CLASS XII
Chemistry
Sample Paper Solution 2018-19

Time allowed: 3 Hours **Max. Marks: 70**

Section A (1 mark each)

Q#1: Give 2 Properties of Hydrogen-Bonded molecular solids.
A#1: they do not conduct electricity and they generally are soft solids or volatile liquids at room temperature and pressure.

Q#2: Define the term 'Mole fraction'.
A#2 mole fraction of a component is defined as:
(the total number of moles of the specific component) / (total number of moles of all the components)

(OR)

Q#2: Define Mass Percentage of a component.
A#2: Mass percentage of a component in a solution is given by:
[(Mass of the component in soln.) / (total mass of the soln.)] * 100

Q#3: give 2 factors on which the conductivity of electrolytic solutions is dependent.
A#3: (i) concentration of electrolyte (ii) size and solvation of the generated ions.

Q#4: Write the chemical reaction for the enzyme-catalyzed inversion of cane sugar.
A#4:

$$C_{12}H_{22}O_{11}(aq) + H_2O(l) \overset{Invertase}{\rightarrow} C_6H_{12}O_6(aq) + C_6H_{12}O_6(aq)$$

Q#5: What are the products formed when phenol is heated with zinc dust?
A#5: benzene and zinc oxide.

(OR)

Q#5: Give 2 Methods for the preparation of phenol.
A#5: (i) fusing of Chlorobenzene with sodium hydroxide at 623K, 320 atm.
(ii) warming of diazonium salts with water.

Section B (2 marks each)

Q#6: How is the solubility of solids in liquids affected by (i)temperature, and (ii)pressure.
A#6: (i) solubility of solids in liquids increases with an increase in temperature. (ii) the solubility of solids in liquids is not very dependant on pressure since solids are highly incompressible.

Q#7: What is Reverse Osmosis?
A#7: when a pressure that is larger than the osmotic pressure of the system is applied on the solution side, the direction of the osmosis is reversed. The phenomenon where the direction of osmosis is reversed is called reverse osmosis. It can be used for desalination of seawater.

Q#8: Name 2 methods of preparing haloalkanes with examples.
A#8: (i) From Alcohols:

$$R - OH + HCl \overset{ZnCl_2}{\rightarrow} R - Cl + H_2O$$

(ii) From Finkelstein Reaction (Halogen Exchange):

$$R - X + NaI \rightarrow R - I + Na - X$$

Q#9: What are Grignard reagents? Give a chemical reaction for their preparation.
A#9: Alkyl Magnesium Halides are referred to as Grignard reagents. They can be prepared by reacting a haloalkane with magnesium in dry ether.

$$CH_3CH_2Br + Mg \overset{dryether}{\rightarrow} CH_3CH_2MgBr$$

Q#10: What is a Polyhalogen compound? Give 2 examples.
A#10: Polyhalogen compounds are carbon compounds that contain more than one halogen atom. Many such compounds are very useful in industry. Examples: trichloromethane (or chloroform) and triiodomethane (or iodoform).

Q#11: What are the categories polymers into which can be classified based on the source?
A#11: Polymers can be classified into 3 categories based on the source - (i) Natural Polymers, (ii) Semi-synthetic polymers, and (iii) Synthetic Polymers.

(OR)

Q#11: What are the categories into which polymers can be classified based on their structure?
A#11: Polymers can be classified into 3 categories based on their structure - (i) Linear Polymers, (ii) Branched-chain Polymers, and (iii) Cross-linked / Network Polymers.

Q#12: What are Tranquilizers? What are their uses?

A#12: Tranquilizers are neurologically active drugs that affect the transfer of messages from nerves to the receptors. They are used to treat stress and some mental diseases. They produce a sense of well being in humans.

(OR)

Q#12: What are Analgesics? What are their uses?

A#12: Analgesics are neurologically active drugs that affect the transfer of messages from nerves to the receptors. They are used to reduce or completely abolish pain. They can be further classified into narcotic and non-narcotic analgesics.

Section C (3 marks each)

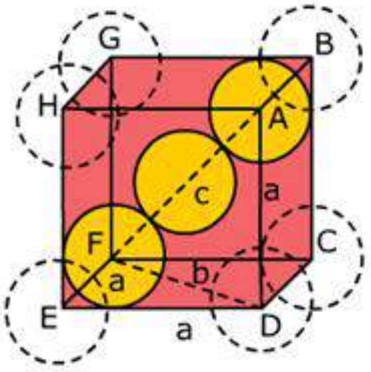
Q#13: Obtain the total number of atoms in (i) primitive unit cell (ii) Body-centered cubic unit cell (iii) Face-centered cubic unit cell.

