

Aldehydes, Ketones and Carboxylic Acids — NEET Chemistry PYQ (2005-2021)

Class 12 Chemistry · 41 real NEET & AIPMT questions, year-tagged · answers checked by RankUp

NEET 2021

1. What is the IUPAC name of the organic compound formed in the following chemical reaction ?

Acetone $\xrightarrow{[(i) C_2H_5MgBr, \text{ dry Ether; } (ii) H_2O, H^+]} \text{Product}$

- (A) 2-methyl propan-2-ol
- (B) pentan-2-ol
- (C) pentan-3-ol
- (D) 2-methyl butan-2-ol

NEET 2021

2. Match List - I with List - II.

List - I | List - II

(a) $C_6H_6 \xrightarrow{(CO, HCl; \text{ Anhyd. } AlCl_3/CuCl)} \rightarrow$ | (i) Hell-Volhard-Zelinsky reaction

(b) $R-CO-CH_3 + NaOX \rightarrow$ | (ii) Gattermann-Koch reaction

(c) $R-CH_2-OH + R'COOH \xrightarrow{(\text{Conc. } H_2SO_4)} \rightarrow$ | (iii) Haloform reaction

(d) $R-CH_2COOH \xrightarrow{((i) X_2/\text{Red P; } (ii) H_2O)} \rightarrow$ | (iv) Esterification

Choose the correct answer from the options given below.

- (A) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
- (B) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)
- (C) (a)-(i), (b)-(iv), (c)-(iii), (d)-(ii)
- (D) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

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3. The intermediate compound 'X' in the following chemical reaction is :

$C_6H_5-CH_3 + CrO_2Cl_2 \xrightarrow{-CS_2} X \xrightarrow{-H_3O^+} C_6H_5-CHO$

- (A) $C_6H_5-CH(OCrOHCl_2)_2$
- (B) $C_6H_5-CH(OCOCH_3)_2$
- (C) $C_6H_5-CHCl_2$
- (D) $C_6H_5-CH_2Cl$

NEET 2020 · Q107

4. Reaction between benzaldehyde and acetophenone in presence of dilute NaOH is known as :

- (A) Aldol condensation
- (B) Cannizzaro's reaction
- (C) Cross Cannizzaro's reaction
- (D) Cross Aldol condensation

NEET 2019 · Q78

5. The major product of the following reaction is: phthalic acid (benzene-1,2-dicarboxylic acid) + $NH_3 \xrightarrow{\text{strong heating}}$

- (A) 2-carbamoylbenzoic acid (o- $HOOC-C_6H_4-CONH_2$, phthalamic acid)
- (B) Phthalimide (cyclic imide, $C_6H_4(CO)_2NH$)
- (C) 2-Aminobenzoic acid (o- $H_2N-C_6H_4-COOH$)
- (D) Benzene-1,2-diamine (o- $C_6H_4(NH_2)_2$)

NEET 2018 · Q67

6. Carboxylic acids have higher boiling points than aldehydes, ketones and even alcohols of comparable molecular mass. It is due to their

- (A) more extensive association of carboxylic acid via van der Waals force of attraction
- (B) formation of carboxylate ion
- (C) formation of intramolecular H-bonding
- (D) formation of intermolecular H-bonding

NEET 2017 · Q44

7. Consider the reactions: $X (C_2H_6O) \xrightarrow{Cu/573\text{ K}} A$; $A \xrightarrow{[Ag(NH_3)_2]^+, ^-OH, \Delta} \text{Silver mirror observed}$; $A \xrightarrow{(^-OH, \Delta)} Y$; $A \xrightarrow{(NH_2-NH-CO-NH_2)} Z$. Identify A, X, Y and Z

- (A) A-Methoxymethane, X-Ethanoic acid, Y-Acetate ion, Z-hydrazine.
- (B) A-Methoxymethane, X-Ethanol, Y-Ethanoic acid, Z-Semicarbazide.
- (C) A-Ethanal, X-Ethanol, Y-But-2-enal, Z-Semicarbazone.
- (D) A-Ethanol, X-Acetaldehyde, Y-Butanone, Z-Hydrazone.

