32. Amines - Multiple Choice Questions

1. Preparation of Nitrogen Containing Compounds

1. $CH_3CH_3 + HNO_3 \xrightarrow{675K}$

(a) $CH_3CH_2NO_2$

(b) $CH_3CH_2NO_2 + CH_3NO_2$

(c) $2CH_3NO_2$

(d) $CH_2 = CH_2$

2. Leakage of which gas was responsible for the Bhopal tragedy in 1984

(a) $CH_3 - N = C = O$ (b) $CH_3 - C - N = S$

(c) $CHCl_3$ (d) C_6H_5COCl

3. Which of the following gives *RNC*, when reacted with $CHCl_3$ and *KOH*

(a) RNH_2 (b) R_2NH

(c) R_3N (d) $R_4N^+Cl^-$

4. $R - NH - COH \xrightarrow[\text{pyridine}]{POCl_3}$ product

In the given reaction what will be the product

(a) $R - N = C = O$ (b) $R - \overset{+}{N} \equiv C^-$

(c) $R - C \equiv N$ (d) None of these

5. The best method for preparation of Me_3CCN is

(a) To react Me_3COH with *HCN*

(b) To react Me_3CBr with *NaCN*

(c) To react Me_3CMgBr with *ClCN*

(d) To react Me_3CLi with NH_2CN

6. Which of the following reagents can be used to convert primary amides into primary amines containing the same number of carbon atoms

(a) $Br_2 + NaOH$ (b) $LiAlH_4$

(c) $Sn + HCl$ (d) $Na + C_2H_5OH$

7. Which of the following is a 3° amine

(a) 1 –methylcyclohexylamine

(b) Triethylamine

(c) Tert-butylamine

(d) N-methylaniline

8. In order to prepare a 1° amine from an alkyl halide with simultaneous addition of one CH_2 group in the carbon chain, the reagent used as source of nitrogen is.....

(a) Sodium amide, $NaNH_2$

(b) Sodium azide, NaN_3

(c) Potassium cyanide, *KCN*

(d) Potassium phthalimide $C_6H_4(CO)_2N^-K^+$

9. The best reagent for converting 2-phenylpropanamide into 2-phenylpropanamine is.....

(a) Excess H_2

(b) Br_2 in aqueous *NaOH*

(c) Iodine in the presence of red phosphorus

(d) $LiAlH_4$ in ether

10. The best reagent for converting, 2-phenylpropanamide into 1-phenylethanamine is .....

(a) Excess H_2 / Pt (b) $NaOH / Br_2$

(c) $NaBH_4$ / methanol (d) $LiAlH_4$ / ether

11. Hofmann bromamide degradation reaction is shown by.....

(a) $ArNH_2$ (b) $ArCONH_2$

(c) $ArNO_2$ (d) $ArCH_2NH_2$

12. In the given set of reactions

$$2-Bromopropane \xrightarrow[alc./heat]{AgCN} X \xrightarrow{LiAlH_4} Y$$

The IUPAC name of product 'Y' is

(a) Butan–2-amine

(b) N– methylpropanamine

(c) N–methylpropan-2-amine

(d) N-isopropylmethanamine

13. The correct IUPAC name for $CH_2 = CHCH_2NHCH_3$ is

(a) Allyl methylamine

(b) 2-amino-4-pentene

(c) 4-aminopent-1 ene

(d) N-methylprop-2-en-1-amine

14. Which of the following reagents would not be a good choice for reducing an aryl nitro compound to an amine

(a) $H_2(excess) / Pt$ (b) $LiAlH_4$ in ether

(c) *Fe* and *HCl* (d) *Sn* and *HCl*

15. Amongst the given set of reactants, the most appropriate for preparing 2° amine is .....

(a) $2^{\circ}R-Br+NH_3$

(b) $2^{\circ}R-Br+NaCN$ followed by H_2/Pt

(c) $1^{\circ}R-NH_2+RCHO$ followed by H_2/Pt

(d) $1^{\circ}R-Br(2\,mol)+$ potassium phthalimide followed by H_3O^+ / heat

16. Best method for preparing primary amines from alkyl halides without changing the number of carbon atoms in the chain is