(OR)

Q#13: Calculate the packing efficiency in BCC structures.

A#13: (i) primitive cell
Total number of atoms in each corner = $\frac{1}{8}$
Total number of corners = 8
Therefore, the total number of atoms = $8*\frac{1}{8} = 1$
(ii) BCC
Total number of atoms in each corner = $\frac{1}{8}$
Total number of corners = 8
Total number of body-centered atoms = 1
Therefore, the total number of atoms = $(8*\frac{1}{8}) + 1 = 2$
(iii) FCC
Total number of atoms in each corner = $\frac{1}{8}$
Total number of corners = 8
Total number of atoms per face center = $\frac{1}{2}$
Total number of face centers = 6
Therefore, the total number of atoms = $(8*\frac{1}{8}) + (6*\frac{1}{2}) = 1+3 = 4$

(OR)



From the above-given diagram of a BCC structure, observing triangle EFD,
$b^2 = a^2 + a^2 = 2a^2$ (Pythagoras theorem)

Therefore, $b = \sqrt{2}a$

Now, in triangle AFD,
$c^2 = a^2 + b^2$
But, $b^2 = 2a^2$

Therefore, $c^2 = 3a^2$, $c = \sqrt{3}a$

Since three atoms in the BCC diagonally touch, and the center of two of these atoms are at the corners, we can equate.

c = (diagonal of the body-centered atom) + 2 (radius of corner atom)
$c = d + 2r = 4r$

To get the relation between the radius of the atom and the side length of the cube, we substitute the value of c;

$c = \sqrt{3}a = 4r$

Therefore, $a = 4r/\sqrt{3}$; $r = \sqrt{3}a/4$

Now, the total volume of the atoms in the BCC can be written as :

(Number of atoms) * (volume of one atom)
$= 2*(4\pi/3)(r^3)$

The total volume of the unit cell $= a^3 = (4r/\sqrt{3})^3$

Therefore, packing efficiency =

$$\frac{2*(4/3)*(\pi r^3)}{(4r/\sqrt{3})^3} * 100 Percent$$

=68%

Thus the packing efficiency in BCC structures is 68%

Q#14: the electrical resistance of a sodium hydroxide cylinder is $5.55 * 10^3$ ohms. Given its diameter is 2 cm and its length is 100 cm, find its resistivity and conductivity.

(OR)

Q#14: What is a battery? Give two differences between primary and secondary batteries.

A#14: we know that resistance, R can be given by the formula:

$$R = \frac{\rho l}{A}$$

Therefore, resistivity (ρ) can be given by:

$$\rho = \frac{RA}{l}$$

Area, A = □r^2 = 3.14*1cm*1cm = 3.14 cm^2 = 3.14*10^{-4} m^2

Length, l = 100cm = 1m

Therefore ,

$$\rho = \frac{5.55 * 10^3\Omega * 3.14 * 10^{-4} m^2}{1m}$$

= 1.7427 □ m

Conductivity can be obtained from the resistivity as:

$$\kappa = 1/\rho = \frac{1}{1.7427\Omega m}$$

= 0.5738 S/m

(OR)

A#14: A battery has one or more cells that are connected in a series format. It can be considered as a galvanic cell where electrical energy is produced from the chemical energies of redox reactions.

Primary Battery	**Secondary Battery**
The reaction occurs only once	The reaction can occur many times as charging and discharging cycles
These batteries cannot be reused once dead	These batteries are reusable

Q#15: Give 3 differences between adsorption and absorption.

(OR)

Q#15: State any two properties of colloidal solutions.

A#15:

Adsorption	Absorption
It is an exothermic process	It is an endothermic process
It is a surface phenomenon	It is a bulk phenomenon
The concentration at the surface is different from the concentration in the bulk	Concentration is uniform throughout the material.

(OR)

A#15: (i) colligative properties: colloidal solutions show smaller values of colligative properties when compared to true solutions of equal concentration. Examples for such properties are - elevation in boiling point, depression in freezing point, and osmotic pressure.
(ii) Tyndall effect: when a beam of light is passed through a colloidal solution, the light gets scattered and the path of the beam of light is illuminated. This effect is called the Tyndall effect and it occurs due to the fact that light is scattered in all directions by the bulky colloidal particles.