NEET 2017 (Gujarati paper) · Q9

8. If the rate of the reaction: $R-CO-Z + Nu^- \rightarrow R-CO-Nu + Z^-$ is fastest, then Z is:

- (A) Cl
- (B) NH_2
- (C) OC_2H_5
- (D) $OCOCH_3$

NEET 2017 (Gujarati paper) · Q22

9. Consider the following sequence of reactions: Benzene $\xrightarrow{(CO, HCl, \text{anhydrous } AlCl_3/CuCl)}$ A $\xrightarrow{('B', ^-OH, 293\text{ K})}$ $C_6H_5-CH=CH-CO-C_6H_5$. The substance 'B' is:

- (A) Benzene
- (B) Acetophenone
- (C) Benzaldehyde
- (D) Acetone

NEET 2017 (Gujarati paper) · Q33

10. Among the following acids, the strongest acid is:

- (A) $NCCH_2COOH$
- (B) O_2NCH_2COOH
- (C) F_3CCOOH
- (D) Cl_3CCOOH

NEET 2016 Phase 2 · Q87

11. The correct structure of the product A formed in the reaction cyclohex-2-en-1-one $\xrightarrow{(H_2 \text{ (gas, 1 atmosphere), Pd/carbon, ethanol)}}$ A is

- (A) Cyclohex-2-en-1-ol
- (B) Cyclohexanone
- (C) Cyclohex-3-en-1-ol
- (D) 2-Hydroxycyclohexyl carbocation

NEET 2016 Phase 1 · Q54

12. The correct statement regarding a carbonyl compound with a hydrogen atom on its alpha-carbon, is:

- (A) a carbonyl compound with a hydrogen atom on its alpha-carbon never equilibrates with its corresponding enol.
- (B) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as aldehyde-ketone equilibration.
- (C) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as carbonylation.
- (D) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism.

NEET 2016 Phase 1 · Q83

13. The product formed by the reaction of an aldehyde with a primary amine is:

- (A) Schiff base
- (B) Ketone
- (C) Carboxylic acid
- (D) Aromatic acid

AIPMT 2015

14. An organic compound 'X' having molecular formula $C_5H_{10}O$ yields phenyl hydrazone and gives negative response to the Iodoform test and Tollens' test. It produces n-pentane on reduction. 'X' could be:

- (A) n-amyl alcohol
- (B) pentanal
- (C) 2-pentanone
- (D) 3-pentanone

AIPMT 2014

15. Which one is most reactive towards Nucleophilic addition reaction?

- (A) $C_6H_5COCH_3$ (acetophenone)
- (B) $p-CH_3-C_6H_4-CHO$ (p-methylbenzaldehyde)
- (C) $p-NO_2-C_6H_4-CHO$ (p-nitrobenzaldehyde)
- (D) C_6H_5CHO (benzaldehyde)

NEET 2013

16. Reaction by which benzaldehyde cannot be prepared

- (A) Toluene + CrO_2Cl_2 in CS_2 followed by H_3O^+
- (B) Benzoyl chloride (C_6H_5COCl) + H_2 in presence of $Pd-BaSO_4$
- (C) Benzene + $CO + HCl$ in presence of anhydrous $AlCl_3$
- (D) Benzoic acid (C_6H_5COOH) + Zn/Hg and conc. HCl

AIPMT 2012 Mains

17. Consider the following reaction:



The product 'A' is

- (A) C_6H_5CHO
- (B) C_6H_5OH
- (C) $C_6H_5COCH_3$
- (D) C_6H_5Cl

AIPMT 2012 Mains

18. Consider the reaction: $RCHO + NH_2NH_2 \rightarrow RCH=N-NH_2$. What sort of reaction is it?

- (A) Electrophilic addition - elimination reaction
- (B) Free radical addition - elimination reaction
- (C) Electrophilic substitution - elimination reaction
- (D) Nucleophilic addition - elimination reaction

AIPMT 2012 Prelims

19. CH_3CHO and $C_6H_5CH_2CHO$ can be distinguished chemically by

- (A) Fehling solution test
- (B) Benedict test
- (C) Iodoform test
- (D) Tollens' reagent test

AIPMT 2012 Prelims

20. Acetone is treated with excess of ethanol in the presence of hydrochloric acid.

The product obtained is:

- (A) $(CH_3)_2C(OC_2H_5)_2$
- (B) $CH_3CH_2CH_2-CO-CH_3$
- (C) $CH_3CH_2CH_2-CO-CH_2CH_2CH_3$
- (D) $(CH_3)_2C(OH)(OC_2H_5)$

