

Questions and Answers – Optical Isomerism

1. Optical activity is the property in which a substance is unable to rotate the plane of polarisation.

- a) True
- b) False

Answer: b

Explanation: Optical activity is the property in which a substance is able to rotate the plane of polarisation of plane polarised light.

2. Select the incorrect statement from the following option.

- a) Racemic modification is an equimolar mixture of dextrorotatory and levorotatory isomers
- b) Meso compounds contain more than one chiral carbon centre
- c) Meso compounds are externally compensated
- d) Racemic mixture is designated as dl-pair

Answer: c

Explanation: Meso compounds are internally compensated form whereas racemic mixtures are externally compensated modification. All the other options are correct.

3. Select the correct statement from the following option.

- a) Meso compound possess both plane of symmetry and centre of symmetry
- b) Meso compound possess either plane or centre of symmetry
- c) Meso compound does not possess either plane or centre of symmetry
- d) Meso compounds are externally compensated form

Answer: b

Explanation: Meso compound possess either plane or centre of symmetry. They do not possess both plane of symmetry and centre of symmetry and also they are internally compensated form.

4. How many optical isomers are possible in a compound with one chiral carbon?

- a) 5
- b) 4
- c) 2
- d) 3

Answer: d

Explanation: A compound with one chiral carbon has three optical isomers (+), (-) and (\pm).

5. Which of the following compound would show optical isomerism?

- a) $\text{CH}_3 - \text{CH}(\text{OH}) \text{COOH}$
- b) $\text{H}_2\text{N} \text{CH}(\text{CH}_3)_2$
- c) $(\text{CH}_3)_2 \text{CHCHO}$
- d) $\text{H}_2\text{N} \text{CH}_2 \text{COOH}$

Answer: a

Explanation: $\text{CH}_3 - \text{CH}(\text{OH}) \text{COOH}$ will show optical isomerism as it possess chiral carbon.

6. The number of configurational isomers of molecules having (n) different chiral carbons is

-
- a) $2n$
 - b) 2^n
 - c) 2^{n-1}
 - d) 2^{n+1}

Answer: b

Explanation: The number of configurational isomers of molecules having (n) different chiral carbons is 2^n . It is calculated mathematically.

7. The number of racemic forms of molecules having (n) different chiral carbons is

-
- a) $2n$
 - b) 2^n
 - c) 2^{n-1}
 - d) 2^{n+1}

Answer: c

Explanation: The number of racemic forms of molecules having (n) different chiral carbons is 2^{n-1} whereas the number of configurational isomers of molecules having (n) different chiral carbons is 2^n .

8. For a molecule with two like chiral carbon atoms, the number of optically inactive form is?

- a) 1
- b) 2
- c) 3
- d) 4

Answer: a

Explanation: For a molecule with two like chiral carbon atoms, the number of optically inactive form is one. This is always used for the calculation of optically inactive forms.

9. For a molecule with two like chiral carbon atoms, the number of optically active form is?

- a) 4
- b) 3
- c) 1
- d) 2

Answer: d

Explanation: For a molecule with two like chiral carbon atoms, the number of optically active form is two. This is always used for the calculation of optically active forms.

10. Find the number of stereoisomers for $\text{CH}_3 - \text{CHOH} - \text{CH} = \text{CH} - \text{CH}_3$.

- a) 1
- b) 2
- c) 3

d) 4

Answer: d

Explanation: The number of stereoisomers for $\text{CH}_3 - \text{CHOH} - \text{CH} = \text{CH} - \text{CH}_3$ is four. This is calculated by the formula 2^{n+1} .

11. The necessary condition for showing optical activity is the chirality of a molecule as a whole.

- a) True
- b) False

Answer: a

Explanation: The necessary condition for showing optical activity is the chirality of a molecule as a whole. It is the most important condition for showing optical activity.

12. The sufficient condition for showing optical activity is _____

- a) Molecule should have measurable amount of optical activity only
- b) Polarimeter should have capacity of recording low-degree optical activity only
- c) Chirality of molecule as a whole only
- d) Both, the molecule should have measurable amount of optical activity and polarimeter should have capacity of recording low-degree optical activity

Answer: d

Explanation: The molecule should have measurable amount of optical activity and polarimeter should have capacity of recording low-degree optical activity.