Q#16: Briefly explain any three methods for the refining of metals.

(OR)

Q#16: Briefly explain any three procedures used in the concentration of metal ores.

A#16: (i) Distillation - in order to obtain the pure metal as a distillate, the impure metal block is evaporated. This method can be used for metals with low boiling points such as zinc or mercury.
(ii) Liquation - Metals with low boiling points are made to flow on a sloped surface, thereby separating them from the impurities which have higher boiling points. Example: Tin can be refined via this method.
(iii) Zone Refining **-** the principle of this method is that impurities are more soluble in their melt state when compared to the corresponding solid state. A mobile heater moves along the metal block/rod and the impurities move along with it. Eg: Silicon and Germanium are generally purified via this method.

(OR)

A#16: (i) Hydraulic Washing: in this procedure, the ore is first powdered. A stream of water running in an upward direction is now used to wash the ore which was powdered earlier. The heavy ore particles remain after the washing, whereas the gangue particles are washed away.
(ii) Magnetic Separation: This method can be employed if either the ore or the gangue particles are attracted by a magnetic field. In this method, the ore is finely powdered and placed on a conveyer belt which is moved over a magnetic roller. The particles which are not attracted by the magnetic field fall off the conveyer belt.
(iii) Froth Floatation: this procedure is generally used in the removal of gangue in sulfide ores. The ore is powdered and made to form a suspension with water. Now, collectors such as fatty acids and pine oils are added along with froth stabilizers. The mineral particles are wet by oils whereas the gangue particles are wet by water. The froth is now skimmed off and dried in order to recover the ore.

Q#17: Write any three methods to prepare dinitrogen. Give reactions for each method written.
A#17: (i) sodium nitrite is reacted with an aqueous solution of ammonium chloride. Then, the N_2 gas formed is passed through a solution of aqueous sulfuric acid and potassium dichromate.

$$NH_4Cl(aq) + NaNO_2(aq) \rightarrow N_2(g) + 2H_2O(l) + NaCl(aq)$$

(ii) heating to of ammonium dichromate to cause its thermal decomposition.

$$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + 4H_2O + Cr_2O_3$$

(iii) the thermal decomposition of barium azide gives rise to nitrogen gas of high purity.

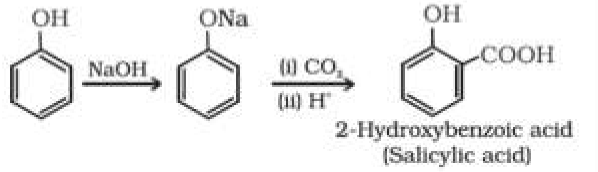
$$Ba(N_3)_2 \xrightarrow{\Delta} Ba + 3N_2$$

Q#18: What are the types of isomerism in coordination compounds? Describe each type.
A#18: there are two primary isomerism types shown by coordination compounds - stereoisomerism and structural isomerism.

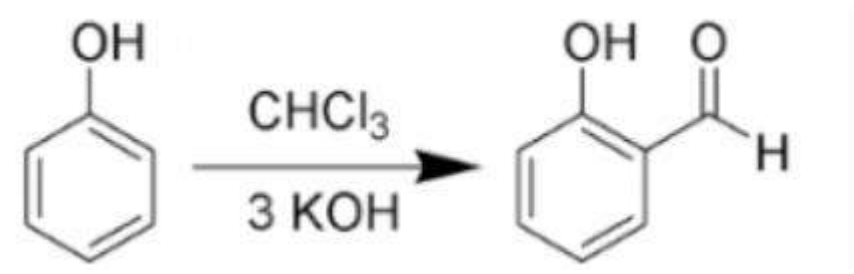
Stereoisomerism involves compounds with the same chemical formulae and bonds but differing in spatial arrangement. It can further be divided into :
(i) Geometrical Isomerism, which arises commonly in heteroleptic complexes. This type of isomerism arises due to the different possible geometric arrangements for the ligands.
(ii) Optical isomerism, which arises in chiral molecules or ions are mirror images of each other. However, they cannot be superimposed on each other.

Structural isomerism involves compounds with the same chemical formulae, but have different chemical bonds in the molecules. It can further be divided into:
(i) Linkage Isomerism, which arises generally in ambidentate ligand containing coordination compounds.
(ii) Coordination isomerism, which arises due to the interchange (between the cationic and the anionic parts of the metal ions) of ligands.
(iii) Ionization Isomerism, which arises when counter ions can act as potential ligands in complex salts.
(iv) Solvate isomerism, which arises when water is used as a solvent. It is also known as hydrate isomerism.