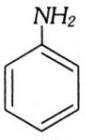
(a) Hofmann bromamide reaction

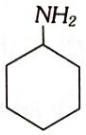
(b) Gabriel phthalimide synthesis

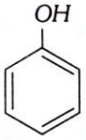
(c) Sandmeyer reaction

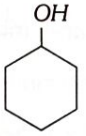
(d) Reaction with NH_3

17. Which of the following compounds is the weakest Bronsted base

(a) 

(b) 

(c) 

(d) 

18. Which of the following methods of preparation of amines will not give same number of carbon atoms in the chain of amines as in the reactant

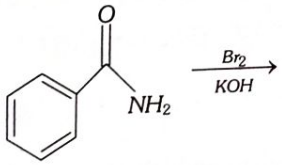
(a) Reaction of nitrile with $LiAlH_4$

(b) Reaction of amide with $LiAlH_4$ followed by treatment with water

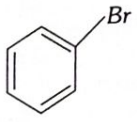
(c) Heating alkylhalide with potassium salt of phthalimide followed by hydrolysis

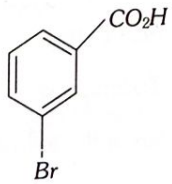
(d) Treatment of amide with bromine in aqueous solution of sodium hydroxide

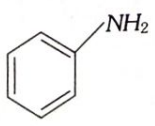
19. In the following reaction

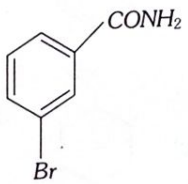


The major product is

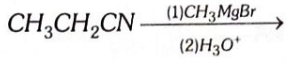
(a) 

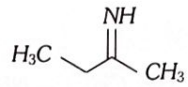
(b) 

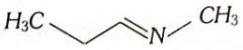
(c) 

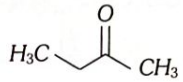
(d) 

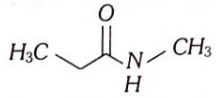
20. The major final product in the following reaction is



(a) 

(b) 

(c) 

(d) 

2. Properties of Nitrogen Containing Compounds

1. Which one of the following nitro compounds when reacted with nitrous acid followed by treatment with alkali produces blue colour

(a) 2-methyl-2-nitropropane (b) 2-methyl-1-nitropropane

(c) 2-nitropropane (d) Nitrobenzene

2. $CH_3CN \xrightarrow{Na+C_2H_5OH} X$

The compound X is

(a) CH_3CONH_2 (b) $CH_3CH_2NH_2$

(c) C_2H_6 (d) CH_3NHCH_3

3. The alkyl cyanides when hydrolysed to the corresponding acid, the gas evolved is

(a) N_2 (b) O_2

(c) NH_3 (d) CO_2

4. In presence of acid, hydrolysis of methyl cyanide gives

(a) Acetic acid (b) Methylamine

(c) Methyl alcohol (d) Formic acid

5. Which one of the following statements about CH_3CN is not true

(a) Its IUPAC name is ethanenitrile

(b) The bond between C and N is a triple bond

(c) The C–C–N bond angle in 180°

(d) The carbon–carbon bond is longer than the carbon–nitrogen bond

(e) It has a relatively high boiling point due to hydrogen bonding

6. Given the following sequence of reaction

$$CH_3CH_2I \xrightarrow{NaCN} A \xrightarrow[\text{partial hydrolysis}]{OH^-} B \xrightarrow{Br_2/NaOH} C$$