13. Which of the following is an example of optically active compounds without chirality?

- a) Tartaric acid
- b) Sulphonium salt
- c) Diphenic acid
- d) Glyceraldehyde

Answer: b

Explanation: Sulphonium salt is an example of optically active compounds without chirality. It is a special case. There are various such molecules which are optically active compounds without chirality.

14. Spiranes exhibit optical isomerism because of restricted rotation.

- a) True
- b) False

Answer: a

Explanation: Spiranes exhibit optical isomerism because of restricted rotation. They cannot rotate about any axis.

15. Which of the following is not optically active compound?

- a) 1,7- Dicarboxylic spirocycloheptane
- b) 1,3- Diphenyl propadiene
- c) Meso-tartaric acid

d) Glyceraldehyde

Answer: c

Explanation: Meso-tartaric acid is an optically inactive molecule with a chiral carbon atom. It is a special case of optical activity

Questions and Answers – E and Z Nomenclature of Geometric Isomers

1. What are Stereoisomers?

- a) Isomers having a same molecular formula and same configuration
- b) Isomers having a same molecular formula but different configuration
- c) Isomers having a different molecular formula but the same configuration
- d) Isomers having a different molecular formula and different configuration

Answer: b

Explanation: Stereoisomerism is exhibited by isomers having the same molecular formula but different configuration.

2. What are diastereomers?

- a) Molecules with non-superimposable mirror images
- b) Molecules with superimposable mirror images
- c) Molecules which do not have non-superimposable mirror images
- d) None of the mentioned

Answer: c

Explanation: Diastereomers are those stereoisomers which do not have non-superimposable mirror images.

3. Which type of compounds cannot exhibit geometrical isomerism?

- a) Singly Bonded
- b) Doubly Bonded
- c) Triply Bonded
- d) Cyclic Compounds

Answer: c

Explanation: Triply bonded compounds cannot exhibit geometrical isomerism as the $-C\equiv C-$ bond in these molecules is linear.

4. Choose the correct option from the following.

- a) A group gets priority if its atomic number is high
- b) When atoms attached to a double bond have same atomic number, the first atoms are considered
- c) A group gets priority if its atomic number is low
- d) Lone pair gets more priority and is ranked above hydrogen

Answer: a

Explanation: A group gets priority if its atomic number is high and When atoms attached to a double bond have same atomic number, the second atoms are considered.

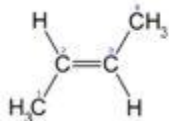
5. In which type of projection we can get staggered and eclipsed conformations?

- a) Newman Projection
- b) Sawhorse Projection
- c) Fischer Projection
- d) Wedge Projection

Answer: b

Explanation: A sawhorse projection can reveal staggered and eclipsed conformations.

6. Assign E or Z configuration to the given compound.



- a) E-configuration
- b) Z-configuration
- c) S-configuration
- d) R-configuration

Answer: a

Explanation: Trans-2-butene has two geometric isomers and this is E-configuration.

7. Which of the following compounds have Z-configuration?

- a) $\text{CH}_3^{\text{CH}_3}\text{CH}_2 > \text{C}=\text{C} <^{\text{H}}\text{CH}_3$
- b) $\text{H}^{\text{Ph}} > \text{C}=\text{C} <^{\text{COOH}}\text{Ph}$
- c) $\text{H}_2\text{N}^{\text{Cl}} > \text{C}=\text{C} <^{\text{COOH}}\text{Br}$
- d) $\text{CH}_3^{\text{Ph}} > \text{C}=\text{C} <^{\text{CH}_2}\text{CH}_3\text{Br}$

Answer: b

Explanation: All the other options are in E-configuration. Only the second option shows the Z-configuration.