AIPMT 2012 Prelims

21. Which of the following acids does not exhibit optical isomerism?

- (A) Tartaric acid
- (B) Maleic acid
- (C) α -Amino acids
- (D) Lactic acid

AIPMT 2012 Prelims

22. The correct order of decreasing acid strength of trichloroacetic acid (A), trifluoroacetic acid (B), acetic acid (C) and formic acid (D) is:

- (A) $A > C > B > D$
- (B) $B > A > D > C$
- (C) $B > D > C > A$
- (D) $A > B > C > D$

AIPMT 2012 Prelims

23. Predict the products in the given reaction:

m-Chlorobenzaldehyde ($m\text{-Cl-C}_6\text{H}_4\text{-CHO}$) $\xrightarrow{(50\% \text{ KOH})}$?

- (A) $m\text{-HO-C}_6\text{H}_4\text{-CH}_2\text{OH} + m\text{-HO-C}_6\text{H}_4\text{-COO}^-$
- (B) $m\text{-Cl-C}_6\text{H}_4\text{-CH}_2\text{OH} + m\text{-Cl-C}_6\text{H}_4\text{-CH}_2\text{COO}^-$
- (C) $m\text{-HO-C}_6\text{H}_4\text{-CH}_2\text{OH} + m\text{-HO-C}_6\text{H}_4\text{-OH}$
- (D) $m\text{-Cl-C}_6\text{H}_4\text{-CH}_2\text{OH} + m\text{-Cl-C}_6\text{H}_4\text{-COO}^-$

AIPMT 2011 Mains

24. Match the compounds given in List-I with List-II and select the suitable option using the code given below.

List-I: a. Benzaldehyde, b. Phthalic anhydride, c. Phenyl benzoate, d. Methyl salicylate

List-II: (i) Phenolphthalein, (ii) Benzoin condensation, (iii) Oil of wintergreen, (iv) Fries rearrangement

- (A) a(ii), b(iii), c(iv), d(i)
- (B) a(ii), b(i), c(iv), d(iii)
- (C) a(iv), b(i), c(iii), d(ii)
- (D) a(iv), b(ii), c(iii), d(i)

AIPMT 2011 Mains

25. The order of reactivity of phenyl magnesium bromide (PhMgBr) with the following compounds:

(I) CH_3CHO , (II) $(\text{CH}_3)_2\text{C=O}$ and (III) $\text{Ph}_2\text{C=O}$ is

- (A) $\text{I} > \text{III} > \text{II}$
- (B) $\text{I} > \text{II} > \text{III}$
- (C) $\text{III} > \text{II} > \text{I}$
- (D) $\text{II} > \text{I} > \text{III}$

AIPMT 2011 Prelims

26. Clemmensen reduction of a ketone is carried out in the presence of which of the following?

- (A) H_2 and Pt as catalyst
- (B) Glycol with KOH
- (C) Zn-Hg with HCl
- (D) LiAlH_4

27. In a set of reactions, ethyl benzene yielded a product D:
 $\text{C}_6\text{H}_5\text{CH}_2\text{CH}_3 \xrightarrow{(\text{KMnO}_4, \text{KOH})} \text{B} \xrightarrow{(\text{Br}_2, \text{FeCl}_3)} \text{C} \xrightarrow{(\text{C}_2\text{H}_5\text{OH}, \text{H}^+)} \text{D}$
'D' would be

- (A) Ethyl 3-bromobenzoate ($\text{m-Br-C}_6\text{H}_4\text{-COOC}_2\text{H}_5$)
- (B) $\text{C}_6\text{H}_5\text{-CH}_2\text{-CH(Br)-COOC}_2\text{H}_5$
- (C) Ethyl (2,4-dibromophenyl)acetate ($2,4\text{-Br}_2\text{C}_6\text{H}_3\text{-CH}_2\text{COOC}_2\text{H}_5$)
- (D) 3-Ethoxybenzoic acid ($\text{m-CH}_3\text{CH}_2\text{O-C}_6\text{H}_4\text{-COOH}$)

28. Which of the following reactions will not result in the formation of carbon-carbon bonds?

- (A) Friedel-Crafts acylation
- (B) Reimer-Tiemann reaction
- (C) Cannizzaro reaction
- (D) Wurtz reaction

29. Among the given compounds, the most susceptible to nucleophilic attack at the carbonyl group is

- (A) CH_3COCl
- (B) $\text{CH}_3\text{COOCH}_3$
- (C) CH_3CONH_2
- (D) $\text{CH}_3\text{COOCOCH}_3$