The major product 'C' is

(a) $CH_3CH_2NH_2$ (b) $CH_3CH_2\overset{\overset{O}{\|}}{C}-NHBr$

(c) $CH_3CH_2-COONH_4$ (d) $CH_3CH_2\overset{\overset{O}{\|}}{C}-NBr_2$

7. An isocyanide on hydrolysis gives

(a) An amide

(b) A carboxylic acid and ammonia

(c) A N-substituted amide

(d) A 1°-amine and formic acid

8. Which is not the property of ethanenitrile (CH_3CN)

(a) Undergoes acidic hydrolysis to give carboxylic acid

(b) Undergoes alkaline hydrolysis to give salt of carboxylic acid

(c) It tautomerises to give methyl isocyanide

(d) It gives carbylamine reaction with chloroform

9. Alkyl cyanides undergo Stephen reduction to produce

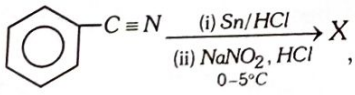
(a) Aldehyde (b) Secondary amine

(c) Primary amine (d) Amide

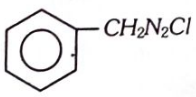
10. Hydrolysis of phenyl isocyanide forms

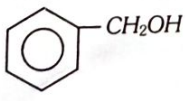
(a) Benzoic acid (b) Formic acid

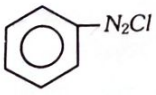
(c) Acetic acid (d) None of these

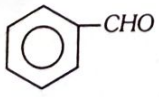
11. 

, X is

(a) 

(b) 

(c) 

(d) 

12. The weakest base among the following is

(a) Phenylmethanamine (b) N-methylmethanamine

(c) Ethanamine (d) Methanamine

(e) Benzenamine

13. The end product of the reaction is

$$C_2H_5NH_2 \xrightarrow{HNO_2} A \xrightarrow{PCl_5} B \xrightarrow{H\ NH_2} C$$

(a) Ethyl cyanide (b) Ethyl amine

(c) Methyl amine (d) Acetamide

14. Primary and secondary amines are distinguished by

(a) Br_2/KOH (b) $HClO_4$

(c) HNO_2 (d) NH_3

15. The decreasing order of the basic character of the three amines and ammonia is

(a) $NH_3 > CH_3NH_2 > C_2H_5NH_2 > C_6H_5NH_2$

(b) $C_2H_5NH_2 > CH_3NH_2 > NH_3 > C_6H_5NH_2$

(c) $C_6H_5NH_2 > C_2H_5NH_2 > CH_3NH_2 > NH_3$

(d) $CH_3NH_2 > C_2H_5NH_2 > C_6H_5NH_2 > NH_3$

16. Ethyl amine on acetylation gives

(a) N-ethyl acetamide (b) Acetamide

(c) Methyl acetamide (d) None

17. Which of the following reacts with $NaNO_2 + HCl$ to give phenol

(a) $C_6H_5CH_2NHCH_3$ (b) $(CH_3)_2NH$

(c) CH_3NH_2 (d) $C_6H_5NH_2$

18. Most basic compound is

(a) $C_6H_5NH_2$ (b) NH_3

(c) CH_3NH_2 (d) $(C_6H_5)_2NH$

19. Which one of the following compounds when heated with KOH and a primary amine gives carbylamine test

(a) $CHCl_3$ (b) CH_3Cl

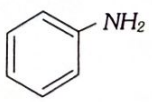
(c) CH_3OH (d) CH_3CN

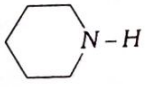
20. Primary, secondary and tertiary amines can be distinguished by

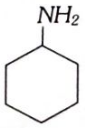
(a) Schiff's test (b) Fehling's test

(c) Tollen's test (d) Hinsberg test

21. Which of the following is the weakest Bronsted base

(a) 

(b) 

(c) 

(d) CH_3NH_2

22. Benzylamine may be alkylated as shown in the following equation

$$C_6H_5CH_2NH_2 + R-X \longrightarrow C_6H_5CH_2NHR$$

Which of the following alkyl halides is best suited for this reaction through S_{N^1} mechanism