8. Select the incorrect option from the following.

- a) Fischer projections are two dimensional representations of three dimensional molecules
- b) A molecule is achiral if it cannot be superimposed on its mirror reflection
- c) E and Z notations are based on Cahn, Ingold and Prelog priority system
- d) Chiral molecules which are non-superimposable mirror images of each other are enantiomers

Answer: b

Explanation: A molecule is achiral if it is superimposable on its mirror reflection. All the other options are correct.

9. The cis-trans nomenclature is not applicable when _____

- a) The different groups attached to the carbon atom of double bond are same
- b) Atleast one of the group attached to each carbon atom is same
- c) The different groups attached to the carbon atom of double bond are not same

d) The cis-trans nomenclature is applicable for all compounds

Answer: c

Explanation: The cis-trans nomenclature is applicable when the different groups attached to the carbon atom of double bond are same or atleast one of the group attached to each carbon atom is same.

10. In glyceraldehydes, the complete sequence of priority is _____

- a) $-\text{OH} > -\text{CH}_2\text{OH} > -\text{CHO} > -\text{H}$
- b) $-\text{H} > -\text{CH}_2\text{OH} > -\text{CHO} > -\text{OH}$
- c) $-\text{H} > -\text{OH} > -\text{CH}_2\text{OH} > -\text{CHO}$
- d) $-\text{OH} > \text{CHO} > -\text{CH}_2\text{OH} > -\text{H}$

Answer: d

Explanation: In glyceraldehydes, the complete sequence of priority is $-\text{OH} > \text{CHO} > -\text{CH}_2\text{OH} > -\text{H}$.

Questions and Answers – R, S- Configuration and Water Softening

1. Which of the following is not a priority rule for R, S-Configuration?

- a) If the four atoms attached to the chiral centre are all different, priority depends on atomic number, with the atom of lower atomic numbers getting lower priority
- b) If the two atoms attached to chiral centre are same, the atoms attached to each of these first atoms are compared
- c) When there is a double bond or triple bond, both atoms are considered to be duplicated or triplicated
- d) If the four atoms attached to the chiral centre are all different, priority depends on atomic number, with the atom of higher atomic numbers getting lower priority

Answer: d

Explanation: If the four atoms attached to the chiral centre are all different, priority depends on atomic number, with the atom of lower atomic numbers getting lower priority.

2. If our eyes travel in counter clockwise direction from the ligand of highest priority to the ligand of lowest priority, the configuration is _____

- a) R-Configuration
- b) S-Configuration
- c) E-Configuration
- d) C-Configuration

Answer: b

Explanation: In S-Configuration, our eyes travel in counter clockwise direction from the ligand of highest priority to the ligand of lowest priority.

3. According to the selection rules, the decreasing order of preference is _____

- a) $-\text{NH}_2 > -\text{C}_6\text{H}_5 > -\text{CH}(\text{CH}_3)_2 > -\text{H}$
- b) $-\text{CH}(\text{CH}_3)_2 > -\text{C}_6\text{H}_5 > -\text{H} > -\text{NH}_2$
- c) $-\text{NH}_2 > -\text{CH}(\text{CH}_3)_2 > -\text{C}_6\text{H}_5 > -\text{H}$



Answer: a

Explanation: The atom of higher atomic numbers gets higher priority. So, $-NH_2$ group has the highest priority of all.

4. The process of removal of hardness of water, irrespective of whether it is temporary or permanent is termed as _____

- a) Cleansing action of water
- b) Hardness of water
- c) Softening of water
- d) Purity of water

Answer: c

Explanation: The process of removal of hardness of water, irrespective of whether it is temporary or permanent is termed as softening of water. This process includes both temporary as well as permanent hardness.

5. The external treatment of water does not include _____

- a) Lime-soda process
- b) Sequestration
- c) Zeolites
- d) Ion-exchange process

Answer: b

Explanation: The external treatments of water include lime-soda, zeolites and ion-exchange processes. It does not include sequestration.

6. Which of the following conditioning method is not used in internal treatment?

- a) Colloidal
- b) Calgon
- c) Carbonate
- d) Bicarbonate

Answer: d

Explanation: Colloidal, calgon, phosphate and carbonate conditioning methods are used in internal treatment. Bicarbonate is not used for this purpose.

