



## CHEMISTRY

### BOOKS - CENGAGE CHEMISTRY (HINGLISH)

#### NCERT BASED EXERCISE

##### In Text Questions

1. Why are solid rigid?



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2. Why do solids have a definite volume?



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3. Classify the following as amorphous or crystalline solids: polyurethane, naphthalene, benzoic acid, teflon, potassium nitrate, cellophane, polyvinyl chloride, fibre glass, copper.

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4. Why is glass considered a supercooled liquid?

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5. The refractive index of a solid is observed to have the same value along all direction. Comment on the nature of this solid. Would it show cleavage property?

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6. Solid  $A$  is a very hard electrical insulator in solid as well as in molten state and melts at extremely high temperature. What type of solid is it?

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7. Ionic solids conduct electrical insulator in solid as well as in molten state but not in solid state. Explain

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8. What type of solids are electrical conductors, malleable or ductile?

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9. Give the significance of "lattice point."

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10. Name the parameters that characterized a unit cell.

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11. Distinguish between

a. Hexagonal and monoclinic unit cells

(b) Face-centred and end-centred unit cells

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12. Explain how much portion of an atom located at (a) corner and

(b) body centre of a cubic unit cell is part of its neighbouring unit

cell.

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**13.** What is the two-dimensional coordination number of a molecule in square close-packed layer?

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**14.** A compound is formed hexagonal close-packed structure. What is the total number of voids in 0.5 mol of it? How many of these are tetrahedral voids?

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15. A compound formed by two elements  $M$  and  $N$ . Element  $N$  forms ccp and atoms of  $M$  occupy  $1/3rd$  of tetrahedral voids. What is the formula of th compound?

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16. Which of the following lattices has the highest packing efficiency (a) simple cubic, (b) body-centred cubic, and (c ) hexagonal close-packed lattice?

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17. An element with molar mass  $2.7 \times 10^2 \text{kgmol}^{-1}$  forms a  $2.7 \times 10^3 \text{kg}^{-3}$ , what is the nature of the cubic unit cell?

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18. What type of defect can arise when a solid is heated?

Which physical property is affected by it and in what way?

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19. What type of stoichiometric defect is shown by:

(a)  $ZnS$  (b)  $AgBr$

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20. Explain how vacancies are introduced in an ionic solid when a cation of higher valence is added as an impurity in it.

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21. Ionic solids, which have anioninc vacancies due to metal excess defect, developed colour. Explain with the help of a suitalbe example.

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22. A group-14 element is to be converted into n-type semiconductor by doping it with a suitalbe impurity. To which group this impurity belong?

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23. What type of substances would make better permanent magnets, ferromagnetic or ferrimagnetic? Justify your answer.

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24. Calculate the mass percentage of benzene ( $C_6H_6$ ) and carbon tetrachloride ( $CCl_4$ ) if 22g of benzene is dissolved in 122g of carbon tetrachloride.

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25. Calculate the mole fraction of benzene in solution containing 30 % by mass in carbon tetrachloride.

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26. Calculate the molarity of each of the following solutions :

a. 30g of  $Co(NO_3)_2 \cdot 6H_2O$  in 4.3L of solution

b. 30mL of 0.5M  $H_2SO_4$  diluted to 500mL.

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27. Calculate the mass of urea ( $NH_2CONH_2$ ) required in making 2.5kg of 0.25molal aqueous solution.

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28. Calculate the (a) molality, (b) molarity, and (c) mole fraction of  $KI$  if the density of 20% ( mass / mass ) aqueous  $KI$  is  $1.202gmL^{-1}$ .

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29.  $H_2S$ , a toxic gas with rotten egg like smell, is used for the qualitative analysis. If the solubility of  $H_2S$  in water at  $STP$  is  $0.195m$ , calculate Henry's law constant.

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30. Henry's law constant for  $CO_2$  in water is  $1.67 \times 10^8 Pa$  at  $298K$ . Calculate the quantity of  $CO_2$  in  $500mL$  of soda water when packed under  $2.5atmCO_2$  pressure at  $298K$ .

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31. The vapour pressure of pure liquids  $A$  and  $B$  is  $450$  and  $700mmHg$ , respectively, at  $350K$ . Find out the composition of the liquid mixture if the total vapour pressure is  $600mmHg$ . Also find the composition of the vapour phase.

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32. Vapour pressure of pure water at  $298K$  is  $23.8mmHg$ .  $50g$  of urea ( $NH_2CONH_2$ ) is dissolved in  $850g$  of water. Calculate the

vapour pressure of water for this solution and its relative lowering.

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**33.** The boiling point of water at  $750\text{mmHg}$  is  $99.63^\circ\text{C}$ . How much sucrose is to be added to  $500\text{g}$  of water such that it boils at  $100^\circ\text{C}$ .

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**34.** Calculate the mass of ascorbic acid ( Vitamin C,  $\text{C}_6\text{H}_8\text{O}_6$ ) to be dissolved in  $75\text{g}$  of acetic acid to lower its melting point by  $1.5^\circ\text{C}$ .  $K_f = 3.9\text{Kkgmol}^{-1}$

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35. Calculate the osmotic pressure in pascals exerted by a solution prepared by dissolving 1.0g of polymer of molar mass 185,000 in 450mL of water at 37°C.

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36. How would you determine the standard reduction potential of the system  $Mg^{2+} | Mg$ ?

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37. Can you store  $CuSO_4$  solution in Zn pot ?

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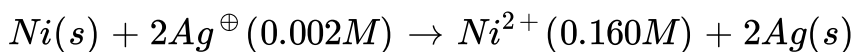
**38.** Consult the table of standard electrode potential and suggest three substances that can oxidize  $Fe^{2+}$  ions under suitable conditions.

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**39.** Calculate the potential of hydrogen electrode in contact with a solution whose  $pH = 10$ .

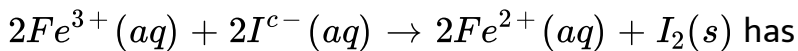
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**40.** Calculate the  $EMF$  of the cell in which the following reaction takes place :



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41. The cell in which the following reaction occurs :



$E^{\circ}_{cell} = 0.2136V$  at  $298K$ . Calculate the standard Gibbs energy and the equilibrium constant of the cell reaction.

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42. Why does the conductivity of a solution decrease with dilution ?

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43. Suggest a way to determine  $\Lambda_{m^{\circ}}$  value of water.

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44. The molar conductivity of  $0.25\text{molL}^{-1}$  methanoic acid is  $46.1\text{Scm}^2\text{mol}^{-1}$ . Calculate the degree of dissociation constant.

Given :  $\lambda_{(H^{\oplus})}^{\circ} = 349.6\text{Scm}^2\text{mol}^{-1}$  and

$\lambda_{(CHM_3COO^{c-})}^{\circ} = 54.6\text{Scm}^2\text{mol}^{-1}$

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45. If a current of  $0.5\text{A}$  flows through a metallic wire for 2 hours, then how many electrons would flow through the wire ?

