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Class XI Chemistry ***Unit -1. Some Basic Concepts of Chemistry***

Topic – 1.1 Measurement in Chemistry & Classification Of Matter

Work Sheet (WS – 1 . 1)

Name - _____. Class/ sec. _____. Roll No. _____.

Subject – Chemistry. Date- _____. Discussed/ Not Discussed .

A. Fill in the blanks:

1. _____ have definite volume but not the definite shape.
2. _____ have no definite volume & no the definite shape.
3. Pure substances are further classified as _____ & _____ .
4. _____ is the amount of substance that contains as many elementary entities as there are atoms in 0.012 kg of C-12.
5. A jug contains 2 L of milk , its volume in m^3 is _____ m^3.
6. Matter can neither be created nor be destroyed according to_____ _____.
7. A given compound always contains exactly the same proportion of elements by weight according to _____ .
8. According to Avogadro's law " equal volumes of gases at the same temperature & pressure should contain _____ .
9. According to the law of Multiple Proportions " If two elements can combine to form more than one compound, the masses of one element that combine with a fixed mass of the other element, are _____ .
10. Irrespective of the source , a given compound always contains same elements in the _____ _____ .
11. cisplatin and taxol, are effective in _____ therapy and AZT (Azidothymidine) used for helping _____ victims.
12. _____ particles are held very close to each other in an orderly fashion and there is not much freedom of movement.
13. Anything which has mass and occupies space is called _____ .
14. In a _____ mixture, the components completely mix with each other and its composition is uniform throughout.
15. When two or more atoms of different elements combine, the molecule of a _____ is obtained.
16. _____ properties are those properties which can be measured or observed without changing the identity or the composition of the substance.
17. The *metre* is the length of the path traveled by light in vacuum during a time interval of 1/299 792 458 of a _____.
18. The *kelvin*, unit of thermodynamic temperature, is the fraction 1/273.16 of the thermodynamic temperature of the _____ point of water.
19. The *mole* is the amount of substance of a system which contains as many elementary entities as there are _____ in 0.012 kilogram of carbon-12.
20. _____ refers to the closeness of various measurements for the same quantity.

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Class XI Chemistry *Unit -1. Some Basic Concepts of Chemistry*

Topic – 1.1 Measurement in Chemistry & Classification Of Matter

Class Assignment (CA - 1.1) :- NCERT Exercise question numbers 1.13 to 1.16 & 1.18 to1.21.

NCERT Exercise question numbers 1.13 to 1.16 & 1.18 to1.21.

1.13 Pressure is determined as force per unit area of the surface. The SI unit of pressure, pascal is as shown below :

$1Pa = 1N\ m^{-2}$

If mass of air at sea level is 1034 g cm^{-2}, calculate the pressure in pascal.

1.14 What is the SI unit of mass? How is it defined?

1.15 Match the following prefixes with their multiples:

Prefixes	**Multiples**
(i) micro	10^{6}
(ii) deca	10^{9}
(iii) mega	10^{-6}
(iv) giga	10^{-15}
(v) femto	10

1.16 What do you mean by significant figures?

1.18 Express the following in the scientific notation:

(i) 0.0048 ; (ii) 234,000 ; (iii) 8008 ; (iv) 500.0 ; (v) 6.0012

1.19 How many significant figures are present in the following?

(i) 0.0025 ; (ii) 208 ; (iii) 5005 ; (iv) 126,000 ; (v) 500.0 ; (vi) 2.0034

1.20 Round up the following upto three significant figures:

(i) 34.216 ; (ii) 10.4107 ; (iii) 0.04597 ; (iv) 2808

1.21 The following data are obtained when dinitrogen and dioxygen react together to form different compounds :

	Mass of dinitrogen	**Mass of dioxygen**
(i)	14 g	16 g
(ii)	14 g	32 g
(iii)	28 g	32 g
(iv)	28 g	80 g

(a) Which law of chemical combination is obeyed by the above experimental data? Give its statement.

(b) Fill in the blanks in the following conversions:

(i) 1 km = ... mm = ... pm

(ii) 1 mg = ... kg = ... ng

(iii) 1 mL = ... L = ... dm^3

Home Assignment (HA – 1.1) : - NCERT Exercise question numbers 1.22 , 1.27 & 1.31.

NCERT Exercise question numbers 1.22 , 1.27 & 1.31.

1.22 If the speed of light is 3.0×10^{8} m s^{-1}, calculate the distance covered by light in 2.00 ns.

1.27 Convert the following into basic units:

(i) 28.7 pm ; (ii) 15.15 pm ; (iii) 25365 mg

1.31 How many significant figures should be present in the answer of the following calculations?

(i) $\frac{0.02856 \times 29}{0.5}$; (ii) 5 X 5.364 ; (iii) 0.0125 X 0.7864 / 0.0215

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Class XI Chemistry *Unit -1. Some Basic Concepts of Chemistry*

Topic – 1.2 Mole Concepts & Stoichiometry

Work Sheet (WS – 1 . 2)

Name - _____. Class/ sec. _____. Roll No. _____.

Subject – Chemistry. Date- _____. Discussed/ Not Discussed .

A. Fill in the blanks:

1. The mass of 1 mole of a substance in grams is called its _____.
2. An _____ represents the simplest whole number ratio of various atoms present in a compound.
3. The value of Avogadro's constant is _____ .
4. Number of moles of carbon atoms in 3 moles of ethane C_2H_6 are _____ .
5. 1 gramatom of oxygen means _____ gram of oxygen.
6. The quantitative study of the reactants required & the products formed is called _____.
7. Molarity is defined as " the no. of moles of solute present in _____ .
8. _____ is temperature independent.
9. The reactant which gets consumed first in a reaction is called _____ .
10. The mass % age of solution prepared by mixing 3 g of a solute in 17 g of solvent will be _____ .
11. _____ is defined as the number of moles of solute present in 1 kg of solvent.
12. _____ is defined as the number of moles of the solute in 1 litre of the solution.
13. The reactant which gets consumed, limits the amount of product formed and is, therefore, called the _____ reagent.
14. One mole of $CH_4(g)$ reacts with _____ moles of $O_2(g)$ to give _____ mole of $CO_2(g)$ and _____moles of $H_2O(g)$.
15. _____ deals with the calculation of masses (sometimes volumes also) of the reactants and the products involved in a chemical reaction.
16. One mole is the amount of a substance that contains as many particles or entities as there are _____ in exactly 12 g (or 0.012 kg) of the ^{12}C isotope.
17. The mass of one mole of a substance in _____ is called its molar mass.
18. Molecular mass of glucose ($C_6 H_{12} O_6$) molecule is _____ _____ .
19. Compounds are formed when atoms of different elements combine in a _____ ratio.
20. One _____ _____ unit is defined as a mass exactly equal to one-twelfth the mass of one carbon - 12 atom.