7. Select the incorrect statement from the following option.

- a) Internal treatment is carried out outside the boiler before water enters into the boiler
- b) Internal treatment methods are followed by blow-down operations
- c) Internal treatment is required in low pressure boilers
- d) Internal treatment is a corrective method

Answer: a

Explanation: Internal treatment is carried out inside the boiler. All the other options are correct.

8. External treatment is a preventive method and it is required in high pressure boilers.

- a) True
- b) False

Answer: a

Explanation: External treatment is a preventive method and it is required in high pressure boilers. External treatment is carried out outside the boilers.

9. Potable water treatment does not involve _____

- a) Disinfection
- b) Demineralisation
- c) Coagulation
- d) Sedimentation

Answer: b

Explanation: Potable water treatment does not involve demineralisation. It involves disinfection, coagulation and sedimentation processes.

10. The exhausted anion exchangers can be regenerated by working with _____

- a) Acid solution
- b) Alcohol solution
- c) Alkali solution
- d) Water

Answer: c

Explanation: The exhausted anion exchangers can be regenerated by working with alkali solution because alkali solution or basic solution does not contain reactive ions.

Questions and Answers – Chirality

1. Chiral molecules are those which are?

- a) Shows geometrical isomerism
- b) Superimposable on their mirror images
- c) Not superimposable on their mirror images
- d) Unstable molecules

Answer: c

Explanation: Chiral molecules are those which are not superimposable on their mirror images. The presence of an asymmetric carbon atom is one of several structural features that induce chirality in organic and inorganic molecules.

2. Which of the following is not an example of chiral object?

- a) Cylindrical helix
- b) Square box
- c) Sandal or shoe
- d) Glove

Answer: b

Explanation: A square box is not chiral as it gives super-imposable mirror image. All the other mentioned options does not give the super-imposable mirror images.

3. For any given substance, the amount of rotation does not depends upon _____

- a) Wavelength of light used
- b) Nature of the solvent
- c) Temperature
- d) Pressure

Answer: d

Explanation: For any given substance, the amount of rotation depends upon the concentration, nature of solvent, temperature, length of layer traversed and the wavelength of light used. It does not depend upon the pressure conditions.

4. If the rotation of the plane is clockwise, the substance is dextrorotatory.

- a) True
- b) False

Answer: a

Explanation: If the rotation of the plane is clockwise, the substance is dextro rotatory. And if the rotation of the plane is anti-clockwise, the substance is leavo rotatory.

5. The specific rotation is inversely proportional to _____

- a) Observed rotation
- b) Temperature
- c) Concentration of solution
- d) D-line of sodium vapour light

Answer: c

Explanation: The specific rotation is inversely proportional to the concentration of solution and length of sample tube.

6. 0.5 g of an optically active compound was dissolved in 2mL of solvent at 25⁰C. The solution was kept in a cell of length 10 cm and observed rotation was +10⁰. What is the specific rotation of its enantiomer?

- a) -40⁰
- b) +40⁰
- c) -10⁰
- d) +10⁰

Answer: b

Explanation: $[\alpha] = \alpha/lC = +10^0/(1*0.5/2) = +40^0$.

7. To avoid excessive high value of molecular rotation, concentration is taken as _____

- a) 1 centi-mole/mL
- b) 1 milli-mole/mL
- c) 1 mole/mL

d) 1 kilo-mole/mL

Answer: a

Explanation: To avoid excessive high value of molecular rotation, concentration is taken as 1 centi-mole/mL.

8. Chiral molecules which are non-super-imposable mirror images of each other are called

- a) Diastereomers
- b) Meso compounds
- c) Racemic mixture
- d) Enantiomers

Answer: d

Explanation: Chiral molecules which are non-superimposable mirror images of each other are called enantiomers. Enantiomer members often have different chemical reactions with other enantiomer substances.