30. Propionic acid with Br_2/P yields a dibromo product. Its structure would be:

- (A) $\text{CHBr}_2\text{-CH}_2\text{-COOH}$
- (B) $\text{CH}_2\text{Br-CH}_2\text{-COBr}$
- (C) $\text{CH}_3\text{-CBr}_2\text{-COOH}$
- (D) $\text{CH}_2\text{Br-CHBr-COOH}$

31. A strong base can abstract an α -hydrogen from

- (A) Alkane
- (B) Alkene
- (C) Amine
- (D) Ketone

32. The relative reactivities of acyl compounds towards nucleophilic substitution are in the order of

- (A) Acyl chloride > Ester > Acid anhydride > Amide
- (B) Acyl chloride > Acid anhydride > Ester > Amide
- (C) Ester > Acyl chloride > Amide > Acid anhydride
- (D) Acid anhydride > Amide > Ester > Acyl chloride

33. Acetophenone when reacted with a base, $\text{C}_2\text{H}_5\text{ONa}$, yields a stable compound which has the structure?

- (A) $\text{C}_6\text{H}_5\text{-CH(OH)-CH(OH)-C}_6\text{H}_5$
- (B) $\text{C}_6\text{H}_5\text{-C(CH}_3\text{)=CH-CO-C}_6\text{H}_5$
- (C) $\text{C}_6\text{H}_5\text{-CH(CH}_3\text{)-CH}_2\text{-CO-C}_6\text{H}_5$
- (D) $\text{C}_6\text{H}_5\text{-C(CH}_3\text{)(OH)-C(CH}_3\text{)(OH)-C}_6\text{H}_5$

34. Consider the following compounds.

(i) $\text{C}_6\text{H}_5\text{COCl}$

(ii) $\text{O}_2\text{N}-\text{C}_6\text{H}_4-\text{COCl}$ (para)

(iii) $\text{H}_3\text{C}-\text{C}_6\text{H}_4-\text{COCl}$ (para)

(iv) $\text{OHC}-\text{C}_6\text{H}_4-\text{COCl}$ (para)

The correct decreasing order of their reactivity towards hydrolysis is

- (A) (i) > (ii) > (iii) > (iv)
- (B) (iv) > (ii) > (i) > (iii)
- (C) (ii) > (iv) > (i) > (iii)
- (D) (ii) > (iv) > (iii) > (i)

35. Reduction of aldehydes and ketones into hydrocarbons using zinc amalgam and conc. HCl is called

- (A) Cope reduction
- (B) Dow reduction
- (C) Wolff-Kishner reduction
- (D) Clemmensen reduction

36. Which of the following represents the correct order of the acidity in the given compounds?

- (A) $\text{FCH}_2\text{COOH} > \text{CH}_3\text{COOH} > \text{BrCH}_2\text{COOH} > \text{ClCH}_2\text{COOH}$
- (B) $\text{BrCH}_2\text{COOH} > \text{ClCH}_2\text{COOH} > \text{FCH}_2\text{COOH} > \text{CH}_3\text{COOH}$
- (C) $\text{FCH}_2\text{COOH} > \text{ClCH}_2\text{COOH} > \text{BrCH}_2\text{COOH} > \text{CH}_3\text{COOH}$
- (D) $\text{CH}_3\text{COOH} > \text{BrCH}_2\text{COOH} > \text{ClCH}_2\text{COOH} > \text{FCH}_2\text{COOH}$

37. Which one of the following on treatment with 50% aqueous sodium hydroxide yields the corresponding alcohol and acid?

- (A) $\text{C}_6\text{H}_5\text{CHO}$
- (B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CHO}$
- (C) CH_3COCH_3
- (D) $\text{C}_6\text{H}_5\text{CH}_2\text{CHO}$

38. The product formed in Aldol condensation is

- (A) a beta-hydroxy aldehyde or a beta-hydroxy ketone
- (B) an alpha-hydroxy aldehyde or ketone
- (C) an alpha, beta unsaturated ester
- (D) a beta-hydroxy acid

39. A carbonyl compound reacts with hydrogen cyanide to form cyanohydrin which on hydrolysis forms a racemic mixture of α -hydroxy acid. The carbonyl compound is :