Class XI Chemistry *Unit -1. Some Basic Concepts of Chemistry*

Topic – 1.2 Mole Concepts & Stoichiometry

Class Assignment (CA - 1.2) :-

NCERT Exercise question numbers 1.1 to 1.4 , 1.11 , 1.12 & 1.17 ; Solved problems 1.1 & 1.8.

Solved problems 1.1 & 1.8.

Example 1.1 A jug contains 2L of milk. Calculate the volume of the milk in m^3.

Example 1.2 How many seconds are there in 2 days?

Problem 1.1 Calculate molecular mass of glucose ($C_6H_{12}O_6$) molecule.

Problem 1.2 A compound contains 4.07 % hydrogen, 24.27 % carbon and 71.65 % chlorine. Its molar mass is 98.96 g. What are its empirical and molecular formulas ?

Problem 1.3 Calculate the amount of water (g) produced by the combustion of 16 g of methane.

Problem 1.4 How many moles of methane are required to produce 22 g CO_2 (g) after combustion?

Problem 1.5 50.0 kg of N_2 (g) and 10.0 kg of H_2 (g) are mixed to produce NH_3 (g). Calculate the NH_3 (g) formed. Identify the limiting reagent in the production of NH_3 in this situation.

Problem 1.6 A solution is prepared by adding 2 g of a substance A to 18 g of water. Calculate the mass per cent of the solute.

Problem 1.7 Calculate the molarity of NaOH in the solution prepared by dissolving its 4 g in enough water to form 250 mL of the solution.

Problem 1.8 The density of 3 M solution of NaCl is 1.25 g mL^{-1}. Calculate molality of the solution.

NCERT Exercise question numbers 1.1 to 1.4 , 1.11 , 1.12 & 1.17

1.1 Calculate the molecular mass of the following :
(i) H_2O (ii) CO_2 (iii) CH_4

1.2 Calculate the mass per cent of different elements present in sodium sulphate (Na_2SO_4).

1.3 Determine the empirical formula of an oxide of iron which has 69.9% iron and 30.1% dioxygen by mass.

1.4 Calculate the amount of carbon dioxide that could be produced when :
(i) 1 mole of carbon is burnt in air.
(ii) 1 mole of carbon is burnt in 16 g of dioxygen.
(iii) 2 moles of carbon are burnt in 16 g of dioxygen.

1.11 What is the concentration of sugar ($C_{12}H_{22}O_{11}$) in mol L^{-1} if its 20 g are dissolved in enough water to make a final volume up to 2L?

1.12 If the density of methanol is 0.793 kg L^{-1}, what is its volume needed for making 2.5 L of its 0.25 M solution?

1.17 A sample of drinking water was found to be severely contaminated with chloroform, $CHCl_3$, supposed to be carcinogenic in nature. The level of contamination was 15 ppm (by mass).
(i) Express this in percent by mass.
(ii) Determine the molality of chloroform in the water sample.

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Class XI Chemistry *Unit -1. Some Basic Concepts of Chemistry*

Home Assignment (HA – 1.1) : - NCERT Exercise question numbers 1.22 , 1.27 & 1.31.

NCERT Exercise question numbers 1.22 , 1.27 & 1.31.

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1.27 Convert the following into basic units:

(i) 28.7 pm ; (ii) 15.15 pm ; (iii) 25365 mg

1.31 How many significant figures should be present in the answer of the following calculations?

(i) $\frac{0.02856 \times 29}{0.5}$; (ii) 5 X 5.364 ; (iii) 0.0125 X 0.7864 / 0.0215

Home Assignment (HA – 1.2) : -

NCERT Exercise question numbers 1.7 to 1.10 , 1.24 , 1.25 , 1.29 , 1.33 to 1.36.

1.7 How much copper can be obtained from 100 g of copper sulphate ($CuSO_4$) ?

1.8 Determine the molecular formula of an oxide of iron in which the mass per cent of iron and oxygen are 69.9 and 30.1 respectively.

1.9 Calculate the atomic mass (average) of chlorine using the following data :

	% Natural Abundance	**Molar Mass**
^{35}Cl	75.77	34.9689
^{37}Cl	24.23	36.9659

1.10 In three moles of ethane (C_2H_6), calculate the following :

(i) Number of moles of carbon atoms.

(ii) Number of moles of hydrogen atoms.

(iii) Number of molecules of ethane.

1.24 Dinitrogen and dihydrogen react with each other to produce ammonia according to the following chemical equation: N_2 (g) + H_2 (g) → $2NH_3$ (g)

(i) Calculate the mass of ammonia produced if 2.00 $X10^3$ g dinitrogen reacts with 1.00 X 10^3 g of dihydrogen.

(ii) Will any of the two reactants remain unreacted?

(iii) If yes, which one and what would be its mass?

1.25 How are 0.50 mol Na_2CO_3 and 0.50 M Na_2CO_3 different?

1.29 Calculate the molarity of a solution of ethanol in water in which the mole fraction of ethanol is 0.040.

1.33 Calculate the number of atoms in each of the following (i) 52 moles of Ar ; (ii) 52 u of He (iii) 52 g of He.

1.34 A welding fuel gas contains carbon and hydrogen only. Burning a small sample of it in oxygen gives 3.38 g carbon dioxide , 0.690 g of water and no other products. A volume of 10.0 L (measured at STP) of this welding gas is found to weigh 11.6 g. Calculate (i) empirical formula, (ii) molar mass of the gas, and (iii) molecular formula.