(a) CH_3Br (b) C_6H_5Br

(c) $C_6H_5CH_2Br$ (d) C_2H_5Br

23. The amine 'A' when treated with nitrous acid gives yellow oily substance. The amine A is

(a) Triethylamine (b) Trimethylamine

(c) Aniline (d) Methylphenylamine

24. The correct order of basicities of $PhNH_2(A)$, and $Ph_2NH\,(B)$ and cyclohexyl $-NH_2\,(C)$ is

(a) $A > B > C$ (b) $A > C > B$

(c) $C > A > B$ (d) $C > B > A$

25. The amine which can react with $C_6H_5 - SO_2 - Cl$ to form a product insoluble in alkali shall be

(a) Primary amine

(b) Secondary amine

(c) Tertiary amine

(d) Both primary and secondary amines

26. *n*-Butylamine(I), diethylamine(II) and N, N-dimethylethyl amine(III) have the same molar mass. The increasing order of their boiling point is

(a) III < II < I (b) I < II < III

(c) II < III < I (d) II < I < III

(e) III < I < II

27. Presently which reagent is used for separation of 1°, 2° and 3° amines

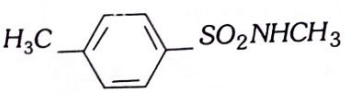
(a) p- toluene sulphonyl chloride

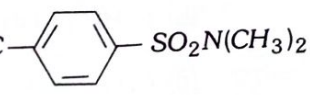
(b) Benzene sulphonyl chloride

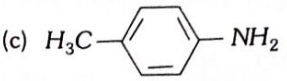
(c) p- Amino benzene sulphonyl chloride

(d) m- toluene sulphonyl chloride

28. Which of the following is soluble in sodium hydroxide

(a) 

(b) 

(c) 

(d) 

29. $C_5H_{13}N$ reacts with HNO_2 to give an optically active alcohol. The compound is

(a) Pentan–1–amine

(b) Pentan–2–amine

(c) *N*, *N*–dimethylpropan–2–amine

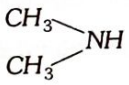
(d) *N*–methylbutan–2– amine

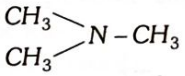
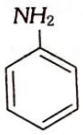
30. Amongst the following, the strongest base in aqueous medium is.....

(a) CH_3NH_2 (b) $NCCH_2NH_2$

(c) $(CH_3)_2NH$ (d) $C_6H_5NHCH_3$

31. The most reactive amine towards dilute hydrochloric acid is

(a) $CH_3 - NH_2$ (b) 

(c)  (d) 

32. Acid anhydrides on reaction with primary amines give.....

(a) Amide (b) Imide

(c) Secondary amine (d) Imine

33. The correct decreasing order of basic strength of the following species is ..... H_2O, NH_3, OH^-, NH_2^-

(a) $NH_2^- > OH^- > NH_3 > H_2O$

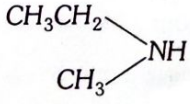
(b) $OH^- > NH_2^- > H_2O > NH_3$

(c) $NH_3 > H_2O > NH_2^- > OH^-$

(d) $H_2O > NH_3 > OH^- > NH_2^-$

34. Which of the following should be most volatile

I. $CH_3CH_2CH_2NH_2$ II. $(CH_3)_3N$

III.  IV. $CH_3CH_2CH_3$

(a) II (b) IV

(c) I (d) III

35. Some reactions of amines are given. Which one is not correct

(a) $(CH_3)_2N-C_6H_4- + NaNO_2 + HCl \rightarrow$

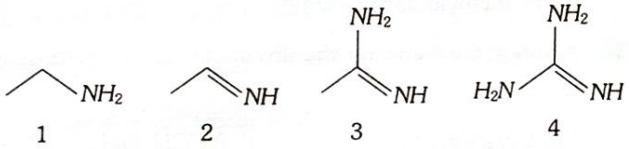
$(CH_3)_2N-C_6H_4-N=NCl$

(b) $CH_3CH_2NH_2 + HNO_2 \rightarrow CH_3CH_2OH + N_2$

(c) $CH_3NH_2 + C_6H_5SO_2Cl \rightarrow CH_3NHSO_2C_6H_5$

(d) $(CH_3)_2NH + NaNO_2 + HCl \rightarrow (CH_3)_2N - N = O$

36. The correct order of basicity of the following compounds is



1 2 3 4

(a) $1 < 2 < 3 < 4$ (b) $1 < 2 < 4 < 3$

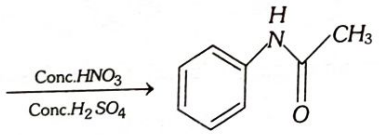
(c) $2 < 1 < 3 < 4$ (d) $4 < 3 < 2 < 1$

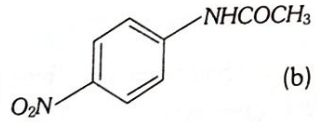
37. Ethyl acetate reacts with $NH_2NHCONH_2$ to form