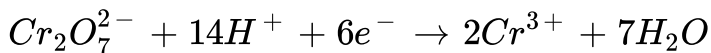
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46. Suggest a list a metals that are extracted electrolytically.

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**47.** Consider the reaction :



What is the quantity of electricity in coulombs needed to reduce

1 mole of  $\text{Cr}_2\text{O}_7^{2-}$  ?

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**48.** Write the chemistry of recharging of lead storage battery highlighting all the materials that are involved during recharging.

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**49.** Suggest two materials other than hydrogen that can be used as fuels in fuel cells.

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50. Explain how rusting of iron is envisaged as setting up of an electrochemical cell.

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### Ncert Exercise

1. Define the term "amorphous". Give a few example of amorphous solids.

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2. Classify each of the following solids as ionic, metallic, molecular, network (covalent), or amorphous.

a. Tetra phosphorus decoxide ( $P_4O_{10}$ )

b. Graphite c. Brass

d. Ammonium phosphate  $(NH_4)_3PO_4$

e. *Sic* f. *Rb* g.  $I_2$  h. *LiBr*

i.  $P_4$  j. *Si* k. Plastic



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3. What is meant by the term "coordination number"?

b. What is the coordination number of atoms:

i. in a cubic-packed structure?

ii. In a body-centred structure?



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4. How can you determine the atomic mass of an unknown metal if you know its density and the dimension of its unit cell? Explain.



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5. a. "Stability of a crystal is reflected is reflected in the magnitude of its melting points" Comment.

b. Melting points of some compounds are given below water =  $273K$ , ethyl alcohol =  $153.7K$ , diethyl ether =  $156.8K$ , methane =  $90.5K$ . What can you say about the intermolecular forces between the molecules of these compounds?

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6. How will you distinguish between the following pairs of terms?

a. Hexagonal close-packing and cubic close-packing

b. Crystal lattice and unit cell

c. Tetrahedral void octahedral void

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7. How many lattice points are there in one unit cell of each of the following lattice?

- a. Face-centred cubic
- b. Face-centred tetragonal
- c. Body-centred



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8. Explain

- a. The basic of similarities and differences between metallic and ionic crystals.
- b. Ionic solids are hard and brittle.



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9. Calculate the efficiency of packing in case of a metal crystal for

a. Simple cubic

b. Body-centred cubic

c. Face-centred cubic (with the assumptions that atoms are touching each other).

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10. Silver crystallizes in fcc lattice. If the edge length of the cell is  $4.07 \times 10^{-8} \text{ cm}$  and density is  $10.5 \text{ g cm}^{-3}$ . Calculate the atomic mass of silver.

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11. A cubic solid is made of two element  $P$  and  $Q$  Atoms of  $Q$  are the corners of the cube  $P$  at the body-centre. What is the formula

of the compound? What are the coordination number fo  $P$  and  $Q$

?

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12. Niobium crystallizes in body-centred cubic structure. If the density is  $8.55\text{gcm}^{-3}$ , calculate the atomic radius of niobium using its atomic mass  $93u$ .

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13. If the radius of the octahedral void is  $r$  and the radius of the atoms in close-packing is  $R$ , derive relation between  $r$  and  $R$

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14. Copper crystallizes into an fcc lattice with edge length  $3.61 \times 10^8 \text{ cm}$ , Show that the calculated density is in agreement with its measured value of  $8.92 \text{ g cm}^3$ .

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15. Analysis shows that nickel oxide has the formula  $\text{Ni}_{0.98}\text{O}_{1.00}$ . What fractions of nickel "exist" as  $\text{Ni}^{2+}$  and  $\text{Ni}^{3+}$  ions?

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16. What is a semiconductor? Describe the two main types of semiconductor and contrast their conduction mechanism.

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17. Non-stoichiometric cuprous oxide.  $Cu_2O$  can be prepared in laboratory. In this oxide, copper-to-oxygen ratio is slightly less than 2 : 1. can you account for the fact that this substance is a p-type semiconductors?

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18. Ferric oxide crystallizes in a hexagonal close-packed array of oxide ions with two out of every three octahedral holes occupied by ferric ions. Derive the formula of the ferric oxide.

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19. Classify each of the following as being either a p-type or an n-type semiconductor

a. Ge doped with In

b. B doped with Si



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**20.** Gold (atomic radius = 0.144 nm) crystallizes in a face-centred unit cell. What is the length of a side of the cell?



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**21.** In terms of band theory, what is the difference between

- a conductor and an insulator
- a conductor and a semiconductor



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**22.** Explain the following terms with suitable example:

- Schottky defect
- Frenkel defect
- Interstitials
- F-centres



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23. Aluminium crystallizes in a cubic close-packed structure. Its metallic radius is  $125p \pm$

- What is the length of the side of the unit cell?
- How many unit cells are there in  $1.00\text{cm}^3$  of aluminium?



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24. If  $\text{NaCl}$  is doped with  $10^{-3}$  mole of  $\text{SrCl}_2$  then number of cationic vacancies is



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25. Explain the following with suitable examples:

- Ferromagnetism
- Paramagnetism

c. Ferrimagnetism d. Antiferromagnetism

e. 12 - 46 and 13 - 15 group compounds

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## Short Answer Type Questions

1. Why amorphous solids are called as supercooled liquids?

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2. Why benzoic acid has a sharp melting point but glass does not?

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3. Classify the following into ionic, molecular, covalent and metallic crystals:

$SiO_2$  (quartz), brass bronze, dry ice, nitre diamond,  $H_2O$  (ice),

$SO_2$ ,  $I_2$ ,  $CaO$

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4. A  $CsCl$  crystal is found to have  $NaCl$  structure. How it happened?

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5. A  $NaCl$  crystal is found to have  $CsCl$  structure. How it happened?

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6. What is the coordination number of  $TV_s$  and  $OV_s$



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7. What is the coordination number of each ion present in the closed packed structures of (a)  $Na_2O$  (b)  $CaF_2$  at ordinary temperature and pressure?



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8. What is the coordination number of hcp and ccp?



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9. How does the structure of amorphous silica (quartz glass) differ from quartz?



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10. Do all metals possess a closest packed structure?



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11. Why do some substances exist as solids?



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12. Why do the window glasses of old buildings (a) look milky and (b) become thick at the bottom?



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13. Why the melting points of  $NaF$  and  $MgO$  ( $990^{\circ}C$  and  $2640^{\circ}C$ ) are so different although both have same number of electrons and nearly the same internuclear distance (236 pm and 216 pm)?

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14. How many types of centred unit cells exist?

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15. How many types of two-dimensional lattice exist? Why pentagonal lattices not possible?

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16. How many  $TVs$  and  $OVs$  occur per unit cell and per atom in a closest packed structure?

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17. Where the  $TVs$  and  $OVs$  are located in a closet packed structure?

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18. What is the distance between two  $TVs$ ?