- (A) acetaldehyde
- (B) acetone
- (C) diethyl ketone
- (D) formaldehyde

40. Nucleophilic addition reaction will be most favoured in :

- (A) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CO}-\text{CH}_3$
- (B) $(\text{CH}_3)_2\text{C}=\text{O}$
- (C) $\text{CH}_3\text{CH}_2\text{CHO}$
- (D) CH_3CHO

41. In a set of reactions, acetic acid yielded a product D.



The structure of D would be :

- (A) $\text{C}_6\text{H}_5\text{-C(OH)(CH}_3\text{)-COOH}$
- (B) $\text{C}_6\text{H}_5\text{-CH}_2\text{-C(OH)(CH}_3\text{)-COOH}$
- (C) $\text{C}_6\text{H}_5\text{-CH}_2\text{-C(OH)(CH}_3\text{)-CN}$
- (D) $\text{C}_6\text{H}_5\text{-C(OH)(CH}_3\text{)-CN}$

Answer key and explanations

1. Answer: (D) 2-methyl butan-2-ol

$\text{C}_2\text{H}_5\text{MgBr}$ adds to the carbonyl carbon of acetone, and hydrolysis gives the tertiary alcohol $(\text{CH}_3)_2\text{C(OH)CH}_2\text{CH}_3$. Its longest chain has four carbons with OH and CH_3 on C-2: 2-methylbutan-2-ol. 2-methylpropan-2-ol would come from CH_3MgBr .

2. Answer: (D) (a)-(ii), (b)-(iii), (c)-(iv), (d)-(i)

Benzene + CO/HCl with $\text{AlCl}_3/\text{CuCl}$ gives benzaldehyde (Gattermann-Koch). A methyl ketone with NaOX gives haloform (haloform reaction). Alcohol + carboxylic acid with conc. H_2SO_4 gives an ester (esterification). An acid with $\text{X}_2/\text{red P}$ gives an α -halo acid (Hell-Volhard-Zelinsky).

3. Answer: (A) $\text{C}_6\text{H}_5\text{-CH(OCrOHCl}_2\text{)}_2$

In the Etard reaction, chromyl chloride in CS_2 converts the methyl group of toluene into a brown chromium complex, $\text{C}_6\text{H}_5\text{CH(OCrOHCl}_2\text{)}_2$, which is hydrolysed to benzaldehyde. The diacetate $\text{C}_6\text{H}_5\text{CH(OCOCH}_3\text{)}_2$ is the intermediate of the $\text{CrO}_3/\text{acetic anhydride}$ route, not chromyl chloride.

4. Answer: (D) Cross Aldol condensation

Acetophenone has α -hydrogens and forms an enolate that attacks benzaldehyde, which has none; condensation between two different carbonyl compounds is a cross aldol (Claisen-Schmidt) condensation, giving benzalacetophenone. Cannizzaro reaction needs concentrated alkali and an aldehyde without α -hydrogen reacting with itself or another such aldehyde.

5. Answer: (B) Phthalimide (cyclic imide, $\text{C}_6\text{H}_4(\text{CO})_2\text{NH}$)

Phthalic acid first forms the ammonium salt, then the amide, and on strong heating the amide nitrogen attacks the second carboxyl group with loss of water to give the cyclic phthalimide. The mono-amide is only an intermediate at moderate temperature.

6. Answer: (D) formation of intermolecular H-bonding

Carboxylic acids form strong intermolecular hydrogen bonds and exist as dimers even in the vapour phase, raising the boiling point. Intramolecular H-bonding would lower, not raise, the boiling point.

7. Answer: (C) A-Ethanal, X-Ethanol, Y-But-2-enal, Z-Semicarbazone.

$\text{C}_2\text{H}_6\text{O}$ that is dehydrogenated by Cu at 573 K must be ethanol, giving ethanal as A, which gives the silver mirror with Tollens' reagent. With dilute alkali and heat ethanal undergoes aldol condensation to but-2-enal as Y, and with semicarbazide it forms the semicarbazone Z. Methoxymethane is also $\text{C}_2\text{H}_6\text{O}$ but cannot be dehydrogenated to an aldehyde.

8. Answer: (A) Cl

Nucleophilic acyl substitution is fastest when Z^- is the best leaving group, i.e. the weakest base. Cl^- (conjugate base of the strong acid HCl) leaves most easily, so acid chlorides are most reactive; acetate is next, while ethoxide and especially NH_2^- are poor leaving groups.