1.35 Calcium carbonate reacts with aqueous HCl to give $CaCl_2$ and CO_2 according to the reaction, $CaCO_3$ (s) + 2 HCl (aq) → $CaCl_2$ (aq) + CO_2(g) + H2O(l)

What mass of $CaCO_3$ is required to react completely with 25 mL of 0.75 M HCl?

1.36 Chlorine is prepared in the laboratory by treating manganese dioxide (MnO_2) with aqueous hydrochloric acid according to the reaction

4 HCl (aq) + MnO_2(s) → 2 H_2O (l) + $MnCl_2$ (aq) + Cl_2 (g)

How many grams of HCl react with 5.0 g of manganese dioxide?

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Class-XI Chemistry (*REVISION ASSIGNMENT*) Unit-1.Some Basic Concepts of Chemistry

(Prepared by Mr.B.K.Goel,P.G.T.,Chemistry)

Special Assignment (SA – 1.1)

1. How many significant figures are there in each of the following numbers?
   (i) 6.200 (ii) 0.052 (iii) 67.32- 6.3 (iv) 4.2+ 7.589 (v) $(5.56)^2(8.24)/93.6)$
2. Vanadium metal is added to steel to impart strength. The density of vanadium is 5.96 g/cm^3. Express this in S.I. units (kg/m^3).
3. 2.16g of copper metal when treated with nitric acid followed by ignition of the nitrate gave 2.70g of copper oxide. In another experiment 1.15g of copper oxide upon reduction with hydrogen gave 0.92g of copper. Show that the above data illustrate the Law of Definite Proportions.
4. Carbon is found to form two oxides, which contain 42.9% and 27.3% of carbon respectively Show that these figures illustrate the law of multiple proportions.
5. What is the mass in grams of: (i) 6.022×10^{23} atoms of oxygen? (ii) 1.0×10^{23} molecules of H_2S? (iii) 6.022×10^{23} molecules of oxygen ? (iv) 1.5 moles of H_2SO_4?
6. How many moles and how many grams of sodium chloride (NaCl) are present in 250 cm^3 of a 0.50 M NaCl solution?
7. Concentrated aqueous sulphuric acid is 98% H_2SO_4 by mass and has a density of 1.84g cm^{-3}. What volume of the concentrated acid is required to make 5.0 litre of 0.500 M H_2SO_4 solution?
8. An organic substance containing carbon, hydrogen and oxygen gave the following percentage composition. C = 40.687%; H = 5.085% and O = 54.228%
   The vapour density of the compound is 59. Calculate the molecular formula of the compound.
9. Calculate the mass of 60% H_2SO_4 required to decompose 50g of chalk (calcium carbonate).
10. One gram of a mixture of potassium and sodium chlorides on treatment with excess of silver nitrate gave 2g of AgCl. What was the composition of the two salts in the original mixture?
11. Calculate the amount of water (g) produced by the combustion of 16g of methane.
12. 5.0g of marble was added to 7.5g dilute hydrochloric acid. After the reaction was over, it was found that o.5g of marble was left unused. Calculate the percentage strength of hydrochloric acid. What volume of Co_2 measured at STP will be evolved in the above reaction?
13. 3.0g of H_2 react with 29.0g of O_2 to form H_2O.
    (i) Which is the limiting reactant?
    (ii) Calculate the maximum amount Of H_2O that can be formed.
    (iii) Calculate the amount of the reactant left unreacted.

    Molecular mass of H_2 = 2.016.
14. 5.6 litres of methane (CH_4) gas are ignited in oxygen gas. Calculate the number of moles of CO_2 formed.
15. Calculate the number of moles in each of the following:- (i) 392 grams of sulphuric acid (ii) 44.8 litres of carbon dioxide at STP (iii) 6.022×10^{23} molecules of oxygen (iv) 9.0 grams of aluminium (v) 1 metric ton of iron (1 metric ton = 10^3 kg) (vi) 7.9 mg of Ca

****

*Ans **1**. (i) 4, (ii) 2, (iii) 3, (iv) 3, (v) 2; **2**.5960 kg/m^3 **5**. (i) 16.0g , (ii) 5.645g, (iii) 32.0g, (iv) 147.0g; **6**. 0.125mole, 7.312g; **7**. 136 cm^3 ; **9**. 81.67g ; **10**. NaCl = 14%, KCl = 86% ; **11**.36g ; **12**. 43.8% and 1008 cm^3 ; **14**. 0.25 mole ; **15**. (i) 4, (ii) 2, (iii) 1, (iv) 0.33, (v) 1.786×10^4 (vi) 1.975×10^{-4}.*

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Class XI Chemistry ***Unit -2. Structure Of Atom***

Topic – 2.1 Sub-Atomic Particles & Developments Of Structure Of Atom

Work Sheet (WS – 2 . 1)

Name - _____. Class/ sec. _____. Roll No. _____.