9. Select the correct statement from the following option.

- a) Enantiomer rotate plane of polarised light in opposite direction and to different extent
- b) Enantiomer rotate plane of polarised light in same direction but to different extent
- c) Enantiomer rotate plane of polarised light in same direction and to same extent
- d) Enantiomer rotate plane of polarised light in opposite direction but to same extent

Answer: d

Explanation: Enantiomer rotate plane of polarised light in opposite direction but to same extent. Enantiomer members often have different chemical reactions with other enantiomer substances.

10. Enantiomerism is the phenomenon of existence of enantiomers in a single structural formula, in _____ configuration.

- a) Same
- b) Opposite
- c) Same as well as opposite
- d) Initially opposite and then same

Answer: b

Explanation: Enantiomerism is the phenomenon of existence of enantiomers in a single structural formula but in opposite configuration.

11. Select the incorrect statement from the following option.

- a) The physical properties of enantiomers are identical
- b) In symmetrical environment, the chemical properties of enantiomers are identical
- c) The enantiomers react at same rate and form products in same amounts in asymmetrical environment
- d) Enantiomers have different solubilities in the same chiral solvent

Answer: c

Explanation: The enantiomers react at different rate and form products in different amounts in asymmetrical environment. All the other options are correct.

12. Optical activity can also result from the lack of molecular symmetry in molecules.

- a) True
- b) False

Answer: a

Explanation: Optical activity can also result from the lack of molecular symmetry in molecules which do not have chiral carbon.

13. The plane which divides the molecule into two equal parts so that each half is the mirror image of other half is called _____

- a) Centre of symmetry
- b) Plane of symmetry
- c) Axis of symmetry
- d) Angle of symmetry

Answer: b

Explanation: The plane divides the molecule into two equal parts so that each half is the mirror image of other half is called plane of symmetry. Centre of symmetry is the central point about which the molecule is symmetrical.

14. When a molecule has a plane of symmetry, it will be _____

- a) Optically inactive
- b) Optically active
- c) Both optically active & inactive
- d) Enantiomer

Answer: a

Explanation: When a molecule has a plane of symmetry, it will be optically inactive, even though it might contain chiral carbon.

15. A centre of symmetry is equivalent to _____ fold alternating axis of symmetry.

- a) One
- b) Two
- c) Three
- d) Four

Answer: b

Explanation: A centre of symmetry is equivalent to two-fold alternating axis of symmetry.

16. Diastereomers are _____

- a) Geometrical isomers
- b) Mirror images
- c) Non-mirror images

d) Unstable molecules

Answer: c

Explanation: Diastereomers are not mirror images of each other. Diastereomerism occurs when two or more stereo isomers of a compound have different configurations at one or more of the equivalent stereo centers and are not mirror images of each other.

17. A plane of symmetry is equivalent to _____ fold alternating axis of symmetry.

- a) One
- b) Two
- c) Three
- d) Four

Answer: a

Explanation: A centre of symmetry is equivalent to one-fold alternating axis of symmetry.

18. As the optical activity changes with the wavelength of light, it is necessary not to use monochromatic light to measure optical activity.

- a) True
- b) False

Answer: b

Explanation: As the optical activity changes with the wavelength of light, it is necessary to use monochromatic light to measure optical activity.

Questions and Answers – Stereoselectivity and Stereospecificity

1. The reaction which gives exclusively one of several possible isomeric products is called

- a) Dynamicselective
- b) Stereoselective
- c) Regioselective
- d) Stereospecific

Answer: c

Explanation: The reaction which gives exclusively one of several possible isomeric products is called regioselective reaction. Regioselectivity is the preference of one direction of chemical bond making or breaking over all other possible directions.

2. The reaction that yields predominantly one enantiomer of a possible pair is called

- a) Dynamicselective
- b) Stereoselective
- c) Regioselective
- d) Stereospecific

Answer: b

Explanation: The reaction that yields predominantly one enantiomer of a possible pair is called stereoselective reaction. Stereoselectivity is the property of a chemical reaction in which a single

reactant forms an unequal mixture of stereo isomers during the non-stereo specific creation of a new stereo center or during the non-stereo specific transformation of a pre-existing one.