9. Answer: (B) Acetophenone

The Gattermann-Koch reaction converts benzene into benzaldehyde, the intermediate A. A base-catalysed cross aldol (Claisen-Schmidt) condensation of benzaldehyde with acetophenone, $\text{C}_6\text{H}_5\text{COCH}_3$, then gives benzalacetophenone, $\text{C}_6\text{H}_5\text{CH=CHCOCH}_3$. Acetone would give $\text{C}_6\text{H}_5\text{CH=CHCOCH}_3$, not the diphenyl product.

10. Answer: (C) F_3CCOOH

Electron-withdrawing groups on the α -carbon stabilise the carboxylate ion. Three fluorine atoms, the most electronegative, withdraw electrons most strongly, making trifluoroacetic acid the strongest (pK_a about 0.2), ahead of trichloroacetic acid and the single-substituent acids.

11. Answer: (B) Cyclohexanone

H_2 with Pd/C at 1 atm hydrogenates the $\text{C}=\text{C}$ double bond of the α,β -unsaturated ketone but does not reduce the $\text{C}=\text{O}$ group under these mild conditions, so cyclohexanone is formed. Reducing the carbonyl to an alcohol while keeping the $\text{C}=\text{C}$ would need a hydride reagent such as NaBH_4 with CeCl_3 .

12. Answer: (D) a carbonyl compound with a hydrogen atom on its alpha-carbon rapidly equilibrates with its corresponding enol and this process is known as keto-enol tautomerism.

An α -hydrogen can shift to the carbonyl oxygen, giving an enol that is in rapid equilibrium with the keto form; this proton-shift isomerism is keto-enol tautomerism. Carbonylation means introducing a CO group, which is a different reaction altogether.

13. Answer: (A) Schiff base

A primary amine adds to the carbonyl group and then loses water to form an imine, $R-CH=N-R'$, known as a Schiff base. The reaction is a condensation, not an oxidation, so no acid or ketone is formed.

14. Answer: (D) 3-pentanone

Forming a phenylhydrazone shows a $C=O$ group; a negative Tollens' test rules out pentanal; a negative iodoform test rules out the CH_3CO- group of 2-pentanone. Reduction to n-pentane needs an unbranched chain, so X is 3-pentanone ($CH_3CH_2COCH_2CH_3$).

15. Answer: (C) p-NO₂-C₆H₄-CHO (p-nitrobenzaldehyde)

Aldehydes are more reactive than ketones, and an electron-withdrawing $-NO_2$ at the para position makes the carbonyl carbon more electrophilic. Electron-donating $-CH_3$ lowers reactivity, so p-nitrobenzaldehyde is most reactive.

16. Answer: (D) Benzoic acid (C₆H₅COOH) + Zn/Hg and conc. HCl

Etard reaction (toluene + CrO_2Cl_2), Rosenmund reduction (benzoyl chloride + $H_2/Pd-BaSO_4$) and Gattermann-Koch reaction (benzene + CO + HCl/ $AlCl_3$) all give benzaldehyde. Zn/Hg with conc. HCl (Clemmensen conditions) does not convert benzoic acid into benzaldehyde.

17. Answer: (A) C₆H₅CHO

This is the Rosenmund reduction: hydrogen over poisoned $Pd-BaSO_4$ reduces an acid chloride only as far as the aldehyde, so benzoyl chloride gives benzaldehyde, C_6H_5CHO . The poisoned catalyst prevents further reduction to the alcohol.

18. Answer: (D) Nucleophilic addition - elimination reaction

The nucleophilic nitrogen of hydrazine adds to the electrophilic carbonyl carbon, and the intermediate then loses water to form the hydrazone $C=N$ bond. This is nucleophilic addition followed by elimination, not an electrophilic or free-radical process.

19. Answer: (C) Iodoform test

CH_3CHO contains a CH_3CO- group and gives a yellow iodoform precipitate with $I_2/NaOH$, while $C_6H_5CH_2CHO$ has no methyl ketone/aldehyde group and does not. Both are aldehydes with α -hydrogen, so both reduce Tollens' reagent and (being aliphatic-type aldehydes) Fehling's and Benedict's solutions, which therefore cannot distinguish them.