A. Fill in the blanks:

1. The cathode rays start from _____ and move towards the _____.
2. In the absence of electrical or magnetic field, _____ rays travel in straight lines.
3. In 1897, British physicist _____ measured the ratio of electrical charge (*e*) to the mass of electron (*me*) by using cathode ray tube.
4. _____ concluded that the magnitude of electrical charge, *q*, on the droplets is always an integral multiple of the electrical charge, 'e'.
5. The smallest and lightest positive ion was obtained from hydrogen and was called _____.
6. The presence of electrically neutral particle,_____, as one of the constituent of atom, were discovered by _____.
7. _____, in 1898, proposed that an atom possesses a spherical shape (radius approximately 10^{-10} m) in which the positive charge is uniformly distributed.
8. An important feature of _____ model is that the mass of the atom is assumed to be uniformly distributed over the atom.
9. Most of the space in the atom is _____ as most of the alpha–particles passed through the foil undeflected.
10. The positive charge and most of the mass of the atom was densely concentrated in extremely small region, this very small portion of the atom was called _____ by Rutherford.
11. _____ are the atoms with same mass number but different atomic number.
12. Atoms with identical atomic number but different atomic mass number are known as _____.
13. Chemical properties of atoms are controlled by the number of _____, which are determined by the number of protons in the nucleus.
14. Plum Pudding Model was given by _____.
15. According to Dalton , atom is the _____.
16. Nucleus of the atom was discovered by Rutherford's _____ experiment.
17. Most of the space in an atom is empty according to _____ model of atom.
18. Rutherford could not explain the _____ of the atom as a whole.
19. The number of protons, neutrons and electrons in $_{35}Br^{80}$ are _____, _____ & _____.
20. Stability of an atom could not be explained on the basis of _____ model of atom.

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Class XI Chemistry *Unit -2. Structure Of Atom*

Topic – 2.1 Sub-Atomic Particles & Developments Of Structure Of Atom

Class Assignment (CA - 2.1) :-

NCERT Solved problems 2.1 to 2.9. & NCERT Exercise question numbers 2.1 & 2.2.

Solved problems 2.1 to 2.9.

Problem 2.1 Calculate the number of protons, neutrons and electrons in $_{35}Br^{80}$.

Problem 2.2 The number of electrons, protons and neutrons in a species are equal to 18, 16 and 16 respectively. Assign the proper symbol to the species.

Problem 2.3 The Vividh Bharati station of All India Radio, Delhi, broadcasts on a frequency of 1,368 kHz (kilo hertz). Calculate the wavelength of the electromagnetic radiation emitted by transmitter. Which part of the electromagnetic spectrum does it belong to?

Problem 2.4 The wavelength range of the visible spectrum extends from violet (400 nm) to red (750 nm). Express these wavelengths in frequencies (Hz). (1nm = 10^{-9} m).

Problem 2.5 Calculate (a) wave number and (b) frequency of yellow radiation having wavelength 5800 Å.

Problem 2.6 Calculate energy of one mole of photons of radiation whose frequency is 5×10^{14} Hz.

Problem 2.7 A 100 watt bulb emits monochromatic light of wavelength 400 nm. Calculate the number of photons emitted per second by the bulb.

Problem 2.8 When electromagnetic radiation of wavelength 300 nm falls on the surface of sodium, electrons are emitted with a kinetic energy of 1.68×10^5 J mol^{-1}. What is the minimum energy needed to remove an electron from sodium? What is the maximum wavelength that will cause a photoelectron to be emitted ?

Problem 2.9 The threshold frequency v_0 for a metal is 7.0×10^{14} s^{-1}. Calculate the kinetic energy of an electron emitted when radiation of frequency v =1.0×10^{15} s^{-1} hits the metal.

NCERT Exercise question numbers 2.1, 2.2, 2.5 to2.11, 2.38, 2.42 to 2.44 & 2.47.

2.1 (i) Calculate the number of electrons which will together weigh one gram.
(ii) Calculate the mass and charge of one mole of electrons.

2.2 (i) Calculate the total number of electrons present in one mole of methane.
(ii) Find (a) the total number and (b) the total mass of neutrons in 7 mg of ^{14}C.
(Assume that mass of a neutron = 1.675×10^{-27} kg).
(iii) Find (a) the total number and (b) the total mass of protons in 34 mg of NH_3 at STP.
Will the answer change if the temperature and pressure are changed ?

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Home Assignment (HA – 2.1) : -

NCERT Exercise question numbers 2.5 to2.11, 2.38, 2.42 to 2.44 & 2.47.

NCERT Exercise question numbers 2.5 to2.11, 2.38, 2.42 to 2.44 & 2.47.

2.5 Yellow light emitted from a sodium lamp has a wavelength (λ) of 580 nm.
Calculate the frequency (v) and wave number (v) of the yellow light.

2.6 Find energy of each of the photons which
(i) correspond to light of frequency 3×10^{15} Hz.
(ii) have wavelength of 0.50 Å.

2.7 Calculate the wavelength, frequency and wave number of a light wave whose period is 2.0×10^{-10} s.

2.8 What is the number of photons of light with a wavelength of 4000 pm that provide 1J of energy?

2.9 A photon of wavelength 4×10^{-7} m strikes on metal surface, the work function of the metal being 2.13 eV. Calculate (i) the energy of the photon (eV), (ii) the kinetic energy of the emission, and (iii) the velocity of the photoelectron (1 eV= 1.6020×10^{-19} J).

2.10 Electromagnetic radiation of wavelength 242 nm is just sufficient to ionise the sodium atom. Calculate the ionisation energy of sodium in kJ mol^{-1}.

2.11 A 25 watt bulb emits monochromatic yellow light of wavelength of 0.57μm. Calculate the rate of emission of quanta per second.

2.38 A certain particle carries 2.5×10^{-16}C of static electric charge. Calculate the number of electrons present in it.

2.42 An element with mass number 81 contains 31.7% more neutrons as compared to protons. Assign the atomic symbol.

2.43 An ion with mass number 37 possesses one unit of negative charge. If the ion contains 11.1% more neutrons than the electrons, find the symbol of the ion.

2.44 An ion with mass number 56 contains 3 units of positive charge and 30.4% more neutrons than electrons. Assign the symbol to this ion.

2.47 Neon gas is generally used in the sign boards. If it emits strongly at 616 nm, calculate (a) the frequency of emission, (b) distance traveled by this radiation in 30 s (c) energy of quantum and (d) number of quanta present if it produces 2 J of energy.

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Class XI Chemistry *Unit -2. Structure Of Atom*

Topic – 2.2 Bohr's & Quantum Mechanical Models Of Structure Of Atom

Work Sheet (WS – 2 . 2)

Name - _____. Class/ sec. _____. Roll No. _____.

