. Assuming that under given conditions, 50% of the absorbed energy is re-emitted out as fluorescence and the ratio of number of quanta emitted out to the number of quanta absorbed is 5 : 8, find the wavelength of absorbed light (in Å) : [hc = 12400 eVÅ]
(A) 4000 Å (B) 3000 Å (C) 2000 Å (D) 1000 Å

2. Two electrons A and B in an atom have the following set of quantum numbers; what is true for A and B :

For A; n = 3, ℓ = 2, m = –2, s = $\pm\frac{1}{2}$; For B; n = 3, ℓ = 0, m = 0, s = $\pm\frac{1}{2}$

(A) A and B have same energy (B) A has more energy than B
(C) B has more energy than A (D) A and B represent the same electron

3. Which of the following pair of orbitals for mentioned species have equal energy:
(A) 2s (He^+) and 4p (H) (B) 8p (He^+) and 6s (Li^{2+})
(C) 6s (He^+) and 18s (Be^{3+}) (D) 4p (He^+) and 8d (Be^{3+})

4. Which of the following statements is incorrect with respect to V^{4+} ion :
(A) Maximum possible number of electrons with clockwise spin and m = 0 is 11.
(B) The quantum numbers for the unpaired electron is n = 4, ℓ = 0, m = 0.
(C) Total number of electrons in orbitals with one radial node and m_s = 1/2 is 4.
(D) Total number of filled orbitals having ℓ = 0 is 6.

5. Which of the following set of orbitals are arranged in correct energy order ?
(A) $3p_x > 3s > 2p_z$ (in He) (B) $3p_x = 3s = 2p_z$ (in H)
(C) $4p_x = 4p_y = 4p_z$ (in He^+) (D) $4p_x = 4p_y = 4p_z = 4s = 4d_{xy}$ (in H)

Comprehension

Azimuthal quantum number (ℓ) :

It describes the shape of electron cloud and the number of subshells in a shell.

* It can have values from 0 to (n – 1)
* **value of ℓ** 0 1 2 3
  subshell s p d f
* Number of orbitals in a subshell = $2\ell + 1$
* Orbital angular momentum L = $\frac{h}{2\pi}\sqrt{\ell(\ell+1)} = \hbar\sqrt{\ell(\ell+1)}$ $\left[\hbar = \frac{h}{2\pi}\right]$

Magnetic quantum number (m) :

It describes the orientations of the subshells. It can have values from $-\ell$ to + ℓ including zero, i.e., total (2ℓ + 1) values. Each value corresponds to an orbital. s-subshell has one orbital, p-subshell three orbitals (p_x, p_y and p_z), d-subshell five orbitals ($d_{xy}, d_{yz}, d_{zx}, d_{x^2-y^2}, d_{z^2}$) and f-subshell has seven orbitals.

Spin quantum number (s) :

It describes the spin of the electron. It has values +1/2 and –1/2. Signifies clockwise spinning and anticlockwise rotation of electron about its own axis.

Spin of the electron produces angular momentum equal to S = $\sqrt{s(s+1)}\frac{h}{2\pi}$ where s = + $\frac{1}{2}$.

Total spin of an atom = $+\frac{n}{2}$ or $-\frac{n}{2}$ (where n is the number of unpaired electron)

The magnetic moment of an atom

$\mu_s = \sqrt{n(n+2)}$ B.M. n = number of unpaired electrons
B.M. (Bohr magneton)

6. A d-block element has total spin value of +3 or –3 then the magnetic moment of the element is approximately:
(A) 2.83 B.M. (B) 3.87 B.M. (C) 5.9 B.M. (D) 6.93 B.M.

7. The correct order of the maximum spin of [$_{25}Mn^{4+}$, $_{24}Cr^{3+}$, $_{26}Fe^{3+}$] is :
(A) $Fe^{3+} > Cr^{3+} = Mn^{4+}$ (B) $Fe^{3+} = Cr^{3+} > Mn^{4+}$
(C) $Cr^{3+} = Mn^{4+} > Fe^{3+}$ (D) $Fe^{3+} > Mn^{4+} > Cr^{3+}$

8. Orbital angular momentum of an electron is $\sqrt{3}\frac{h}{\pi}$ then the number of orientations of this orbital in space are:
(A) 3 (B) 5 (C) 7 (D) 9

9. In one experiment, a proton having initial kinetic energy of 1 eV is accelerated through a potential difference of 3 V. In another experiment, an α-particle having initial kinetic energy 20 eV is retarded by a potential difference of 2 V. Calculate the ratio of de-Broglie wavelengths of proton and α-particle.

10. If the value of Azimuthal Quantum Number ℓ for an electron in a particular subshell is 3, then what will be the minimum value of shell number associated with this electron.