Q#19: Describe (i) Kolbe's Reaction, (ii) Reimer-Tiemann reaction. Provide example reactions.
A#19: (i) Kolbe's Reaction: in this reaction, phenol is treated with sodium hydroxide, leading to the generation of the phenoxide ion. This phenoxide ion undergoes electrophilic substitution with CO_2 to give ortho-hydroxybenzoic acid as the primary product.



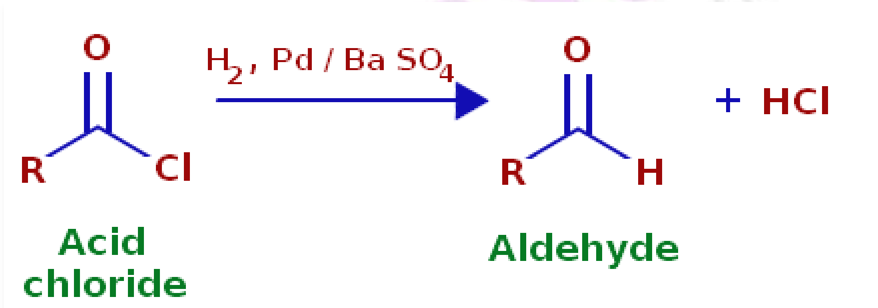
(ii) Reimer-Tiemann reaction: in this reaction, phenol is treated with chloroform with NaOH or KOH Present. This reaction leads to the addition of -CHO group to the ortho position of the aromatic ring.



Q#20: What is (a) Stephen reaction (b) Rosenmund reduction? Provide reactions for both.
A#20: (a) Stephen reaction: this is the organic named reaction wherein first, the reduction of nitriles to their corresponding imine form takes place with the help of stannous chloride. This corresponding imine is hydrolyzed to give the required aldehyde.

$$RCN + SnCl_2 + HCl \rightarrow RCH = NH \overset{H_3O^+}{\rightarrow} R - CHO$$

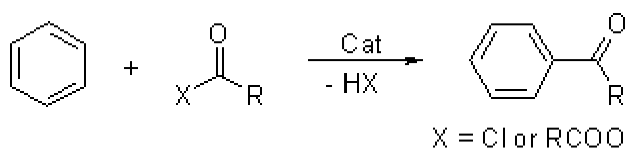
(b) Rosenmund Reduction: The organic named reaction wherein the hydrogenation of an acyl chloride group over palladium on $BaSO_4$ catalyst takes place is called Rosenmund reduction. The reaction can be given by:



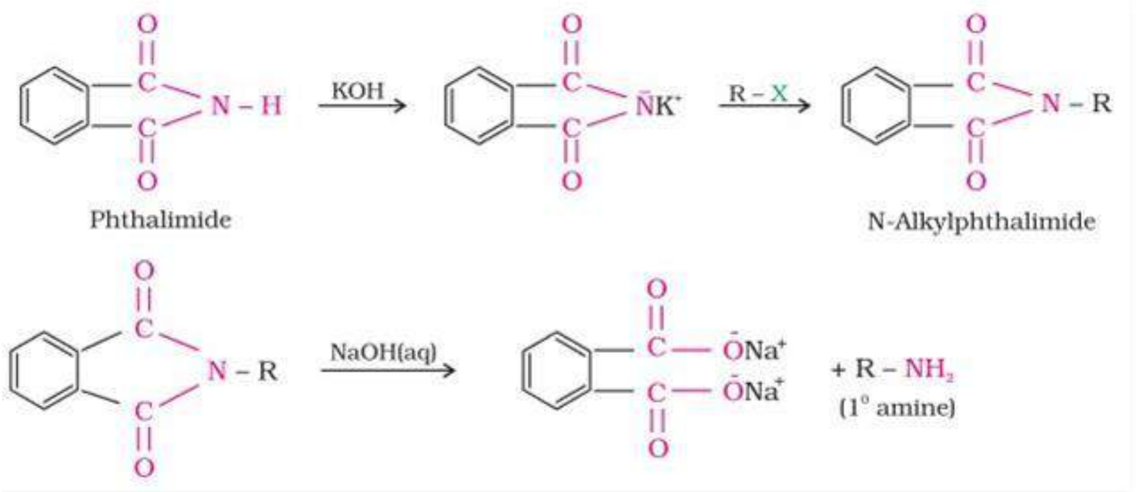
Q#21: Give any two methods of preparing ketones. Provide reactions for each.
A#21: (i) preparing ketones from acid chlorides: ketones are produced when acyl chlorides are treated with dialkyl cadmium (which is prepared from the reaction of a Grignard reagent with $CdCl_2$).

