Q1. Which of the following is the most stable carbocation?

A. CH_3^+
B. $CH_3CH_2^+$
C. $(CH_3)_2CH^+$
D. $(CH_3)_3C^+$

Answer: D. $(CH_3)_3C^+$
Explanation: Tertiary carbocations are most stable due to the +I effect and hyperconjugation from three methyl groups.

Q2. Which of the following species is a nucleophile?

A. BF_3
B. $AlCl_3$
C. NH_3
D. H^+

Answer: C. NH_3
Explanation: NH_3 has a lone pair and donates it to electrophiles; thus, it acts as a nucleophile.

Q3. Which effect explains the acidic character of carboxylic acids?

A. Electromeric effect
B. Resonance effect
C. Inductive effect
D. Hyperconjugation

Answer: B. Resonance effect
Explanation: Resonance in the carboxylate ion stabilizes it, enhancing acidity of carboxylic acids.

Q4. Which of the following represents hyperconjugation?

A. $\pi \rightarrow \pi^*$
B. $\sigma \rightarrow \pi$
C. $\sigma \rightarrow \pi^*$
D. $n \rightarrow \pi^*$

Answer: C. $\sigma \rightarrow \pi^*$
Explanation: In hyperconjugation, electrons from a σ-bond (usually C–H) are delocalized into an adjacent π system or empty p-orbital.

Q5. Which of the following is the correct order of basicity?

A. $NH_2^- > NH_3 > NH_4^+$
B. $NH_4^+ > NH_3 > NH_2^-$
C. $NH_3 > NH_2^- > NH_4^+$
D. $NH_2^- > NH_4^+ > NH_3$

Answer: A. $NH_2^- > NH_3 > NH_4^+$
Explanation: NH_2^- is a strong base (negative charge), NH_3 is neutral, and NH_4^+ is acidic.

Q6. Which is not a correct statement about resonance?

A. Resonance structures differ in arrangement of electrons
B. Resonance structures differ in position of nuclei
C. Resonance hybrid is more stable than any individual resonance structure
D. Resonance explains delocalization of electrons

Answer: B. Resonance structures differ in position of nuclei
Explanation: Only electrons shift, not nuclei, in resonance.

Q7. Which of the following is an example of an electrophilic substitution reaction?

A. Halogenation of alkene
B. Nitration of benzene
C. Hydrolysis of ester
D. Wurtz reaction

Answer: B. Nitration of benzene
Explanation: Benzene undergoes substitution with an electrophile like NO_2^+.

Q8. Which of the following has the highest acidic strength?

A. CH_3COOH

B. $ClCH_2COOH$
C. FCH_2COOH
D. CH_3CH_2COOH

Answer: C. FCH_2COOH
Explanation: Fluorine is highly electronegative and pulls electrons, stabilizing the conjugate base.

Q9. Which pair are positional isomers?

A. Ethanol and dimethyl ether
B. Propan-1-ol and propan-2-ol
C. Acetone and propanal
D. Acetic acid and methyl formate

Answer: B. Propan-1-ol and propan-2-ol
Explanation: They differ in the position of the –OH group but have same molecular formula.

Q10. Which of the following is not a type of structural isomerism?

A. Chain isomerism
B. Position isomerism
C. Optical isomerism
D. Functional group isomerism

Answer: C. Optical isomerism
Explanation: Optical isomerism is stereoisomerism, not structural isomerism.

Q11. The most reactive towards nucleophilic substitution among the following is:

A. Benzyl chloride
B. Vinyl chloride
C. Chlorobenzene
D. Chloroethane

Answer: A. Benzyl chloride
Explanation: Benzyl cation is resonance-stabilized, so substitution is easy.

Q12. Which effect stabilizes free radicals?

A. Electromeric effect
B. Hyperconjugation
C. Resonance
D. Both B and C

Answer: D. Both B and C
Explanation: Free radicals are stabilized by hyperconjugation and resonance delocalization.

Q13. Identify the electrophile in the nitration of benzene.

A. NO_2^-
B. NO_2^+
C. HNO_3
D. H_2SO_4

Answer: B. NO_2^+
Explanation: Nitronium ion (NO_2^+) is the active electrophile generated in the reaction.

Q14. The IUPAC name of isobutane is:

A. 2-Methylpropane
B. 1-Methylpropane
C. Butane
D. Propylmethane

Answer: A. 2-Methylpropane
Explanation: The main chain is propane and one methyl branch at 2nd position.

Q15. Which of the following is the correct order of stability for carbanions?

A. $CH_3^- > CH_2{=}CH^- > C_6H_5^-$
B. $C_6H_5^- > CH_2{=}CH^- > CH_3^-$
C. $CH_2{=}CH^- > CH_3^- > C_6H_5^-$
D. $CH_3^- > C_6H_5^- > CH_2{=}CH^-$

Answer: B. $C_6H_5^- > CH_2{=}CH^- > CH_3^-$

Explanation: Phenyl carbanion is resonance stabilized; vinyl is sp^2 hybridized (more electronegative); methyl is least stable.