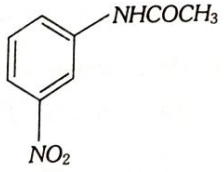
(a) $CH_3CONHCONHNH_2$ (b) $CH_3CON(NH_2)CONH_2$

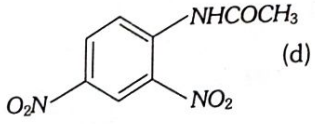
(c) $CH_3CONHNHCONH_2$ (d) $CH_3CH_2NHNHCONH_2$

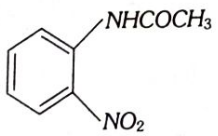
38. The major product formed in the following reaction is



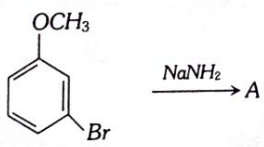
(a) 

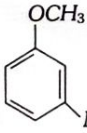
(b) 

(c) 

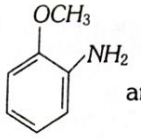
(d) 

39. Identify A and predict the type of reaction

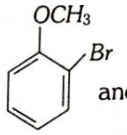


(a) 

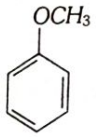
and substitution reaction

(b) 

and elimination addition reaction

(c) 

and cine substitution reaction

(d) 

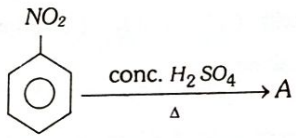
and cine substitution reaction

3. Aromatics Nitro Compound

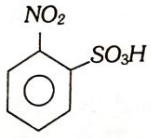
1. Nitrobenzene combines with hydrogen in the presence of platinum to produce

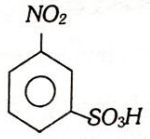
(a) Toluene (b) Benzene

(c) Aniline (d) Azobenzene

2. 

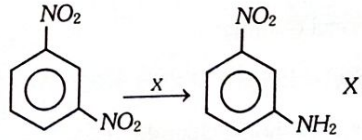
Product 'A' in above reaction is

(a) 

(b) 

(c) 

(d) None of these

3. 

X is

(a) Na_2S (b) Sn/HCl

(c) $LiAlH_4$ (d) All of these

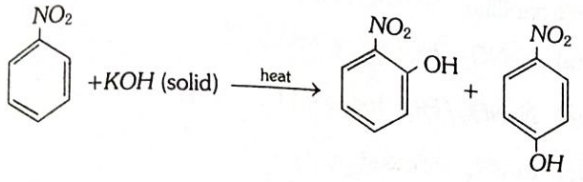
4. Identify the product C in the series

$$C_6H_5NO_2 \xrightarrow{Fe/HCl} A \xrightarrow[273K]{NaNO_2+HCl} B \xrightarrow[283K]{H_2O} C$$

(a) C_6H_5OH (b) $C_6H_5CH_2OH$

(c) C_6H_5CHO (d) $C_6H_5NH_2$

5. The following reaction is



(a) Nucleophilic substitution (b) Electrophilic substitution

(c) Free radical substitution (d) None of these

6. Reduction of aromatic nitro compounds using Fe and HCl gives.....

(a) Aromatic oxime (b) Aromatic hydrocarbon

(c) Aromatic primary amine (d) Aromatic amide

7. Nitrobenzene on further excessive nitration gives

(a) Trinitrobenzene (b) *m*-dinitrobenzene

(c) *p*-dinitrobenzene (d) All of these

8. Which of the following would be most reactive towards nitration

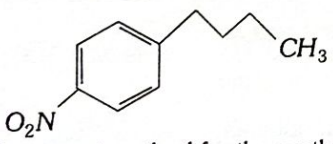
(a) Benzene (b) Nitro benzene

(c) Toluene (d) Chloro benzene

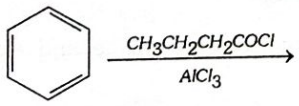
9. In the nitration of benzene using a mixture of conc. H_2SO_4 and conc. HNO_3, the species which initiates the reaction is