$$2R' - COCl + R_2Cd \rightarrow 2R' - CO - R + CdCl_2$$

(ii) Friedel-Crafts acylation reaction: Ketones are produced when acid chlorides are used to treat benzene (or substituted aromatic rings) with anhydrous $AlCl_3$ is present.



Q#22: What is (i) Gabriel phthalimide synthesis (ii) Hoffmann bromamide reaction? Provide reactions for each.
A#22: (i) Gabriel Phthalimide synthesis: primary amines can be prepared via the treatment of phthalimide with ethanolic KOH and the heating of the resulting potassium salt of the phthalimide with an alkyl halide and finally subjecting this to alkaline hydrolysis. This process is called Gabriel phthalimide synthesis.



(ii) Hoffmann bromamide reaction: primary amines can be prepared by the treatment of an amide with bromine in an ethanolic (or aqueous) solution of NaOH. This reaction is called the Hoffmann bromamide reaction.

$$R-(CO)-NH_2+Br_2+4NaOH \rightarrow R-NH_2+Na_2CO_3+2NaBr+2H_2O$$

Q#23: Briefly describe the three categories into which carbohydrates can be classified.
A#23: (i) Monosaccharides : these carbohydrates cannot undergo hydrolysis to yield simpler polyhydroxy aldehyde or ketone units. E.g. glucose, ribose.
(ii) Oligosaccharides: these carbohydrates can undergo hydrolysis to give 2-10 monosaccharide carbohydrates. E.g. sucrose, maltose.
(iii) Polysaccharides: these carbohydrates can undergo hydrolysis to give a large number of monosaccharide carbohydrates. E.g. starch, glycogen.

Q#24: Write short notes on: (i) enzymes (ii) vitamins.
A#24: (i) enzymes are biocatalysts that help the reactions in the bodies of living things to proceed under relatively mild conditions. Enzymes are generally globular proteins. An example of an enzyme is maltase, which helps catalyze the hydrolysis of maltose into glucose.
(ii) vitamins are organic chemical compounds that are necessary for humans since their lack would lead to deficiency diseases. Most of the vitamins are not synthesized by the human body but are obtained from other sources, such as plants. Examples - Vitamin B_1 (or thiamine), Vitamin C (or Ascorbic acid).

Section D (5 marks each)

Q#25: What is Half-Life of a reaction? Obtain the relation between the rate constant and half-life of zero order and first order reactions.

(OR)

Q#25: (i)What are the factors that influence the rate of a reaction?
(ii) what is the rate determining step of a reaction?
(iii) What is the rate law? Give its expression.

A#25: Half-Life of a reaction refers to the time taken for the reduction in the concentration of a react to half of its initial concentration. It can be denoted by '$t_{1/2}$'.

(i) Half-Life of Zero-order reactions:

We know that the rate constant for a zero order reaction can be written as:

$$\kappa = \frac{[R]_0 - [R]}{t}$$

From the definition of half-life, we can substitute t = $t_{1/2}$ and [R] = ½ $[R]_0$;

$$\kappa = \frac{[R]_0 - (1/2)[R]_0}{t_{1/2}}$$

Therefore, the half-life of a zero order reaction can be written as:

$$t_{1/2} = \frac{[R]_0}{2\kappa}$$

(ii) Half-Life of First-order reactions:

For first-order reactions, the rate constant can be written as:

$$\kappa = \frac{2.303}{t} log \frac{[R]_0}{[R]}$$

From the definition of half-life, we can substitute t = $t_{1/2}$ and [R] = ½ $[R]_0$;

$$\kappa = \frac{2.303}{t_{1/2}} log \frac{[R]_0}{[R]_0/2}$$

Therefore, the half-life of a first-order reaction can be written as:

$$t_{1/2} = \frac{2.303}{\kappa} log 2 = \frac{2.303}{\kappa} * 0.301$$

$$t_{1/2} = \frac{0.693}{\kappa}$$

(OR)

A#25: (i) The primary factors affecting the rate of a reaction include :

- Concentration of reactants
- Temperature
- Presence of a Catalyst

(ii) a chemical reaction can take place over several steps. However, the slowest step of the reaction controls the overall reaction rate. This slowest step of the reaction is called the rate-determining step of the reaction.