11. What is the maximum possible number of electrons in an atom with $(n + \ell = 7)$:

12. **Match the column**

	Column-I **Analysis of Atoms**		**Column-II** **Characteristics**
(A)	Total number of filled orbitals with m = 0 in $_{30}Zn$ atom	(p)	Number is even
(B)	Total number of electrons with ℓ = 0 in $_{12}Mg$ atom	(q)	Number is odd
(C)	Maximum number of electrons with ℓ + m = 0 in $_{17}Cl$ atom	(r)	Number is same as the number of unpaired electrons in $_{25}Mn^{2+}$ ion
(D)	Total number of electrons with anticlockwise spin in $_{10}Ne$ atom	(s)	Number is greater than 5
		(t)	Number is less than the number of fully filled orbitals in $_{18}Ar$ atom

REVISION DPP

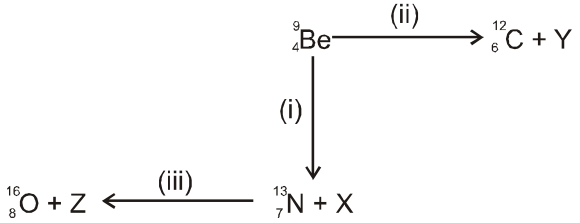
Total Marks: 39 **Max. Time: 27 min.**

Single choice Objective ('–1' negative marking) Q.1 to Q.3	**(3 marks, 2 min.)**	**[09, 06]**
Multiple choice objective ('–1' negative marking) Q.4 to Q.6	**(4 marks, 2 min.)**	**[12, 06]**
Comprehension ('–1' negative marking) Q.7 to Q.9	**(3 marks, 2 min.)**	**[09, 06]**
Numerical Value Questions ('0' negative marking) Q.10 to Q.12	**(3 marks, 3 min.)**	**[09, 09]**

1. Among the following, which orbital in Be^{3+} has same energy as that of electron in He^{+} in ground state and also has 2 angular nodes?

(A) 2s (B) $2p_x$ (C) $3d_{xy}$ (D) None of these

2. Bombardment by α-particle leads to artificial disintegration in three ways, (I), (II) and (III) as shown. Products **X**, **Y** and **Z** respectively are :



(A) β-particle, proton, positron (B) positron, neutron, proton

(C) β-particle, neutron, proton (D) positron, proton, neutron

3. Which particle must have been produced in the following processes respectively:

(I) $_{7}N^{14} + _{2}He^{4} \rightarrow _{8}O^{17} + ...$ (II) $_{79}Au^{198} \rightarrow _{80}Hg^{198} + ...$

(III) $_{12}Mg^{24} + _{2}He^{4} \rightarrow _{14}Si^{27} + ...$ (IV) $_{11}Na^{23} \rightarrow _{10}Ne^{23} + ...$

(A) Proton, Positron, Neutron, β-particle (B) Positron, β-particle, Neutron, Proton

(C) Proton, β-particle, Neutron, Positron (D) Positron, Neutron, β-particle, Proton

4. If the radius of first Bohr's orbit of H-atom is x, which of the following is/are the CORRECT conclusion :

(A) The de-Broglie wavelength of electron in the third Bohr orbit of H-atom = $6\pi x$

(B) The fourth Bohr's radius of He^{+} ion = 8x

(C) The de-Broglie wavelength of electron in third Bohr's orbit of $Li^{2+} = 2\pi x$

(D) The second Bohr's radius of Be^{2+} = x

5. d_{z^2} – orbital has:

(A) A lobe along z-axis and a ring along xy-plane
(B) A lobe along z-axis and a lobe along xy-plane
(C) It has two angular nodes
(D) It has two radial nodes

6. Which of the following process lead to formation of isobars?

(A) 1 α particle and 2β particles are emitted (B) Positron emission

(C) β particle $\left(\begin{matrix}0\\e\\-1\end{matrix}\right)$ emission (D) K-electron capture

Comprehension

In the disintegration of a radioactive element , α and β particles are evolved from the nucleus.

$$_0^1n \rightarrow {}_1^1H + \text{antineutrino} + \text{energy}$$

$$4\,{}_1^1H \rightarrow {}_2^4He + 2\,{}_{+1}^0e + \text{energy}$$

Then , emission of these particles changes the nuclear configuration and results into a daughter nuclide. Emission of an α-particle results into a daughter element having atomic number lowered by 2 and mass number by 4. On the other hand , emission of $\beta-$particle yields an element having atomic number raised by one.

7. During beta decay , the mass number of atomic nucleus

(A) decreases by 1 unit (B) Increases by 1 unit
(C) decreases by 2 unit (D) Remains unaffected

8. How many α and β particles should be emitted from a radioactive nuclide so that an isobar is formed

(A) 1α, 1β (B) 1α, 2β (C) 2α, 2β (D) nβ

9. Which of the following combinations give finally an isotope of the parent element?

(A) α, α, β (B) α, γ, β (C) α, β, β (D) β, γ, α

10. The de-Broglie wavelength of electron in a certain orbit 'n' of Be^{3+} ion is found to be 5.83 Å. Find the value of 'n'. Take I^{st} Bohr radius for H-atom = 53 pm :

11. Find the value of x + 2y + z.

x = no. of radial nodes in $3p_x$

y = no. of angular nodes in 6s

z = the maximum no. of electrons in $_{24}Cr$ with n = 3 and s = + $\frac{1}{2}$ and orbital angular momentum $\sqrt{6}\ \hbar$

12. $_{75}Re^{162} \longrightarrow {}_{Z_1}X^{A_1}$ + alpha particle

$_{74}W^{188} \longrightarrow {}_{Z_2}Y^{A_2}$ + Beta particle

Value of $\frac{A_2 - A_1}{Z_2 - Z_1}$ is :