Q16. Which of the following compounds shows geometrical isomerism?

A. But-1-ene
B. But-2-ene
C. Propene
D. 2-methylpropene

Answer: B. But-2-ene
Explanation: But-2-ene has restricted rotation about the double bond and different groups on each carbon, allowing cis-trans isomerism.

Q17. Which of the following has the least number of hyperconjugative structures?

A. CH_3^+
B. $CH_3CH_2^+$
C. $(CH_3)_2CH^+$
D. $(CH_3)_3C^+$

Answer: A. CH_3^+
Explanation: CH_3^+ has no adjacent C–H bonds available for hyperconjugation.

Q18. The hybridization of the positively charged carbon in the ethyl carbocation is:

A. sp
B. sp^2
C. sp^3
D. sp^3d

Answer: B. sp^2
Explanation: In carbocations, the carbon is sp^2 hybridized with an empty p orbital.

Q19. Which of the following is not a reaction intermediate?

A. Carbocation

B. Carbanion
C. Alkyl halide
D. Free radical

Answer: C. Alkyl halide
Explanation: Alkyl halides are reactants, not intermediates. The others are short-lived species formed during reactions.

Q20. Which of the following represents a pair of enantiomers?

A. Butan-2-ol and Butan-1-ol
B. (+)-Lactic acid and (−)-Lactic acid
C. Acetone and Propanal
D. Maleic acid and Fumaric acid

Answer: B. (+)-Lactic acid and (−)-Lactic acid
Explanation: These are non-superimposable mirror images (enantiomers) of each other.

Q21. Which of the following electron effects is temporary?

A. Inductive effect
B. Resonance effect
C. Hyperconjugation
D. Electromeric effect

Answer: D. Electromeric effect
Explanation: Electromeric effect occurs only when an attacking reagent approaches; it's temporary and reversible.

Q22. In IUPAC nomenclature, the word root for an organic compound depends on:

A. Number of hydrogen atoms
B. Number of carbon atoms in the longest chain
C. Type of functional group
D. Type of carbon-carbon bond

Answer: B. Number of carbon atoms in the longest chain
Explanation: The base name (word root) is decided by the longest carbon chain.

Q23. Which of the following correctly matches the isomer types?

A. Structural – Same structure, different formula
B. Stereoisomers – Different connectivity
C. Conformers – Same compound, different spatial orientation
D. Geometrical isomers – Same compound, different carbon number

Answer: C. Conformers – Same compound, different spatial orientation
Explanation: Conformers differ in spatial arrangement due to free rotation around σ-bonds.

Q24. Which of the following does not show resonance?

A. Benzene
B. Acetone
C. Nitrobenzene
D. Cyclohexane

Answer: D. Cyclohexane
Explanation: Cyclohexane has only σ-bonds and no delocalizable π-electrons.

Q25. Which group shows +M (positive mesomeric) effect?

A. $–NO_2$
B. –CN
C. –OH
D. –COOH

Answer: C. –OH
Explanation: The –OH group donates electron density via lone pairs into the π system.

Q26. Which of the following is most acidic?

A. Acetylene
B. Ethylene
C. Ethane
D. Benzene

Answer: A. Acetylene
Explanation: Acetylene (sp-hybridized carbon) has highest s-character, thus stronger hold on electrons → more acidic.

Q27. The IUPAC name of the compound $CH_3–CH_2–C≡CH$ is:

A. Butyne
B. But-1-yne
C. But-2-yne
D. 1-Butyne

Answer: D. 1-Butyne
Explanation: Numbering starts from the terminal alkyne group. Correct name: 1-Butyne.

Q28. The major product formed in the reaction of $CH_3CH=CH_2$ with HBr in presence of peroxide is:

A. $CH_3CHBrCH_3$
B. $CH_3CH_2CH_2Br$
C. $CH_3CHBrCH_2$
D. CH_3CH_2CHBr

Answer: B. $CH_3CH_2CH_2Br$
Explanation: Peroxide causes anti-Markovnikov addition of HBr via free radical mechanism.

Q29. In which of the following is mesomeric effect not involved?

A. CH_3COOH
B. $CH_2=CH–NO_2$
C. C_6H_5OH
D. $CH_3CH_2CH_3$

Answer: D. $CH_3CH_2CH_3$
Explanation: Propane has no delocalized π-system, so mesomeric effect is not involved.

Q30. The correct order of reactivity towards electrophilic substitution is:

A. Toluene > Benzene > Nitrobenzene
B. Nitrobenzene > Benzene > Toluene
C. Benzene > Toluene > Nitrobenzene
D. Toluene > Nitrobenzene > Benzene

Answer: A. Toluene > Benzene > Nitrobenzene
Explanation: Toluene activates the ring (electron-donating group), nitro group deactivates it.

Q31. What is the correct IUPAC name for $CH_3–CH_2–CH(CH_3)–CH_2–OH$?