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19. In an hcp structure, calculate

a.  $Z_{eff}$

Base area of hexagon

c. Height of hexagon

d. Volume of unit cell of hexagon

e. Packing fraction

f.  $c/a$  ratio of ideally closed hcp crystal

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**20.** In a diamond cubic (dc) structure, calculate

(a)  $Z_{\text{eff}}$  (b)  $CN$  radius of  $C$ -atom and (d)  $PF$

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**21.** What is the ratio of  $(TV/OV)_{\text{occupied}}$  in spinel an inverse spinel structure?

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22. What is the  $CN$  of cation and anion in a corundum structure?

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23. What is the occurrence of different forms of the same compound called?

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24. How many types of allotropy exist?

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25. How can a substance be made amorphous?

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26. Why does  $ZnO$  show increased electrical conductivity and turns yellow on heating?



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27. Why  $NiO$  and  $FeO$  are nonstoichiometric with the formula  $Ni_{0.98}O$  and  $Fe_{0.95}O$ ?



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28. Why the defects of the crystalline solids are called thermodynamic defects?



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29. Why stoichiometric defects are also called intrinsic defects?

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30. Give the name of one solid which shows both Schottky and Frenkel defects?

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31. Why Frenkel defects are not found in pure alkali metal halides?

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32. Why common salt ( $NaCl$ ) sometimes appear yellow?

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**33.** How do the electrical conductivity and resistivity of metallic conductors, semi-conductors, and super conductors vary with temperature ?

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**34.** What is energy gap in bond theory?

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**35.** What is photo voltaic cell?

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**36.** What happens when ferrimagnetic  $Fe_3O_4$  is heated to  $850K$ ?



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37. What happens when ferromagnetic substance is heated to high temperature?



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38. Which type of defect is product when  $NaCl$  is dopped with  $AlCl_3$ ?



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39. Which point defect lowers the density of a crystal?



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40. At what temperature range most of the metals becomes superconductors

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41. What is curie temperature?

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42. Name the compound that can be added to  $AgCl$  so as to produce cation vacancies.

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43. Which point defect does not change the density of  $AgCl$  crystals?



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44. What other elements may be added to silicon to make electrons available for conduction of an electric current?

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45. What are the types of lattice imperfection found in crystals?

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46. What is dislocation in the crystals

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47. Which transition metal oxide has appearance and conductivity like that of copper

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48. How is electrical conductivity caused in (a) semiconductors, (b) metals, and (c) ionic compounds?

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49. Name the compound which shows both electric and ferroelectric properties.

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50. Name the compound which shows anti-ferroelectric property.



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51. When and why is molality preferred over molarity in handling solution in CHMemistry?



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52. What is the effect of temperature on molarity of a solution?



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53. Whivh aqueous solution has higher concentration : 1 molar or 1 molal solution of the same solute ?



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54. Why vapour pressure of a liquid decreases when a non – volatile solute is added to it ?

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55.  $10dm^3$  of a liquid  $A$  was mixed with  $10dm^3$  of liquid  $B$  . The volume of the resulting solution was found to be  $19dm^3$  . What do you conclude ?

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56. What do you expect to happen when red blood corpuscles ( $RBCs$ ) are placed in (a)  $0.5\%$   $NaCl$  solution and (b)  $1\%$   $NaCl$  solution ?

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57. What will happen to the boiling point of a solution if the weight of the solute dissolved is doubled but the weight of solvent taken is halved ?

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58. What type of liquids form ideal solution ?

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59. How much molecular mass of  $NaCl$  is obtained experimentally using colligative properties ?

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60. Why an azeotropic mixture gets distilled without any change in composition ?

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61. Why do radioactive element decay?

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62. How can a nucleus lose electrons ( $\beta$ -particles) even though free electrons are not present in it?

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63. What is the total life of a radioactive element ?



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64. What is the source of radioactive  $CO_2$  in the atmosphere?

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65. What are transactinides ? To which block do they belong ?

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66. Why is synthesis of transactinides difficult ?

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67. Name the fundamental particle which exists in the nucleus with protons and neutrons.

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68. Which radioactive metal is used as an ingredient of atomic explosive weapons ?



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69.  $C - 14$  is formed in the upper atmosphere. Why it does not occur at the ground level ?



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### Ncert Exercise

1. विलयन को परिभाषित कीजिए । कितने प्रकार के विभिन्न विलयन संभव है ? प्रत्येक प्रकार के विलयन के संबंध में एक उदाहरण देकर संक्षेप में लिखिए ।





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2. Suppose a solid solution is formed between two substances, one whose particles are very large and the other whose particles are very small. What kind of solid solution is this likely to be ?



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3. Define the following terms :

- a. Mole fraction
- b. Molality
- c. Molarity
- d. Mass percentage.



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4. Concentrated nitric acid used in the laboratory work is 68% nitric acid by mass in aqueous solution. What should be the

molarity of such a sample of the acid if the density of solution is  $1.504\text{gmL}^{-1}$ ?

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5. A solution of glucose in water is labelled as 10percent  $w/w$ , what would be the molality and mole fraction of each component in the solution? If the density of the solution is  $1.2\text{gmL}^{-1}$ , then what shall be the molarity of the solution?

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6. How many  $mL$  of a  $0.1M\text{HCl}$  are required to react completely with  $1g$  mixture of  $\text{Na}_2\text{CO}_3$  and  $\text{NaHCO}_3$  containing equimolar amounts of two?

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7. Calculate the percentage composition in terms of mass of solution obtained by mixing 300g of a 25 % and 400g of a 40 % solution by mass.

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8. An antifreeze solution is prepared from 222.6g of ethylene glycol  $[C_2H_4(OH)_2]$  and 200g of water. Calculate the molality of the solution. If the density of the solution is  $1.072gmL^{-1}$  then what shall be the molarity of the solution?

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9. A sample of drinking water was found to be severely contaminated with chloroform,  $CHCl_3$ , supposed to be carcinogen. The level of contamination was 15 ppm (by mass).

(i) Express this in per cent by mass.

(ii) Determine the molality of chloroform in the water sample.

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10. What role does the molecular interaction play in a solution of alcohol and water ?

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11. Why do gases always tend to be less soluble in liquids as the temperature is raised?

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12. State Henry's law and mention some important applications ?



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13. The partial pressure of ethane over a saturated solution containing  $6.56 \times 10^{-2}g$  of ethane is 1 bar. If the solution contains  $5.00 \times 10^{-2}g$  of ethane, then what shall be the partial pressure of the gas?

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14. What is meant by positive and negative deviations from Raoult's law and how is the sign of  $\Delta_{mix}H$  related to positive and negative deviations from Raoult's law ?

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15. An aqueous solution of 2 per cent (*wt. / wt*) non-volatile solute exerts a pressure of 1.004 bar at the boiling point of the solvent. What is the molecular mass of the solute?

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16. Heptane and octane form an ideal solution. At 373K, the vapour pressure of the two liquids are 105.0 kPa and 46.0 kPa, respectively. What will be the vapour pressure, of the mixture of 25g of heptane and 35g of octane ?