A. Fill in the blanks:

1. According to Dual nature of radiation dual means _____ & _____ characters.
2. _____ is localized in space whereas _____ is delocalized in space.
3. Energies of electrons in an atom are _____ according to Bohr's.
4. Bohr's Theory of atom is applicable for _____ for examples for _____.
5. According to Bohr's concept of Quantization of angular momentum ; $m\,v\,r$ = _____.
6. Electronic configuration of Fe^{2+} ion is _____.
7. Write all the four quantum numbers of the electron in the outermost shell of Rb (At. No. = 37) atom.
8. _____ quantum number specify the orientation in space for an electron.
9. Shape of an orbital is determined by _____ quantum number.
10. Total number of electrons in a Shell is given by _____.
11. The number of electrons ejected is proportional to the _____ or _____ of light.
12. The study of emission or absorption spectra is referred to as _____.
13. The electron in the hydrogen atom can move around the nucleus in a circular path of fixed radius and energy, these paths are called _____.
14. The value 109,677 cm^{-1} is called the _____ constant for hydrogen.
15. _____ (1913) was the first to explain quantitatively the general features of hydrogen atom structure and its spectrum.
16. _____ states that it is impossible to determine simultaneously, the exact position and exact momentum (or velocity) of an electron.
17. _____ rules out existence of definite paths or trajectories of electrons and other similar particles.
18. _____ model of the hydrogen atom, therefore, not only ignores dual behaviour of matter but also contradicts Heisenberg uncertainty principle.
19. _____quantum number. '*l*' is also known as orbital angular momentum or subsidiary quantum number.
20. The total number of _____ are given by (*n*–1), i.e., *sum of l,* _____ nodes and (*n* – *l* – 1), _____ nodes.

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Class XI Chemistry *Unit -2. Structure Of Atom*

Topic – 2.2 Bohr's & Quantum Mechanical Models Of Structure Of Atom

Class Assignment (CA – 2 . 2) :-

NCERT Solved problems 2.10 & 2.18 & NCERT Exercise question numbers 2.15, 2.16, 2.20 to 2.25, 2.29 to 2.31.

Solved problems 2.10 & 2.18.

Problem 2.10 What are the frequency and wavelength of a photon emitted during a transition from $n = 5$ state to the $n = 2$ state in the hydrogen atom?

Problem 2.11 Calculate the energy associated with the first orbit of He^+ . What is the radius of this orbit?

Problem 2.12 What will be the wavelength of a ball of mass 0.1 kg moving with a velocity of 10 m s^{-1} ?

Problem 2.13 The mass of an electron is 9.1 X 10^{-31} kg. If its K.E. is 3.0 X 10^{-25} J, calculate its wavelength.

Problem 2.14 Calculate the mass of a photon with wavelength 3.6 Å.

Problem 2.15 A microscope using suitable photons is employed to locate an electron in an atom within a distance of 0.1 Å. What is the uncertainty involved in the measurement of its velocity?

Problem 2.16 A golf ball has a mass of 40g, and a speed of 45 m/s. If the speed can be measured within accuracy of 2%, calculate the uncertainty in the position.

Problem 2.17 What is the total number of orbitals associated with the principal quantum number $n = 3$?

Problem 2.18 Using *s*, *p*, *d*, f notations, describe the orbital with the following quantum numbers : (a) $n = 2$, $l = 1$; (b) $n = 4$, $l = 0$; (c) $n = 5$, $l = 3$; (d) $n = 3$, $l = 2$.

NCERT Exercise question numbers 2.15, 2.16, 2.20 to 2.25, 2.29 to 2.31.

2.15 What is the maximum number of emission lines when the excited electron of a H atom in $n = 6$ drops to the ground state?

2.16 (i) The energy associated with the first orbit in the hydrogen atom is -2.18×10^{-18} J $atom^{-1}$. What is the energy associated with the fifth orbit?

(ii) Calculate the radius of Bohr's fifth orbit for hydrogen atom.

2.20 Calculate the wavelength of an electron moving with a velocity of 2.05 X 10^7 m s^{-1}.

2.21 The mass of an electron is 9.1 X 10^{-31} kg. If its K.E. is 3.0 X 10^{-25} J, calculate its wavelength.

2.22 Which of the following are isoelectronic species i.e., those having the same number of electrons? Na^+, K^+, Mg^{2+}, Ca^{2+}, S^{2-}, Ar.

2.23 (i) Write the electronic configurations of the following ions: (a) H^- (b) Na^+ (c) O^{2-} (d) F^-

(ii) What are the atomic numbers of elements whose outermost electrons are represented by (a) $3s^1$ (b) $2p^3$ and (c) $3p^5$?

(iii) Which atoms are indicated by the following configurations?

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

2.24 What is the lowest value of *n* that allows g orbitals to exist?

2.25 An electron is in one of the 3*d* orbitals. Give the possible values of *n*, *l* and m_l for this electron.

2.29 Using *s*, *p*, *d* notations, describe the orbital with the following quantum numbers.

(a) $n = 1$, $l = 0$; (b) $n = 3$; $l = 1$ (c) $n = 4$; $l = 2$; (d) $n = 4$; $l = 3$.

2.30 Explain, giving reasons, which of the following sets of quantum numbers are not possible.

(a) $n = 0$, $l = 0$, $m_l = 0$, $m_s = + ½$

(b) $n = 1$, $l = 0$, $m_l = 0$, $m_s = – ½$

(c) $n = 1$, $l = 1$, $m_l = 0$, $m_s = + ½$

(d) $n = 2$, $l = 1$, $m_l = 0$, $m_s = – ½$

(e) $n = 3$, $l = 3$, $m_l = –3$, $m_s = + ½$

(f) $n = 3$, $l = 1$, $m_l = 0$, $m_s = + ½$

2.31 How many electrons in an atom may have the following quantum numbers?

(a) $n = 4$, $m_s = – ½$ (b) $n = 3$, $l = 0$

Home Assignment (HA – 2 . 2) : -

NCERT Exercise question numbers 2.13, 2.14, 2.33, 2.34, 2.51, 2.53, 2.59, 2.60, 2.61, 2.63 & 2.67.