20. Answer: (A) (CH₃)₂C(OC₂H₅)₂

In dry HCl, acetone adds one ethanol to give a hemiketal, which with excess ethanol loses water and adds a second ethanol to give the ketal 2,2-diethoxypropane, $(CH_3)_2C(OC_2H_5)_2$. The hemiketal $(CH_3)_2C(OH)(OC_2H_5)$ is only the intermediate, and no C-C bond forming product like a higher ketone is formed.

21. Answer: (B) Maleic acid

Maleic acid ($cis-HOOC-CH=CH-COOH$) is planar with no chiral carbon, so it shows geometrical but not optical isomerism. Lactic acid, tartaric acid and α -amino acids (except glycine) have chiral carbons.

22. Answer: (B) B > A > D > C

Electron-withdrawing ($-I$) groups stabilise the carboxylate ion. F is more electronegative than Cl, so $CF_3COOH > CCl_3COOH$; $HCOOH$ is stronger than CH_3COOH because CH_3 is electron-releasing. Order: trifluoroacetic > trichloroacetic > formic > acetic.

23. Answer: (D) m-Cl-C₆H₄-CH₂OH + m-Cl-C₆H₄-COO⁻

m-Chlorobenzaldehyde has no α -hydrogen, so with concentrated (50%) KOH it undergoes the Cannizzaro reaction: one molecule is reduced to m-chlorobenzyl alcohol and another oxidised to m-chlorobenzoate. The aryl C-Cl bond is not hydrolysed under these conditions, so products with $-OH$ replacing Cl are wrong.

24. Answer: (B) a(ii), b(i), c(iv), d(iii)

Benzaldehyde undergoes benzoin condensation; phthalic anhydride condenses with phenol to give phenolphthalein; phenyl benzoate undergoes Fries rearrangement to hydroxybenzophenones; methyl salicylate is oil of wintergreen. Only one code gives all four pairs correctly.

25. Answer: (B) I > II > III

Nucleophilic addition of PhMgBr gets slower as electron-donating and bulky groups around the carbonyl carbon increase. Acetaldehyde (one H, one CH_3) is most reactive, acetone (two CH_3) is next, and benzophenone (two bulky phenyls with resonance) is least reactive: I > II > III.

26. Answer: (C) Zn-Hg with HCl

Clemmensen reduction converts C=O to CH_2 using zinc amalgam and concentrated HCl. Hydrazine with KOH in ethylene glycol is the Wolff-Kishner reduction, and LiAlH_4 reduces ketones only to alcohols.

27. Answer: (A) Ethyl 3-bromobenzoate ($\text{m-Br-C}_6\text{H}_4\text{-COOC}_2\text{H}_5$)

Alkaline KMnO_4 oxidises the whole ethyl side chain to $-\text{COOH}$, so B is benzoic acid. $-\text{COOH}$ is meta-directing, so $\text{Br}_2/\text{FeCl}_3$ gives m-bromobenzoic acid as C. Esterification with ethanol/ H^+ then gives D, ethyl m-bromobenzoate. Products that keep a CH_2 side chain ignore the side-chain oxidation.

28. Answer: (C) Cannizzaro reaction

The Cannizzaro reaction is a disproportionation of an aldehyde into an alcohol and a carboxylate by hydride transfer; no new C-C bond is formed. Friedel-Crafts acylation, Reimer-Tiemann (ring $-\text{CHO}$) and Wurtz coupling all make new C-C bonds.

29. Answer: (A) CH_3COCl

Acyl chlorides are the most reactive acid derivatives: Cl is strongly electron-withdrawing and gives almost no resonance donation to C=O , and Cl^- is an excellent leaving group. Anhydrides, esters and amides (least) are progressively less reactive.

30. Answer: (C) $\text{CH}_3\text{-CBr}_2\text{-COOH}$

In the Hell-Volhard-Zelinsky reaction, Br_2/P replaces the α -hydrogens (on the carbon next to $-\text{COOH}$). Propionic acid has two α -H, so the dibromo product is $\text{CH}_3\text{-CBr}_2\text{-COOH}$. Substitution at the β -carbon or on both carbons does not occur.

31. Answer: (D) Ketone

The α -hydrogen of a ketone is acidic (pK_a about 19-20), because the carbanion formed is stabilised as a resonance enolate by the C=O group. Alkanes, alkenes and amines have no such electron-withdrawing group to stabilise the carbanion.