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17. The vapour pressure of water is 12.3kPa at 300K. Calculate vapour pressure of 1 molal solution of a solute in it.

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**18.** Calculate the mass of a non-volatile solute ( molecular mass 40) which should be dissolved in 114g octane to reduce its vapour pressure to 80 % .

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**19.** A solution containing 30g of a non-volatile solute exactly in 90g water has a vapour pressure of  $2.8kPa$  at  $298K$ . Further 18g of water is then added to solution, the new vapour pressure becomes  $2.9kPa$  at  $298K$ . Calculate:

- (i) molecular mass of the solute,
- (ii) vapour pressure of water at  $298K$ .

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20. A 5% solution (by mass) of cane sugar in water has freezing point of 271 K. Calculate the freezing point of a 5% glucose (by mass) in water. The freezing point of pure water is 273.15 K.

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21. Two elements  $A$  and  $B$  form compounds having molecular formula  $AB_2$  and  $AB_4$ . When dissolved in 20g of benzene, 1g of  $AB_2$  lowers the freezing point by 2.3K, whereas 1.0g of  $AB_4$  lowers it by 1.3K. The molar depression constant for benzene is  $5.1Kkgmol^{-1}$ . Calculate the atomic mass of  $A$  and  $B$ .

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22. At 300K, 36g of glucose present per litre in its solution has an osmotic pressure of 4.98. If the osmotic pressure of the solution



is  $1.52^-$  at the same temperature, what would be its concentration?

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**23.** Suggest the most important type of intermolecular attractive interaction in the following pairs :

a.  $n$  – Hexane and  $n$  – octane

b.  $I_2$  and  $CCl_4$

c.  $NaClO_4$  and water

d. Methanol and acetone

e. Acetonitrile ( $CHM_3CN$ ) and acetone ( $C_3H_6O$ )

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**24.** Based on solute – solvent interactions, arrange the following in order of increasing solubility in  $n$  – octane and explain the

result. Cyclohexane,  $KCl$ ,  $CHM_3OH$ ,  $CHM_3CN$ .

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25. Among the following compounds, identify which are insoluble, partially soluble, and highly soluble in water ?

a. Phenol b. Toluene

c. Formic acid d. Ethylene glycol

e. Chloroform f. Pentanol

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26. If the density of lake water is  $1.25 \text{ g mL}^{-1}$  and it contains 92 g of  $Na^+$  ions per kg of water, calculate the molality of  $Na^+$  ions in the lake.

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27. If the solubility product of  $CuS$  is  $6 \times 10^{-16}$ , calculate the maximum molarity of  $CuS$  in aqueous solution.

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28. Calculate the mass percentage of aspirin ( $C_9H_8O_4$ ) in acetonitrile ( $CHM_3CN$ ) when 6.5g of  $C_9H_8O_4$  is dissolved in 450g of  $CHM_3CN$ .

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29. Nalorphene ( $C_{19}H_{22}NO_3$ ), similar to morphine, is used to combat withdrawal symptoms in narcotic users. The dose of nalorphene generally given is 1.5mg. Calculate the mass of solution of  $1.5 \times 10^{-3}m$  aqueous solution required for the above dose.



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30. Calculate the amount of benzoic acid ( $C_6H_5COOH$ ) required for preparing  $250\text{mL}$  of  $0.15\text{M}$  solution in methanol.



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31. The depression in freezing point of water observed for the same amount of acetic acid, trichloroacetic acid, and trifluoroacetic acid increases in the order given above. Explain briefly.



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32. Calculate the depression in the freezing point of water when  $10\text{g}$  of  $CH_3CH_2CHClCOOH$  is added to  $250\text{g}$  water.

$$K_a = 1.4 \times 10^{-3}, K_f = 1.86 \text{Kkgmol}^{-1}.$$

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**33.** 19.5g of  $\text{CHM}_2\text{FCOOH}$  is dissolved in 500g of water . The depression in the freezing point of water observed is  $1.0^\circ\text{C}$ . Calculate the Van't Hoff factor and dissociation constant of fluoroacetic acid.

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**34.** The vapour pressure of water at 293K is 17.535mmHg. Calculate the vapour pressure of water at 293K when 25g of glucose is dissolved in 450g of water.

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**35.** Henry's law constant for the molality of methane in benzene at  $298K$  is  $4.27 \times 10^5 \text{ mmHg}$ . Calculate the solubility of methane in benzene at  $298K$  under  $760 \text{ mmHg}$ .

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**36.**  $100g$  of liquid  $A$  ( molar mass  $140 \text{ gmol}^{-1}$ ) was dissolved in  $1000g$  of liquid  $B$  ( molar mass  $180 \text{ gmol}^{-1}$ ). The vapour pressure of pure liquid  $B$  was found to be  $500 \text{ torr}$ . Calculate the vapour pressure of pure liquid  $A$  and its vapour pressure in the solution if the total vapour pressure of the solution is  $475T$  or  $r$

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**37.** Benzene and toluene form ideal solution over the entire range of composition. The vapour pressure of pure benzene and naphthalene at  $300K$  are  $50.71 \text{ mmHg}$  and  $32.06 \text{ mmHg}$ ,

respectively. Calculate the mole fraction of benzene in vapour phase if 80g of benzene is mixed with 100g of naphthalene.

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**38.** The air is a mixture of a number of gases. The major components are oxygen and nitrogen with approximate proportion of 20 % : 79 % by volume at 298K. The water is in equilibrium with air at a pressure of 10atm At 298K if Henry's law constants for oxygen and nitrogen at 298K are  $3.30 \times 10^7 \text{ mm}$  and  $6.51 \times 10^7 \text{ mm}$ , respectively, calculate the composition of these gases in water.

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**39.** Determine the amount of  $\text{CaCl}_2$  ( $i = 2.47$ ) dissolved in 2.5 L of water such that its osmotic pressure is 0.75 atm at  $27^\circ \text{C}$ .



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40. Determine the osmotic pressure of a solution prepared by dissolving  $25\text{mg}$  of  $K_2SO_4$  in  $2\text{L}$  of water at  $25^\circ\text{C}$ , assuming that it is completely dissociated.



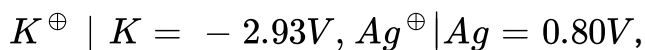
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41. Arrange the following metals in the order in which they displace each other from the solution of their salts. *Al, Cu, Fe, Mg, and Zn.*

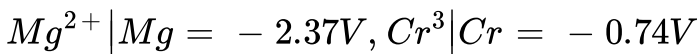
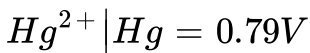


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42. Given standard electrode potentials



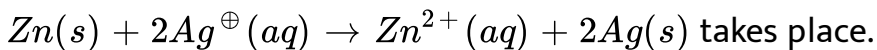




Arrange these metals in their increasing order of reducing power.