2.13 What is the wavelength of light emitted when the electron in a hydrogen atom undergoes transition from an energy level with $n = 4$ to an energy level with $n = 2$?

2.14 How much energy is required to ionise a H atom if the electron occupies $n = 5$ orbit? Compare your answer with the ionization enthalpy of H atom (energy required to remove the electron from $n = 1$ orbit).

2.33 What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition $n = 4$ to $n = 2$ of He^+ spectrum?

2.34 Calculate the energy required for the process :$He^+ (g) \rightarrow He^{2+} (g) + e^-$ .The ionization energy for the H atom in the ground state is $2.18 \text{ X } 10^{-18}$ J $atom^{-1}$.

2.51 The work function for caesium atom is 1.9 eV. Calculate (a) the threshold wavelength and (b) the threshold frequency of the radiation. If the caesium element is irradiated with a wavelength 500 nm, calculate the kinetic energy and the velocity of the ejected photoelectron.

2.53 The ejection of the photoelectron from the silver metal in the photoelectric effect experiment can be stopped by applying the voltage of 0.35 V when the radiation 256.7 nm is used. Calculate the work function for silver metal.

2.59 If the velocity of the electron in Bohr's first orbit is 2.19×10^6 ms^{-1}, calculate the de Broglie wavelength associated with it.

2.60 The velocity associated with a proton moving in a potential difference of 1000 V is 4.37×10^5 ms^{-1} . If the hockey ball of mass 0.1 kg is moving with this velocity, calculate the wavelength associated with this velocity.

2.61 If the position of the electron is measured within an accuracy of + 0.002 nm, calculate the uncertainty in the momentum of the electron. Suppose the momentum of the electron is $h/4\pi\, m \times 0.05$ nm, is there any problem in defining this value.

2.63 The bromine atom possesses 35 electrons. It contains 6 electrons in $2p$ orbital, 6 electrons in $3p$ orbital and 5 electrons in $4p$ orbital. Which of these electron experiences the lowest effective nuclear charge?

2.67 (a) How many sub-shells are associated with $n = 4$? (b) How many electrons will be present in the sub-shells having m_s value of $-1/2$ for $n = 4$?

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Special Assignment (SA – 2 . 1) : -

2.4 Bohr's Model for Hydrogen Atom

2.4.1 What are the frequency and wavelength of a photon emitted during a transition from $n = 5$ state to the $n = 2$ state in the hydrogen atom?

2.4.2 Calculate the energy associated with the first orbit of He^+ . What is the radius of this orbit?

2.4.3 What is the wavelength of light emitted when the electron in a hydrogen atom undergoes transition from an energy level with $n = 4$ to an energy level with $n = 2$?

2.4.4 How much energy is required to ionise a H atom if the electron occupies $n = 5$ orbit? Compare your answer with the ionization enthalpy of H atom (energy required to remove the electron from $n = 1$ orbit).

2.4.5 What is the maximum number of emission lines when the excited electron of a H atom in $n = 6$ drops to the ground state?

2.4.6 (i) The energy associated with the first orbit in the hydrogen atom is -2.18×10^{-18} J $atom^{-1}$. What is the energy associated with the fifth orbit?

(ii) Calculate the radius of Bohr's fifth orbit for hydrogen atom.

2.4.7 Calculate the wavenumber for the longest wavelength transition in the Balmer series of atomic hydrogen.

2.4.8 What is the energy in joules, required to shift the electron of the hydrogen atom from the first Bohr orbit to the fifth Bohr orbit and what is the wavelength of the light emitted when the electron returns to the ground state? The ground state electron energy is -2.18×10^{-11} ergs.

2.4.9 The electron energy in hydrogen atom is given by $En = (-2.18 \times 10^{-18})/n^2$ J. Calculate the energy required to remove an electron completely from the $n = 2$ orbit. What is the longest wavelength of light in cm that can be used to cause this transition?

2.4.10 Emission transitions in the Paschen series end at orbit n = 3 and start from orbit n and can be represented as $v = 3.29 \times 10^{15}$ (Hz) $[1/3^2 - 1/n^2]$. Calculate the value of n if the transition is observed at 1285 nm. Find the region of the spectrum.

2.4.11 Calculate the wavelength for the emission transition if it starts from the orbit having radius 1.3225 nm and ends at 211.6 pm. Name the series to which this transition belongs and the region of the spectrum.

2.4.12 What transition in the hydrogen spectrum would have the same wavelength as the Balmer transition $n = 4$ to $n = 2$ of He^+ spectrum?

2.4.13 Calculate the energy required for the process :$He^+ (g) \rightarrow He^{2+} (g) + e^-$ .The ionization energy for the H atom in the ground state is 2.18×10^{-18} J $atom^{-1}$.

2.4.14 The longest wavelength doublet absorption transition is observed at 589 and 589.6 nm. Calculate the frequency of each transition and energy difference between two excited states.

2.4.15 Which series of lines of the hydrogen spectrum lie in the visible region?

2.4.16 What do you mean that energy of the electron is quantized?

2.4.17 Find the wavelength of radiation emitted when an electron from infinity falls to stationary state 1 in a hydrogen atom. ($R_H = 1.09 \times 10^7$ m^{-1})

2.4.18 Calculate the wavelength of the radiation emitted when an electron in a hydrogen atom undergoes a transition from 5^{th} to 3rd energy level. In which part of the electromagnetic spectrum does this line lie?

2.4.19 What are the limitations of Bohr's Model and what are the reasons for its failure.

2.4.20 Calculate: First and second excitation energy of an electron in hydrogen atom. Compare these values with the ionization energy of H atom.