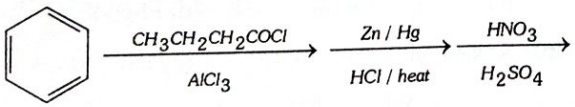
(a) NO_2 (b) NO^+

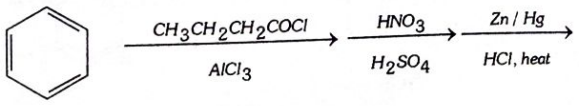
(c) NO_2^+ (d) NO_2^-

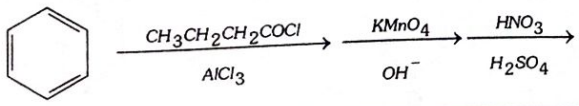
10. 

Identify the correct method for the synthesis of the compound shown above from the following alternatives

(a) 

(b) 

(c) 

(d) 

11. What is obtained when nitrobenzene is treated sequentially with

(i) NH_4Cl / Zn dust and (ii) $H_2SO_4 / Na_2Cr_2O_7$

(a) *Meta*-chlorobenzene (b) *Para*-chloronitrobenzene

(c) Nitrosobenzene (d) Benzene

4. Aniline

1. Aniline when treated with HNO_2 and HCl at $0°C$ gives

(a) Phenol (b) Nitrobenzene

(c) A diazo compound (d) None of these

2. The basicity of aniline is weaker in comparison to that of methyl amine due to

(a) Hyperconjugative effect of *Me* group in $MeNH_2$

(b) Resonance effect of phenyl group in aniline

(c) Lower molecular weight of methyl amine as compared to that of aniline

(d) Resonance effect of $-NH_2$ group in $MeNH_2$

3. Benzylamine is a stronger base than aniline because

(a) The lone pair of electrons on the nitrogen atom in benzylamine is delocalized

(b) The lone pair of electrons on the nitrogen atom in aniline is delocalized

(c) The lone pair of electrons on the nitrogen atom in aniline is not involved in resonance

(d) Benzylamine has a higher molecular mass than aniline

4. Aniline on treatment with excess of bromine water gives

(a) Aniline bromide (b) *o*-bromoaniline

(c) *p*-bromoaniline (d) 2, 4, 6-tribromoaniline

5. Which of following species does not exert a resonance effect

(a) C_6H_5OH (b) C_6H_5Cl

(c) $C_6H_5NH_2$ (d) $C_6H_5\overset{+}{N}H_3$

6. Pure aniline is a

(a) Colourless solid (b) Brown coloured solid

(c) Colourless liquid (d) Brown coloured liquid

7. The basicity of aniline is less than that of cyclohexylamine. This is due to

(a) $+R$-effect of $-NH_2$ group

(b) $-I$ effect of $-NH_2$ group

(c) $-R$-effect of $-NH_2$ group

(d) Hyperconjugation effect

8. Which of the following will be obtained on acetylation of aniline

(a) Paracetamol

(b) *N*–acetyl amino benzene

(c) *o*–amino acetophenone

(d) *p*-amino acetophenone

9. When aniline is nitrated with nitrating mixture in ice cold condition, the major product obtained is

(a) p-nitroaniline (b) 2,4-dinitroaniline

(c) o-nitroaniline (d) m-nitroaniline

10. In hydrolysis of aniline, the reagent used is

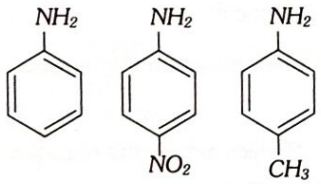
(a) Dil. HCl

(b) Acetyl chloride

(c) CH_3OH

(d) None of these

11. The correct increasing order of basic strength for the following compounds is .....



(I) (II) (III)