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**43.** Depict the galvanic cell in which the reaction :

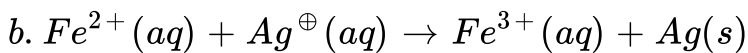
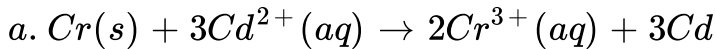


Further show :

- Which of the electrode is negatively charged ?
- The carriers of the current in the cell.
- Individual reaction at each electrode.

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**44.** Calculate the standard cell potentials of galvanic cell in which the following reactions take place :

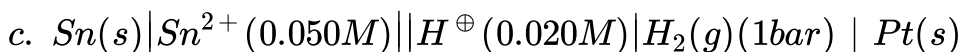
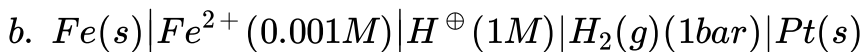
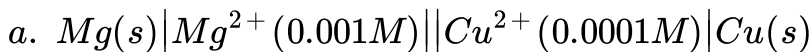


Calculate the  $\Delta_r G^{c-}$  and equilibrium constant of the reactions .

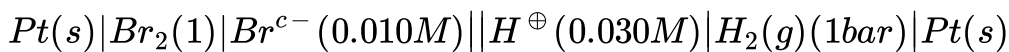


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45. Write the Nernst equation and  $EMF$  of the following cells at 298K:

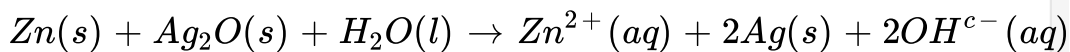


d.



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**46.** In the button cells widely used in watCHMes and other devices the following reaction takes place :



Determine  $\Delta_r G^{c-}$  and  $E^{c-}$  for the reaction.

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**47.** Define conductivity and molar conductivity for the solution of an electrolyte. Discuss their variation with concentration.

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**48.** The conductivity of  $0.20M$  solution of  $KCl$  at  $298K$  is  $0.0248\text{Scm}^{-1}$ . Calculate its molar conductivity.

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49. The resistance of a conductivity cell containing  $0.001M KCl$  solution at  $298K$  is  $1500\Omega$ . What is the cell constant if conductivity of  $0.001M KCl$  solution at  $298K$  is  $0.146 \times 10^{-3} S cm^{-1}$ .

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50. The conductivity of sodium chloride at  $298K$  has been determined at different concentrations and the results are given below :

Concentration(M):	0.001	0.010	0.020	0.050	0.100
$10^2 \times k(Sm^{-1})$ :	1.237	11.85	23.15	55.53	106.74

Calculate  $\Lambda_m$  for all concentrations and draw a plot between  $\Lambda_m$  and  $c^{1/2}$ . Find the value of  $\Lambda_m^\circ$ .

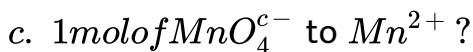
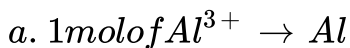
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51. The conductivity of  $0.00241M$  acetic acid is  $7.896 \times 10^{-5} Scm^{-1}$ . Calculate its molar conductivity. If  $\Lambda_m^\circ$  for acetic acid is  $390.5 Scm^2 mol^{-1}$ , what is its dissociation constant ?

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52. How much charge is required for the following reductions

:



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53. How much electricity in terms of Faraday is required to produce.

a. 20.0g of  $Ca$  from molten  $CaCl_2$

b. 40g of  $Al$  from molten  $Al_2O_3$

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54. How much electricity is required in coulomb for the oxidation of 1 liter. a.  $1 \text{ mol of } H_2O \rightarrow O_2$

b.  $1 \text{ mol of } FeO \text{ to } Fe_2O_3$

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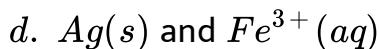
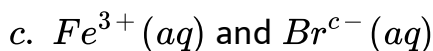
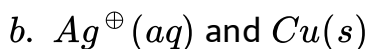
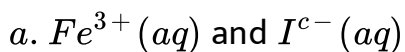
55. A solution of  $Ni(NO_3)_2$  is electrolyzed between platinum electrodes using a current of  $5A$  for  $20 \text{ min}$ . What mass of  $Ni$  is deposited at the cathode ?

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56. Three electrolytic cell  $A$ ,  $B$ , and  $C$  containing solutions of  $ZnSO_4$ ,  $AgNO_3$ , and  $CuSO_4$ , respectively, are connected in series. A steady current of  $1.5A$  was passed through them until  $1.45g$  of silver deposited at the cathode of cell  $B$ . How long did the current flow? What mass of copper and zinc were deposited?

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57. Using the standard electrode potentials given in Table, predict if the reaction between the following is feasible:



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**58.** Predict the products of electrolysis in eaCHM of the following

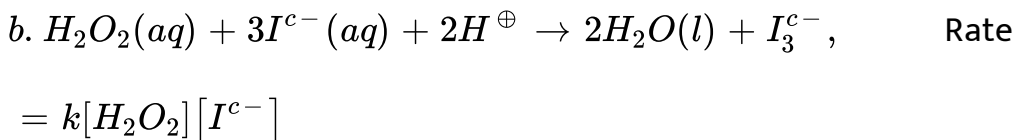
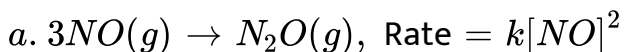
:

- An aqueous solution of  $AgNO_3$  with silver electrodes.
- An aqueous solution of  $AgNO_3$  with platinum electrodes,
- A dilute solution of  $H_2SSO_4$  with platinum electrodes.
- An aqueous solution of  $CuCl_2$  with platinum electrodes.

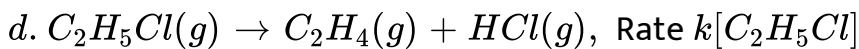
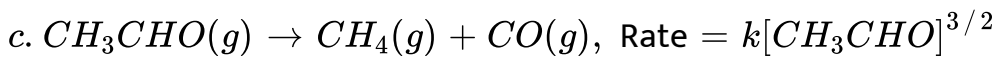


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**59.** From the rater expression for the following reactions, determine their order of reaction and dimensions of the rate constants.

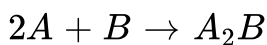






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**60.** For the reaction :



the rate =  $k[A][B]^2$  with  $k = 2.0 \times 10^{-6} \text{mol}^{-2} \text{L}^2 \text{s}^{-1}$ . Calculate

the initial rate of the reaction when

$[A] = 0.1 \text{molL}^{-1}$ ,  $[B] = 0.2 \text{molL}^{-1}$ . Calculate the rate of

reaction after  $[A]$  is reduced to  $0.06 \text{molL}^{-1}$ .

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**61.** The rate for the decomposition of  $NH_3$  on platinum surface is zero order. What are the rate of production of  $N_2$  and  $H_2$  if

$K = 2.5 \times 10^{-4} \text{mol litre}^{-1} \text{s}^{-1}$ ?