2.4.21 Calculate the energy associated with the third orbit of He^+. What is the radius of this orbit?

2.4.22 What is the significance of negative electronic energy?

2.4.23 Which series are produced when electrons from the outer orbits jumps to 3^{rd} orbit?

2.4.24 Which series are produced when electrons from the outer orbits jumps to 3^{rd} orbit?

2.4.25 Calculate the frequency of first line in Balmer series in spectrum of hydrogen atoms.

2.4.26 Find the wavelength of radiation emitted when an electron from infinity falls to stationary state 1 in a hydrogen atom. ($R_H = 1.09 \times 10^7$ m^{-1})

2.4.27 What is the maximum number of emission lines when the excited electron of a H-atom in n = 3 drops to the ground state?

2.4.28 The wavelength of the first line in the Balmer series is 656 nm. Calculate the wavelength of limiting line in Balmer Series.

2.4.29 Which series of lines of the hydrogen spectrum lie in the visible region?

2.4.30 What were the discrepancies observed in Bohr's model?

2.5 Towards Quantum Mechanical Model of the Atom
[de-Broglie Wavelength & Heisenberg's uncertainty Principles]

2.5.1 What will be the wavelength of a ball of mass 0.1 kg moving with a velocity of 10 m s^{-1} ?

2.5.2 The mass of an electron is 9.1 X 10^{-31} kg. If its K.E. is 3.0 X 10^{-25} J, calculate its wavelength.

2.5.3 Calculate the mass of a photon with wavelength 3.6 Å.

2.5.4 A microscope using suitable photons is employed to locate an electron in an atom within a distance of 0.1 Å. What is the uncertainty involved in the measurement of its velocity?

2.5.5 A golf ball has a mass of 40g, and a speed of 45 m/s. If the speed can be measured within accuracy of 2%, calculate the uncertainty in the position.

2.5.6 Calculate the wavelength of an electron moving with a velocity of 2.05 X 10^{7} m s^{-1}.

2.5.7 The mass of an electron is 9.1 X 10^{-31} kg. If its K.E. is 3.0 X 10^{-25} J, calculate its wavelength.

2.5.8 Show that the circumference of the Bohr orbit for the hydrogen atom is an integral multiple of the de Broglie wavelength associated with the electron revolving around the orbit.

2.5.9 Dual behaviour of matter proposed by de Broglie led to the discovery of electron microscope often used for the highly magnified images of biological molecules and other type of material. If the velocity of the electron in this microscope is 1.6 × 10^{6} ms^{-1}, calculate de Broglie wavelength associated with this electron.

2.5.10 Similar to electron diffraction, neutron diffraction microscope is also used for the determination of the structure of molecules. If the wavelength used here is 800 pm, calculate the characteristic velocity associated with the neutron.

2.5.11 If the velocity of the electron in Bohr's first orbit is 2.19 × 10^{6} ms^{-1}, calculate the de Broglie wavelength associated with it.

2.5.12 The velocity associated with a proton moving in a potential difference of 1000 V is 4.37 × 10^{5} ms^{-1} . If the hockey ball of mass 0.1 kg is moving with this velocity, calculate the wavelength associated with this velocity.

2.5.13 If the position of the electron is measured within an accuracy of + 0.002 nm, calculate the uncertainty in the momentum of the electron. Suppose the momentum of the electron is $h/4\pi$ m × 0.05 nm, is there any problem in defining this value.

2.5.14 When a ball is hit with a hockey stick by a player, it does not make a wave. Why?

2.5.15 The uncertainty in momentum of an electron is 1.0 × 10^{-5} Kg ms^{-1} . What is the uncertainty in its position?

2.5.16 Find the de Broglie wavelength in Å of a particle with mass 1g and velocity 100m/s.

2.5.17 Find wavelength of photon having energy 3.03 × 10^{-19} J.

2.5.18 What will be the uncertainty in velocity of an electron (mass of electron = 9.1 × 10^{-28} g) moving with a velocity of 3.0 × 10^{4} ms^{-1} accurate up to 0.011%?

2.5.19 Derive de Broglie's relationship. What is its significance?

2.5.20 A moving electron has 5 × 10^{-25} J of K.E. Calculate its wavelength associated with it.

2.5.21 Calculate the momentum associated with de-Broglie's wavelength of 8 A^{0} .

2.5.22 What will be the uncertainty in velocity of an electron (mass of electron = 9.1 × 10^{-28} g) moving with a velocity of 5.0 × 10^{5} ms^{-1} accurate up to 0.11%?

2.5.23 A moving electron has 5 × 10^{-26} J of K.E. Calculate its wavelength associated with it.

2.5.24 What is the value of Plank's constant in S.I. Units?

2.5.25 The uncertainty in momentum of an electron is 1.0 × 10^{-5} Kg ms^{-1} . What is the uncertainty in its position?

2.5.26 Find the de Broglie wavelength in Å of a particle with mass 1g and velocity 100m/s.

2.5.27 Find wavelength of photon having energy 3.03 $\times 10^{-19}$ J.
2.5.28 Establish relationship between energy of radiations having wavelength 8000 A^0 and 16000 A^0.
2.5.29 Derive de Broglie's relationship. What is its significance?
2.5.30 Name the experiments, which explains the dual nature of light.

2.6 Quantum Mechanical Model of Atom

2.6.1 What is the total number of orbitals associated with the principal quantum number $n = 3$?
2.6.2 Using *s*, *p*, *d*, f notations, describe the orbital with the following quantum numbers :
(a) $n = 2, l = 1$; (b) $n = 4, l = 0$; (c) $n = 5, l = 3$; (d) $n = 3, l = 2$.
2.6.3 Which of the following are isoelectronic species i.e., those having the same number of electrons? Na^+, K^+, Mg^{2+}, Ca^{2+}, S^{2-}, Ar.
2.6.4 (i) Write the electronic configurations of the following ions: (a) H^- (b) Na^+ (c) O^{2-} (d) F^-
(ii) What are the atomic numbers of elements whose outermost electrons are represented by
(a) $3s^1$ (b) $2p^3$ and (c) $3p^5$?
(iii) Which atoms are indicated by the following configurations?
(a) [He] $2s^1$ (b) [Ne] $3s^2\ 3p^3$ (c) [Ar] $4s^2\ 3d^1$.
2.6.5 What is the lowest value of *n* that allows *g* orbitals to exist?
2.6.6 An electron is in one of the 3*d* orbitals. Give the possible values of *n*, *l* and m_l for this electron.
2.6.7 Which atom indicates the given cofigurations? (i) [Ar] $4s^2$ (ii) [Kr]$5s^1$
2.6.8 Point out the differences and similarities in the orbitals represented by following sets of quantum numbers