(iii) the rate law is the representation of the rate of the reaction when compared to the concentration of reactants. It can also be referred to as the rate equation, or as the rate expression. Its expression can be written as:

$$Rate = \kappa[A]^x[B]^y$$

Q#26: Give (i) 2 Methods for the preparation of Nitric acid, and (ii) 3 properties of Nitric acid

(OR)

Q#26: What are Halogens? Write short notes on (i) Electronic Configuration, (ii) Atomic and Ionic Radii, (iii) Enthalpy of Ionization and (iv) Electronegativity of Halogens.

A#26: (i) Nitric acid can be prepared heating either potassium nitrate or sodium nitrate with concentrated sulfuric acid, as shown in the following reaction:

$$NaNO_3 + H_2SO_4 \xrightarrow{\Delta} NaHSO_4 + HNO_3$$

Nitric acid can also be prepared via Oswal's process, wherein the catalyst promotes the oxidation of ammonia by the atmospheric oxygen. This reaction can be written as:

$$3NH_3 + 5O_2 \xrightarrow[Pt/Rh-catalyst]{500K, 9bar} 4NO + 6H_2O$$

This nitric acid forms nitrogen dioxide which in turn is dissolved in water to give nitric acid.

(ii) Properties of Nitric Acid:

- Its freezing point is 231.4K whereas its boiling point is 355.6 K. It has a colorless appearance.
- Conc. nitric acid is a strong oxidizing agent. It can oxidize most metals (it cannot oxidize noble metals like Pt)
- An aqueous solution of nitric acid is strongly acidic since it can give both hydronium and nitrate ions.
- Concentrated nitric acid can also be used to oxidize non-metals. E.g. nitric acid can oxidize iodine to iodic acid.

(OR)

A#26: Elements belonging to group 17 of the periodic table, namely - Fluorine, Chlorine, Bromine, Iodine, Astatine, and Tennessine are commonly referred to as halogens. They are a highly reactive group of non-metals.

(i) the general electronic configuration of the halogens corresponds to - ns^2np^5. They are therefore short of one electron to fill the p orbital.

(ii) Since they have the largest effective nuclear charge in their corresponding periods, halogens are known to have the smallest atomic radii in their periods. Atomic and ionic radii increase in size as we progress down the group, due to the addition of new shells.

(iii) since the halogens are highly electronegative, they do not easily lose electrons. Therefore, they have high values for the enthalpy of ionization. This value decreases as we progress down the group, because of the increase in the atomic size of the atoms.

(iv) the halogens are a very electronegative group of elements. However, this electronegativity decreases as we progress down the group. The first halogen, fluorine is the most electronegative element in the entire periodic table.

Q#27: Write short notes on (i) Physical properties of d block elements, (ii) ionization enthalpies of d block elements, and (iii) oxidation states of d block elements.

(OR)

Q#27: What are Lanthanides and Actinides? Give 3 differences between them.

A#27: (i) d block elements display metallic properties like high tensile strength, malleability, ductility, metallic luster, and high electrical and thermal conductivity. They generally have one or many metallic structures at room temperature. Exceptions for this include zinc, mercury, cadmium, and manganese.

(ii) The ionization enthalpy of d block elements increases with each series when traversing from left to right. This can be explained by the increase in the effective nuclear charge as more protons and neutrons are added to the elements.

(iii) the d block elements exhibit many oxidation states. At the middle of the series, the elements which display the most number of oxidation states can be found. An example of this would be manganese, which can exhibit any oxidation state between +2 and +7.

(OR)

A#27: Lanthanides - these are the elements in which the valence shell contains '4f' electrons. The lanthanide group includes elements from atomic number 57 to atomic number 71. Lanthanum is also considered a lanthanide since its properties closely resemble those of lanthanides.

Actinides - these are the elements in which the valence shell contains '5f' electrons. The actinide group includes elements from atomic number 89 to atomic number 103. Actinium is also considered as an actinide because its properties are similar to those of actinides.

Lanthanide	**Actinide**
They don't tend to form complexes	They readily form complexes

They are not radioactive (except promethium)	They are radioactive
They don't form oxocations	They form oxocations. Example: PuO_2^-