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62. The decomposition of dimethyl ether leads to the formation of  $CH_4$ ,  $H_2$ , and  $CO$  and the reaction rate is given by

$$\text{Rate} = k[CH_3OCH_3]^{3/2}$$

The rate of reaction is followed by increase in the pressure in a closed vessel, so the rate can also be expressed in terms of the partial pressure of dimethyl ether, *i. e.*,

$$\text{Rate} = k[p_{CH_3OCH_3}]^{3/2}$$

If the pressure is measured in bar and time in minutes, then what are the units of rate and rate constant ?



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63. Mention the factors that affect the rate of a chemical reaction.



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**64.** A reaction is second order with respect to a reaction. How is the rate of reaction affected if the  
(a) doubled, (b) reduced to  $1/2$ ?

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**65.** What is the effect of temperature on the rate constant of a reaction? How can this temperature effect on rate constant be represented quantitatively?

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**66.** A reaction is first order in  $A$  second order in  $B$ :

(i) write differential rate equation.

(ii) How is the rate affected when the concentration of  $B$  is tripled

?

(iii) How is the rate affected when the concentration of both  $A$  and  $B$  is doubled?

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**67.** Calculate the half life of a first order reaction from their rate constants given below :

*a.*  $200s^{-1}$ , *b.*  $2min^{-1}$ , *c.*  $4years^{-1}$

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**68.** The half life for radioactive decay of  $^{14}C$  is 5730 years. An archaeological artifact containing wood had only 80% of the  $^{14}C$  found in a living tree. Estimat the age of the sample.

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69. The rate constant for a first order reaction is  $60s^{-1}$ . How much time will it take to reduce the initial concentration of the reactant to its  $1/16th$  value ?

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70. During nuclear explosion, one of the products is  $^{90}Sr$  with half – life of 28.1 years. If  $1\mu g$  of  $^{90}Sr$  was absorbed in the bones of a newly born baby instead of calcium, how much of it will remain after 10 years and 60 years if it is not lost metabolically.

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71. For a first order reaction, show that the time required for 99 % completion is twice the time required for the completion of 90 % of reaction.



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72. A first reaction takes  $40\text{min}$  for  $30\%$  decomposition. Calculate  $t_{1/2}$ .



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73. The rate constant for the decomposition of hydrocarbons is  $2.418 \times 10^{-5}\text{s}^{-1}$  at  $546\text{K}$ . If the energy of activation is  $179.9\text{kJmol}^{-1}$ , what will be the value of pre – exponential factor?



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74. Consider a certain reaction  $A \rightarrow \text{Products}$  with  $k = 2.0 \times 10^{-2}\text{s}^{-1}$ . Calculate the concentration of  $A$  remaining

after 100s if the initial concentration of  $A$  is  $1.0\text{molL}^{-1}$ .

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**75.** Sucrose decomposes in acid solution into glucose and fructose according to the first order rate law, with  $t_{1/2} = 3.00\text{hr}$ . What fraction of sample of sucrose remains after  $8\text{hr}$  ?

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**76.** The decomposition of hydrocarbon follows the equation

$$k = (4.5 \times 10^{11} \text{ s}^{-1}) e^{-28000\text{K}/T}$$

Calculate  $E_a$ .

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**77.** The rate constant for the first order decomposition of a certain reaction is described by the equation

$$\log k(s^{-1}) = 14.34 - \frac{1.25 \times 10^4 K}{T}$$

(a) What is the energy of activation for the reaction?

(b) At what temperature will its half-life period be 256 min ?

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**78.** The decomposition of  $A$  into product has value of  $k$  as  $4.5 \times 10^3 s^{-1}$  at  $10^\circ C$  and energy of activation of  $60 kJ mol^{-1}$ . At what temperature would  $k$  be  $1.5 \times 10^4 s^{-1}$ ?

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**79.** The time required for 10 % completion of a first order reaction at  $298K$  is equal to that required for its 25 % completion at  $308K$



. If the value of  $A$  is  $4 \times 10^{10} \text{ s}^{-1}$ , calculate  $k$  at  $318\text{K}$  and  $E_a$ .

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**80.** The rate of a reaction quadruples when the temperature changes from  $293\text{K}$  to  $313\text{K}$ . Calculate the energy of activation of the reaction assuming that it does not change with temperature.

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**81.** Why are powdered substances more effective adsorbent than their crystalline forms ?

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**82.** What are the factors which influence the adsorption of a gas on a solid ?

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**83.** What is an adsorption isotherm? Describe Freundlich adsorption isotherm.

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**84.** What do you understand by activation of adsorption : How is it achieved.

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**85.** What role does adsorption play in heterogeneous catalysis ?



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**86.** Adsorption is always exothermic.



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**87.** How are the colloidal solutions classified on the the basis of physical states of the dispersed phase and dispersion medium ?



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**88.** Discuss the effect of pressure and temperature on the adsorption of gases on solids.



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**89.** What are lyophilic and lyophobic sols? Give one example of each type ? Why is hydrophobic sol easily coagulated ?

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**90.** What is the difference between multimolecular and macromolecular collids ? Give one example of each . How are associated colloids different from these two types of colloids ?

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**91.** What are enzymes ? Write in brief the mechanism of enzyme catalysis ?

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**92.** Explain what is observed when  
*a.* An electrolyte  $NaCl$  is added to hydrated ferric oxide sol.

*b.* Electric current is passed through a colloidal sol.

*c.* When a beam of light is passed through a colloidal solution.

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**93.** What are emulsions ? What are their different types ? Give an example of each type ?

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**94.** How do emulsifiers stabilise emulsion ? Name two emulsifiers.

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**95.** Action of soap is due to emulsification and micelle formation.

Comment.

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**96.** Give four examples of heterogeneous catalytic reactions.

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**97.** What do you mean by activity and selectivity of catalysts ?

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**98.** Describe some features of catalysis by zeolites.

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99. What is shape – selective catalysis ?

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100. Explain the following terms :

- a. Eletrophoresis*    *b. Coagation*  
*c. Dialysis*            *d. Tyndalle ffect*

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101. Give four uses of emulsion.

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102. What are micelles ? Give an example of a micelle system.

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103. Explain the following terms with suitable examples :

*a. alcisol, b. Aeorsol, c. Hydrosol*

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104. Comment on the statement that colloid is not a substance but state of a substance

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### Short Answer Type Questions Electrochemical Cell

1. What would happen if no salt bridge is used in electrochemical cell ?

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2. What is the use of platinum foil in an *SHE* ?

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3. How the reduction potential of an electrode can be decreased?

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4.  $Cl_2$  and  $F_2$  are added to a solution containing  $1M$  each of  $Cl^{c-}$  and  $Br^{c-}$  . What reaction will occur ?

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Short Answer Type Questions Electrochemical Cell

1.  $Cl_2$  and  $Br_{c-}$  are added to a solution containing  $1M$  each of  $Cl^{c-}$  and  $Br^{c-}$ . What reaction will occur ?

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2.  $Br_2$  and  $I_2$  are added to a solution containing  $1M$  each of  $Br^{c-}$  and  $I^{c-}$ . What reaction will occur ?