	n	l	m
(i)	3	2	+2
(ii)	3	2	–1

2.6.9 (i) An atomic orbital has $n = 3$. What are the possible values of *l* and m_l ?
(ii) List the quantum numbers (m_l and *l*) of electrons for 3*d* orbital.
(iii) Which of the following orbitals are possible? 1*p*, 2*s*, 2*p* and 3*f*.
2.6.10 Using *s*, *p*, *d* notations, describe the orbital with the following quantum numbers.
(a) $n = 1, l = 0$; (b) $n = 3$; $l = 1$ (c) $n = 4$; $l = 2$; (d) $n = 4$; $l = 3$.
2.6.11 Explain, giving reasons, which of the following sets of quantum numbers are not possible.
(a) $n = 0, l = 0, m_l = 0, m_s = +\frac{1}{2}$; (b) $n = 1, l = 0, m_l = 0, m_s = -\frac{1}{2}$;
(c) $n = 1, l = 1, m_l = 0, m_s = +\frac{1}{2}$; (d) $n = 2, l = 1, m_l = 0, m_s = -\frac{1}{2}$;
(e) $n = 3, l = 3, m_l = -3, m_s = +\frac{1}{2}$; (f) $n = 3, l = 1, m_l = 0, m_s = +\frac{1}{2}$.
2.6.12 How many electrons in an atom may have the following quantum numbers?
(a) $n = 4, m_s = -\frac{1}{2}$ (b) $n = 3, l = 0$
2.6.13 Which of the following orbitals are not possible 2*d*, 4f, 6d, 3*g*
2.6.14 How many spherical nodes are present in 3p orbital?
2.6.15 What do you mean that energy of the electron is quantized?
2.6.16 Which quantum number determines the size of the orbital?
2.6.17 Give the significance of $|\psi|^2$
2.6.18 Which orbital does not have directional characteristic?
2.6.19 Which energy level does not have a p – orbital?
2.6.20 If the largest value of *m* for an electron is +2, then the electron may be present in what type of sub shell?
2.6.21 Write the designation for orbitals with following quantum numbers
(a) n = 3, l = 0 (b) n = 5, l = 2
2.6.22 Write the electronic configuration of following atoms/ions F^-, Cr, Mg^{2+}, O^-, Ca
2.6.23 Explain Hund's rule with help of example of nitrogen.
2.6.24 If the largest value of m for an electron is +2, then the electron may be present in what type of sub shell?
2.6.25 Write the electronic configuration of following atoms/ions: F^-, Cr, Mg^{2+}, O^-, Ca
2.6.26 (i) Write values of n and l for 4f orbital.
(ii) Write all possible values of l and m for n = 2.
2.6.27 Explain Hund's rule with the help of example of nitrogen.
2.6.28 Write the designation for orbitals with following quantum numbers-

(a) n = 3, l = 1 (b) n = 5, l = 2

2.6.29 Point out the differences and similarities in the orbitals represented by following sets of quantum numbers-

	n	l	m
(i)	3	2	+2
(ii)	3	2	–1

2.6.30 Which of the following orbitals are not possible - : 2d, 4f, 6d, 3g

2.6.31 Write the equation which relates photons both as wave motion and as stream of particles.

2.6.32 Write the electronic configuration of a divalent ion of a coinage metal.

2.6.33 Which is more paramagnetic Fe^{3+} or Fe^{2+}?

2.6.34 What is the electronic configuration of Cu (Z = 29)

2.6.35 What are degenerate orbitals?

2.6.36 What is the maximum number of electrons that can be accommodated in the d – sub shell?

2.6.37 What do you conclude, when an electron beam after hitting a nickel crystal produces a diffraction pattern?

2.6.38 How many spherical nodes are present in 3p orbital?

2.6.39 What is the physical significance of $|\psi|^2$?

2.6.40 What do you mean that energy of the electron is quantized?

2.6.41 Which quantum number determines the size of the orbital?

2.6.42 Which energy level does not have a p- orbital?

2.6.43 Which orbital does not have directional characteristic?

2.6.44 Explain Hund's rule with the help of example of nitrogen.

2.6.45 (i) Write values of n and l for 4f orbital.
(ii) Write all possible values of l and m for n = 2.

2.6.46 Write the designation for orbitals with following quantum numbers- (a) n = 3, l = 1; (b) n = 5, l = 2.

2.6.47 Which of the following orbitals are not possible - 1d, 2f, 2d, 5g

2.6.48 If the largest value of m for an electron is +2, then the electron may be present in what type of sub shell?

2.6.49 Point out the differences and similarities in the orbitals represented by following sets of quantum numbers-

	n	l	m
(i)	5	2	+2
(ii)	5	1	0

2.6.50 The bromine atom possesses 35 electrons. It contains 6 electrons in 2*p* orbital, 6 electrons in 3*p* orbital and 5 electrons in 4*p* orbital. Which of these electron experiences the lowest effective nuclear charge?

2.6.51 Among the following pairs of orbitals which orbital will experience the larger effective nuclear charge? (i) 2*s* and 3*s*, (ii) 4*d* and 4 *f* , (iii) 3*d* and 3*p*.

2.6.52 The unpaired electrons in Al and Si are present in 3*p* orbital. Which electrons will experience more effective nuclear charge from the nucleus ?

2.6.53 Indicate the number of unpaired electrons in : (a) P, (b) Si, (c) Cr, (d) Fe and (e) Kr.

2.6.54 (a) How many sub-shells are associated with *n* = 4 ? (b) How many electrons will be present in the sub-shells having m_s value of –1/2 for *n* = 4 ?