A. 2-Methylbutan-1-ol
B. 3-Methylbutan-1-ol
C. 2-Methylpentanol
D. 3-Methylpentan-1-ol

Answer: A. 2-Methylbutan-1-ol
Explanation:
Longest chain = 4 carbon atoms (butane), with OH on C1 and methyl on C2 → 2-Methylbutan-1-ol.

Q32. What is the correct IUPAC name for the compound: $CH_3–CH_2–C(CH_3)_2–CH_2–CH_3$?

A. 2,2-Dimethylpentane
B. 3,3-Dimethylpentane
C. 2,3-Dimethylpentane
D. 3,3-Dimethylhexane

Answer: A. 2,2-Dimethylpentane
Explanation:
Longest chain = 5 carbon atoms (pentane); two methyl groups on carbon 2 → 2,2-Dimethylpentane.

Q33. Identify the correct IUPAC name for $CH_3–CH=CH–CH_2–COOH$.

A. Pent-2-enoic acid
B. Pent-3-enoic acid
C. 4-Pentenoic acid
D. 2-Pentenoic acid

Answer: C. 4-Pentenoic acid

Explanation:
Numbering starts from –COOH group. Double bond starts at C4 → 4-Pentenoic acid.

Q34. What is the IUPAC name of the compound: $CH_3–CH_2–CHBr–CH_3$?

A. 2-Bromobutane
B. 3-Bromobutane
C. 1-Bromobutane
D. 2-Bromo-1-butene

Answer: B. 3-Bromobutane
Explanation:
Longest chain = butane; Br on third carbon (from either end) → 3-Bromobutane.

Q35. Which of the following is a nucleophile?

A. BF_3
B. NO_2^+
C. NH_3
D. H^+

Answer: C. NH_3
Explanation:
NH_3 has a lone pair of electrons and donates it to electrophiles, so it's a nucleophile.

Q36. Which of the following carbocations is most stable?

A. CH_3^+
B. $CH_3–CH_2^+$
C. $(CH_3)_2CH^+$
D. $(CH_3)_3C^+$

Answer: D. $(CH_3)_3C^+$
Explanation:
Tertiary carbocation is stabilized by +I effect and hyperconjugation from three alkyl groups.

Q37. Which of the following has maximum +I effect?

A. $-CH_3$
B. $-C_2H_5$
C. $-NO_2$
D. $-(CH_3)_3C$

Answer: D. $-(CH_3)_3C$
Explanation:
Tert-butyl group has strongest +I effect due to three methyl groups donating electrons.

Q38. Which compound is most acidic?

A. Ethyne
B. Ethene
C. Ethane
D. Propane

Answer: A. Ethyne
Explanation:
Acidity: sp (50% s) > sp^2 (33%) > sp^3 (25%) → Ethyne has more s-character, so more acidic.

Q39. Which is the correct order of decreasing acidity?

A. $CH_3COOH > ClCH_2COOH > CH_3CH_2COOH$
B. $ClCH_2COOH > CH_3COOH > CH_3CH_2COOH$
C. $CH_3CH_2COOH > ClCH_2COOH > CH_3COOH$
D. $CH_3CH_2COOH > CH_3COOH > ClCH_2COOH$

Answer: B. $ClCH_2COOH > CH_3COOH > CH_3CH_2COOH$
Explanation:
Electron-withdrawing Cl stabilizes conjugate base → more acidic.

Q40. Which of the following is an electrophile?

A. NH_3
B. $AlCl_3$
C. OH^-
D. Cl^-

Answer: B. $AlCl_3$
Explanation:
$AlCl_3$ is electron-deficient (has incomplete octet), so it's an electrophile.

Q41. Which type of reaction is SN1?

A. Unimolecular nucleophilic substitution
B. Bimolecular electrophilic substitution
C. Elimination reaction
D. Radical substitution

Answer: A. Unimolecular nucleophilic substitution
Explanation:
SN1 stands for Substitution Nucleophilic Unimolecular → rate depends only on substrate.

Q42. How many hyperconjugative structures are possible in propene?

A. 1
B. 2
C. 3
D. 6

Answer: C. 3
Explanation:
Number of α-hydrogens = 3 in methyl group → 3 hyperconjugative structures.

Q43. Which of the following species is most stable due to resonance?

A. $CH_3CH_2^+$
B. $CH_2=CH–CH_2^+$
C. $CH_3–CH^+–CH_3$
D. $(CH_3)_3C^+$

Answer: B. $CH_2=CH–CH_2^+$
Explanation:
Allylic carbocation is stabilized by resonance → most stable.

Q44. Identify the correct classification: Cl^- attacks a carbocation.

A. Electrophile attacking electrophile
B. Nucleophile attacking nucleophile
C. Nucleophile attacking electrophile
D. Electrophile attacking nucleophile

Answer: C. Nucleophile attacking electrophile
Explanation:
Cl^- is nucleophile (electron-rich) attacking carbocation (electron-poor electrophile).

Q45. Which of the following is a free radical?

A. CH_3^-
B. CH_3^+
C. $CH_3\bullet$
D. CH_4

Answer: C. $CH_3\bullet$
Explanation:
A free radical has one unpaired electron → $CH_3\bullet$ is methyl radical.