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3. Why equilibrium constant is related to  $E_{cell}^{c-}$  but not to  $E_{cell}$  ?

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4. What is the free energy change ( $\Delta G$ ) for galvanic and electrolytic cell ?



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5. If an electrochemical cell is made in which current does not flow, what it suggest ?



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6. In each of the following pairs, which will conuct more electricity?

a. *Cu* wire at  $30^{\circ}C$  and  $60^{\circ}C$ .

b. *KBr* solution at  $30^{\circ}C$  and  $60^{\circ}C$ .

c.  $NH_4OH$  solution at  $30^{\circ}C$  and  $60^{\circ}C$ .

d.  $1M$  and  $0.1M$  propanioc acid solutions.



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7. How the weak and strong electrolytes are distinguished?



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8. What flows in the internal circuit of a galvanic cell ?



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9. Why is it not possible to measure the single electrode potential ?



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10. What is electrochemical series ?



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11. What is the *EMF* of a cell?

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12. Why a cell stops working after some time ?

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## Electrolysis Batteries And Rusting

1. What is electrochemical equivalent of a substance ?

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2. An aqueous solution of  $CuSO_4$  is electrolyzed using  $Pt$  electrodes in one case and  $Cu$  electrodes in another case. What are the products of electrolysis in both the cases ?

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3. What are the products of the electrolysis of aqueous solution of  $KF$  ?

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4. Silver is conducting as such while  $AgNO_3$  is conducting in molten state or in aqueous solution. Explain ?

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5. Why  $Zn$  reacts with dilute  $H_2SO_4$  to give  $H_2$  gas but  $Cu$  does not ?

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6. What is overvoltage or bubble voltage ?

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7. Which allotrope of carbon is used for making electrodes?

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8. Which electrolyte is used in dry cell ?

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9. What would happen if the protective tin coating over an iron bucket is broken in some places ?

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10. Which metals can be used in the cathodic protection of  $Fe$  against rusting.

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11. Name the electrodes used in a fuel cell.

 [Watch Video Solution](#)

12. Name the electrolyte used in fuel cell and mercury cell.

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13. Rusting of  $Fe$  is quicker in saline water than in ordinary water.

Why ?

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14. Why  $Cr$  is used for coating  $Fe$  ?

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15. What is the role of  $ZnCl_2$  in dry cell ?

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16. Why a mercury cell gives a constant voltage throughout its life ?

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17. Which types of cells are rechargeable ?

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18. Why a dry cell becomes dead after a long time even if it is not used ?

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19. Why lead storage can be recharged ?



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20. Out of  $Sn$  and  $Zn$  which one protects  $Fe$  better even after cracks ?

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## Conductivity Of Ionic Solutions

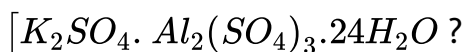
1. Why ac is used in place of dc in measuring the conductance of electrolytes ?

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2. Out of  $HBr$  and  $NaBr$ , which will have greater value for  $\Lambda_m^\circ$  and why ?

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3. What is the relation between molar conductivity ( $\Lambda_m$ ) and equivalent conductivity ( $\Lambda_{eq}$ ) of potash alum



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4. Why in a concentrated solution, a strong electrolyte shows deviation from Debye – Huckel Onsager equation ?

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5. Which equation gives the relationship between equivalent or molar conductance and concentration of a strong electrolyte ?

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6. What is effect of increasing concentration on the molar conductivity of a weak electrolyte ?

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7. Why  $\Lambda_m^\circ$  for weak electrolyte (*e. g.* ,  $NH_4OH$  or  $CH_3COOH$ ) cannot be determined experimentally ?

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8. An aqueous solution of  $K_2SO_4$  is diluted by adding water. How the values of  $G$ ,  $k$ ,  $\Lambda_m$  and  $\Lambda_{eq}$  vary ?

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## Chemical Kinetics In Text Questions

1. The concentration of a reactant changes from  $0.03M$  to  $0.02M$  in 25 min. Calculate the average rate of reaction using time both in minutes and seconds.

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2. In a reaction,  $2A \rightarrow$  Products the concentration of A decreases from  $0.5 \text{ mol litre}^{-1} \rightarrow 0.4 \text{ mol litre}^{-1}$  in 10 minutes. Calculate rate during this interval.

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3. For a reaction,  $A + B \rightarrow$  Product, the rate law is given by  $r = k[A]^{\frac{1}{2}}[B]^2$ . What is the order of the reaction?

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4. The conversion of molecules  $X$  to  $Y$  follows second order kinetics. If the concentration of  $X$  is increased to three times, how will it affect the rate of formation of  $Y$  ?

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5. A first order reaction has a rate constant  $1.15 \times 10^{-3} \text{ s}^{-1}$ . How long will  $5\text{g}$  of this reactant take to reduce to  $3\text{g}$  ?

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6. Time required to decompose  $\text{SO}_2\text{Cl}_2$  to half of its initial amount is  $60\text{min}$ . If the decomposition is a first order reaction, calculate the rate constant of the reaction.

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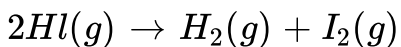
7. What will be effect of temperature on rate constant ?

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8. The rate of the chemical reaction doubles for an increase of  $10K$  in absolute temperature from  $300K$ . Calculate  $E_a$ .

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9. The activation energy for the reaction : ltr.



is  $209.5 kJ mol^{-1}$  at  $581K$ . Calculate the fraction of molecules of reactants having energy equal to or greater than activation energy ?





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## Short Answer Type Question

1. Why cooking food in an open vessel takes more time at a hill station ?



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2. Why coal or petrol does not burn by itself in air but once initiated by flame, it continues to burn?



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3. Why in general does not proceed with a uniform rate throughout?



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4. Why instantaneous rate is preferred over average rate?



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5. Why are reactions of higher order less in number?



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6. Is there any reaction whose rate does not decrease with time ?



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7. What is the order of reaction whose rate constant has the same units as rate of reaction ?

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8. What type of plot is obtained for rate versus time for zero order reaction ?

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9. When is the rate of reaction equal to specific rate constants ?

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10. When does the average rate become equal to instantaneous rate ?



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11. On the basis of enthalpy of formation, graphite is more stable than diamond, yet diamond does not change into graphite for years. Why ?



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12. In some cases, it is found that a large number of colliding molecules have energy more than threshold value, yet the reaction is slow. Why?



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13. Can a reaction have negative or zero activation energy ?



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14. The reactions  $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$  and  $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$  look to be similar. Yet the former is slower than latter at same temperature. Why?

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15. What are the units of a pseudo unimolecular and pseudo bimolecular reaction?

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16. What is the effect of adding catalyst on free energy change ( $\Delta G$ ) of a reaction?

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17. Why equilibrium constant of a reaction does not change in the presence of a catalyst ?

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18. What is the value of  $K$  at high temperature. Is it feasible or not ?

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## Surface Chemistry In Text Question

1. Why are substance such as platinum and palladium often used for carrying out electrolysis of aqueous solutions?

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2. Why does physisorption decrease with increase of temperature ?