32. Answer: (B) Acyl chloride > Acid anhydride > Ester > Amide

Reactivity in nucleophilic acyl substitution follows how easily the leaving group departs: $\text{Cl}^- > \text{RCOO}^- > \text{RO}^- > \text{NH}_2^-$, the weaker the base the better. So acyl chloride > acid anhydride > ester > amide. Placing ester above anhydride ignores that carboxylate is a better leaving group than alkoxide.

33. Answer: (B) $\text{C}_6\text{H}_5\text{-C}(\text{CH}_3)=\text{CH-CO-C}_6\text{H}_5$

Ethoxide removes an α -hydrogen from the CH_3 group, and the enolate attacks a second acetophenone (aldol addition). The β -hydroxy ketone then dehydrates to the conjugated α,β -unsaturated ketone $\text{C}_6\text{H}_5\text{C}(\text{CH}_3)=\text{CH-CO-C}_6\text{H}_5$, which is stabilised by conjugation. The diols are pinacol-type reduction products, not products of base-catalysed condensation.

34. Answer: (C) (ii) > (iv) > (i) > (iii)

Hydrolysis is a nucleophilic attack at the carbonyl carbon, faster when electron-withdrawing groups make it more positive. $-\text{NO}_2$ withdraws more strongly than $-\text{CHO}$, H is neutral and $-\text{CH}_3$ donates, so (ii) > (iv) > (i) > (iii).

35. Answer: (D) Clemmensen reduction

Clemmensen reduction uses Zn-Hg and concentrated HCl to convert C=O into CH_2 . Wolff-Kishner reduction does the same with hydrazine and KOH in ethylene glycol.

36. Answer: (C) $\text{FCH}_2\text{COOH} > \text{ClCH}_2\text{COOH} > \text{BrCH}_2\text{COOH} > \text{CH}_3\text{COOH}$

Electron-withdrawing halogens stabilise the carboxylate ion, more so with higher electronegativity: $\text{F} > \text{Cl} > \text{Br}$, and unsubstituted acetic acid is weakest. So $\text{FCH}_2\text{COOH} > \text{ClCH}_2\text{COOH} > \text{BrCH}_2\text{COOH} > \text{CH}_3\text{COOH}$.

37. Answer: (A) $\text{C}_6\text{H}_5\text{CHO}$

The Cannizzaro reaction (disproportionation into alcohol and acid salt with concentrated alkali) needs an aldehyde with no α -hydrogen, such as benzaldehyde. Butanal and phenylacetaldehyde have α -H and undergo aldol condensation instead.

38. Answer: (A) a beta-hydroxy aldehyde or a beta-hydroxy ketone

The aldol addition of an enolisable aldehyde or ketone gives a β -hydroxy aldehyde or β -hydroxy ketone (which may then dehydrate). The OH ends up on the β -carbon, not the α -carbon, and no ester or acid is formed.

39. Answer: (A) acetaldehyde

Acetaldehyde adds HCN to give $\text{CH}_3\text{CH}(\text{OH})\text{CN}$, whose central carbon has four different groups; attack from either face is equally likely, so a racemic cyanohydrin and, on hydrolysis, racemic lactic acid result. Formaldehyde, acetone and diethyl ketone give cyanohydrins with two identical groups, which are achiral.

40. Answer: (D) CH_3CHO

Aldehydes are more reactive than ketones towards nucleophiles because they have less steric hindrance and only one electron-releasing alkyl group. Among the aldehydes, CH_3CHO has a smaller alkyl group than $\text{CH}_3\text{CH}_2\text{CHO}$, so it reacts most readily. Both ketones are less reactive.

41. Answer: (A) $\text{C}_6\text{H}_5\text{-C}(\text{OH})(\text{CH}_3)\text{-COOH}$

$\text{CH}_3\text{COOH} \rightarrow (\text{SOCl}_2) \text{CH}_3\text{COCl} \rightarrow (\text{C}_6\text{H}_6, \text{AlCl}_3) \text{acetophenone } \text{C}_6\text{H}_5\text{COCH}_3 \rightarrow (\text{HCN}) \text{cyanohydrin } \text{C}_6\text{H}_5\text{C}(\text{OH})(\text{CH}_3)\text{CN} \rightarrow (\text{hydrolysis}) \text{C}_6\text{H}_5\text{C}(\text{OH})(\text{CH}_3)\text{COOH}$. The cyanohydrin is only C, and no CH_2 is inserted between ring and carbon.

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