3. Stereoselectivity can be exhibited in various degrees.

- a) True
- b) False

Answer: a

Explanation: Stereoselectivity can be exhibited in various degrees like completely stereoselective, highly stereoselective, moderately stereoselective and so on.

4. The reaction in which stereochemically different molecules react differently is called

-
- a) Dynamicselective
 - b) Stereoselective
 - c) Regioselective
 - d) Stereospecific

Answer: d

Explanation: The reaction in which stereochemically different molecules react differently is called stereospecific reaction. Stereospecificity is the property of a reaction mechanism that leads to different stereo isomeric reaction products from different stereo isomeric reactants, or which operates on only one of the stereo isomers.

5. Which of the following is an example of regioselective reaction?

- a) Debromination of 2,3- dibromobutane
- b) 2-bromo octane with sodium hydroxide
- c) Addition of HI to propylene
- d) Debromination of meso dibromobutane

Answer: c

Explanation: Addition of HI to propylene is an example of regioselective reaction. Regioselectivity is the preference of one direction of chemical bond making or breaking over all other possible directions.

6. Reaction of (\pm) 2,3- dibromobutane is slower than meso in which the two methyl groups are

-
- a) Skew
 - b) Anti
 - c) Gauche
 - d) Partially eclipsed

Answer: d

Explanation: Reaction of (\pm) 2,3- dibromobutane is slower than meso due to higher transition state in which the two methyl groups are partially eclipsed.

7. Dynamic stereochemistry helps in correlating conformation and reactivity and in stereoselective synthesis.

- a) True
- b) False

Answer: a

Explanation: Dynamic stereochemistry helps in correlating conformation and reactivity and in stereoselective synthesis. Stereoselectivity is the property of a chemical reaction in which a single reactant forms an unequal mixture of stereo isomers during the non-stereo specific creation of a new stereo center

8. $R - C = C - R$ reacts in the presence of lindlar catalyst to give a syn product. This is an example of _____

- a) Dynamicselective
- b) Stereoselective
- c) Regioselective
- d) Stereospecific

Answer: b

Explanation: The above mentioned reaction is an example of stereoselective reaction. Stereoselectivity is the property of a chemical reaction in which a single reactant forms an unequal mixture of stereo isomers during the non-stereo specific creation of a new stereo center

9. Under S_N2 conditions, on reaction with NaOH, (R)-2-bromo octane gives _____

- a) (S)-2-octanol
- b) (R)-2-octanol
- c) Trans-2-butene
- d) Cis-2-butene

Answer: a

Explanation: Under S_N2 conditions, on reaction with NaOH, (R)-2-bromo octane gives (S)-2-octanol. In S_N2 mechanism, one bond is broken and one bond is formed synchronously.

10. Under S_N2 conditions, on reaction with NaOH, (S)-2-bromo octane gives (R)-2-octanol. This is an example of _____

- a) Dynamicselective
- b) Stereoselective
- c) Regioselective
- d) Stereospecific

Answer: d

Explanation: Under S_N2 conditions, on reaction with NaOH, (S)-2-bromo octane gives (R)-2-octanol. This is an example of stereospecific reaction. In S_N2 mechanism, one bond is broken and one bond is formed synchronously.

11. Optical purity is defined as the _____

- a) Ratio of rotation of pure enantiomer to rotation of mixture
- b) Ratio of rotation of mixture to rotation of pure enantiomer
- c) Product of rotation of mixture and rotation of pure enantiomer

d) Sum of rotation of mixture and rotation of pure enantiomer

Answer: b

Explanation: Optical purity is defined as the ratio of rotation of mixture to rotation of pure enantiomer. It is expressed as a percentage. If the sample only rotates plane-polarized light half as much as expected, the optical purity is 50%.

12. The formula of enantiomeric excess is _____

a) $[(d+1)/(d-1)] * 100$

b) $[(d)/(d+1)] * 100$

c) $[(d-1)/(d)] * 100$

d) $[(d-1)/(d+1)] * 100$

Answer: c

Explanation: The formula of enantiomeric excess is $[(d-1)/(d+1)] * 100$. It gives the percentage of excess of an enantiomer.