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3. Why are powdered substances more effective adsorbent than their crystalline forms ?

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4. Why is it necessary to remove  $CO$  when ammonia is obtained by Haber's process?

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5. Why is ester hydrolysis slow in the beginning and becomes faster after some time?

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6. What is the role of desorption in the process of catalysis?

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7. What modification can you suggest in the Hardy Schulze law?

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8. Why is it essential to wash the precipitate with water before estimating it quantitatively?

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## Nuclear Chemistry Ncert Exercise

1. Clearly state, what do you understand by the terms : mass number, nucleons and nuclides?

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2. Describes the properties of radiations which are emitted by radioactive nuclei.

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3. Give one example each of (a)  $\alpha$  – emission, (b)  $\beta^{c-}$  – emission, and (c)  $K$  – capture. Write an equation for these nuclear

changes.

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4. What is group displacement law ? An element belonging to group 1 decay by  $\beta^{c-}$  – emission. To which group of the periodic table the daughter element will belong ?

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5. How many  $\alpha$  – and  $\beta$  – particles will be emitted when  ${}_{90}\text{Th}^{232}$  changes into  ${}_{82}\text{Pb}^{208}$ ?

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6. Write the nuclear reactions for the following radioactive decay:

(a)  ${}_{92}\text{U}^{238}$  undergoes  $\alpha$  – decay.

(b)  ${}_{91}\text{Pa}^{234}$  undergoes  $B\eta$  – decay.

(c)  ${}_{11}\text{Na}^{22}$  undergoes  $B\eta^+$  decay.



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7. How are radioactive decay series distinguished ? Name the decay series which is not natural but artificial.



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8. Calculate the binding energy per nucleon of *Li* isotope, which has the isotopic mass of  $7.016\text{amu}$ . The individual masses of neutron and proton are  $1.008665\text{amu}$  and  $1.007277\text{amu}$ , respectively and the mass of electron =  $0.000548\text{amu}$ .



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9. The atomic mass of  $^{16}\text{O}$  is 15.995 amu while the individual masses of proton and neutron are 1.0073 amu and 1.0087 amu respectively. The mass of electron is 0.000548 amu. Calculate the binding energy of the oxygen nucleus.



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10. The isotopic composition of rubidium is  $\text{Rb}^{85}:73\%$  and  $\text{Rb}^{87}:28\%$ .  $\text{Rb}^{87}$  is weakly radioactive and decays by  $\beta^-$  emission with a decay constant of  $1.1 \times 10^{-11}$  per year. A sample of the mineral pollucite was found to contain 450g  $\text{Rb}$  and 0.72mg of  $\text{Sr}^{87}$ . Estimate the age of mineral pollucite stating any assumption made.



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11. The isotopic masses of  ${}^2_1H$  and  ${}^4_2He$  are 2.0141 and 4.0026 amu respectively and the velocity of light in vacuum is  $2.998 \times 10^8 m/s$ . Calculate the quantity of energy (in  $J$ ) liberated when two mole of  ${}^2_1H$  undergo fusion to form one mole of  ${}^4_2He$

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12. The radioactive isotope  ${}^{60}_{27}Co$  which has now replaced radium in the treatment of cancer can be made by  $\alpha(n, p)$  or  $(n, \gamma)$  reaction. For each reaction, indicate the appropriate target nucleus. If the half life of  ${}^{60}_{27}Co$  is 7 year evaluate the decay constant in  $s^{-1}$ .

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13. A piece of wood from an archaeological source shows a  $^{14}\text{C}$  activity which is 60% of the activity found in fresh wood today. Calculate the age of the archaeological sample. ( $t_{1/2}$  for  $^{14}\text{C} = 5570$  year)

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14. What is a nuclear fission reaction ? Explain the principle of atomic bomb and working of a nuclear reactor to produce electricity.

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15. What is meant by a fissionable isotope? How are such isotopes produced artificially ? Give an example.

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16. In the neutron – induced fission reaction of  ${}_{92}\text{U}^{235}$  one of the products is  ${}_{37}\text{Rb}^{95}$ , in this mode, another nuclide and three neutrons are also produced. Identify the nuclide.

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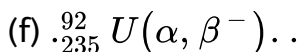
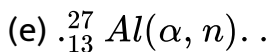
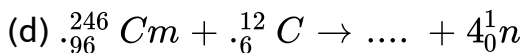
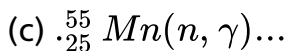
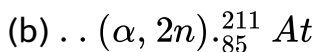
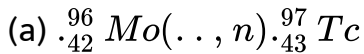
17. Explain the principle of : Itbr. *a.* Activation analysis  
*b.* Breeder reactor

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18. Describe the chief applications of radioisotopes in :  
*a.* The study of reaction mechanism  
*b.* Medicines

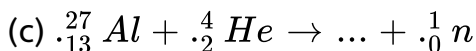
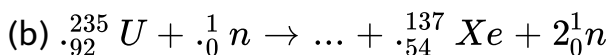
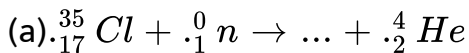
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19. Complete the following nuclear changes.



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20. Complete the equations for the following nuclear processes:





(d) ...  $(n, p)$ .  ${}^{35}_{16}S$

(e)  ${}^{239}_{94}Pu(\alpha, \beta^-)$ ...

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21. Calculate the mass of  ${}^{140}La$  in a sample whose activity is  $3.7 \times 10^{10} Bq$  (1 Becquerel,  $Bq = 1$  disintegration per second) given that its  $t_{1/2}$  is 40 hour.

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22. Calculate the binding energy per nucleon for  $C^{12}$ ,  $N^{14}$ ,  $O^{16}$ , and comment on their relative magnitudes. Masses of proton and neutron are  $1.0078$  and  $1.0087m_u$ , respectively.

$(m_u = 931 MeV)$

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23. The  $\beta$  – activity of a sample of  $CO_2$  prepared from a contemporary wood gave a count rate of 25.5 counts per minute ( $cpm$ ). The same of  $CO_2$  from an ancient wooden statue gave a count rate of 20.5  $cpm$ , in the same counter condition. Calculate its age to the nearest 50 year taking  $t_{1/2}$  for  $^{14}C$  as 5770 year. What would be the expected count rate of an identical mass of  $CO_2$  from a sample which is 4000 year old?

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24. How is  $C^{14}$  produced in nature and what happens to it subsequently? Give equations for these processes.

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**25.** What do you understand by tracers ? Give an example of a tracer that can be used in determining the mechanism of a chemical reaction.

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**26.** What are synthetic elements ? Mention two synthetic elements and write the nuclear equations leading to their synthesis.

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**27.** What is meant by thermonuclear reactions and why are they so called ? Why are these reactions not useful for peaceful purposes ?

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28. Describe the principle of an atom bomb. What is meant by critical mass ? What is the critical mass of  ${}_{92}\text{U}^{235}$  ?

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29. What is the effect of temperature and pressure on the rate of radioactive disintegration ?

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