(a) II < III < I (b) III < I < II

(c) III < II < I (d) II < I < III

12. The gas evolved when methylamine reacts with nitrous acid is

(a) NH_3 (b) N_2

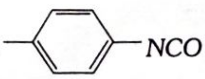
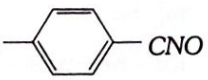
(c) H_2 (d) C_2H_6

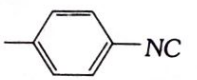
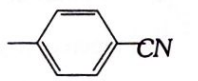
13. Triaminobenzene is a

(a) 2° amine (b) 3° amine

(c) 1° amine (d) Quarternary salt

14. The reaction of $CHCl_3$ and alcoholic KOH with *p*–toluidine gives

(a)  (b) 

(c)  (d) 

15. For the preparation of *p*-nitroiodobenzene from *p*-nitroaniline, the best method is

(a) $NaNO_2/HCl$ followed by KI

(b) $NaNO_2/HCl$ followed by $CuCN$

(c) $LiAlH_4$ followed by I_2

(d) $NaBH_4$ followed by I_2

16. In acid medium nitrobenzene is reduced to aniline as shown in the reaction

$$C_6H_5-NO_2+6[H]\rightarrow C_6H_5-NH_2+2H_2O$$

The reducing agent used in this reaction is .....

(a) $LiAlH_4$ (b) Sn/HCl

(c) Na/alcohol (d) H_2/Ni

17. In the series of reaction $C_6H_5NH_2 \xrightarrow[0-5°C]{NaNO_2/HCl} X \xrightarrow[CH_2O]{HNO_2} Y+N_2+HCl$; X and Y are respectively

(a) $C_6H_5-N=N-C_6H_5, C_6H_5N_2^{\oplus}Cl^{\ominus}$

(b) $C_6H_5N_2^{\oplus}Cl^{\ominus}, C_6H_5-N=N-C_6H_5$

(c) $C_6H_5N_2^{\oplus}Cl^{\ominus}, C_6H_5NO_2$

(d) $C_6H_5NO_2, C_6H_6$

18. Aniline is treated with bromine water to give an organic compound 'X' which when treated with $NaNO_2$ and HCl at $0°C$ gives a water soluble compound 'Y'. Compound 'Y' on treatment with Cu_2Cl_2 and HCl gives compound 'Z'. Compound 'Z' is

(a) o-bromochlorobenzene

(b) p-bromochlorobenzene

(c) 2, 4, 6-tribromophenol

(d) 2, 4, 6-tribromochlorobenzene

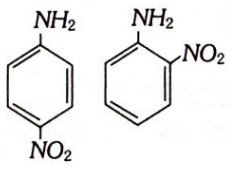
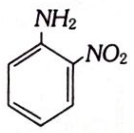
(e) 2, 4-dibromophenol

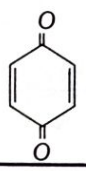
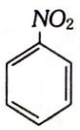
19. Chloroform when treated with aniline and alcoholic KOH gives

(a) Phenyl cyanide (b) Phenyl isocyanide

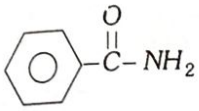
(c) Chlorobenzene (d) Phenol

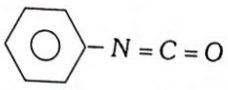
20. Aniline when treated with conc. HNO_3 gives

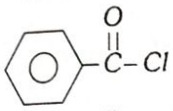
(a)  (b) 

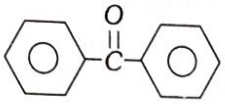
(c)  (d) 

21. The product of the following reaction is

(a) 

(b) 

(c) 

(d) 

22. Aniline is usually purified by

(a) Steam distillation (b) Simple distillation

(c) Vacuum distillation (d) Extraction with a solvent

23. In the following reaction, X is

$$X \xrightarrow{\text{Bromination}} Y \xrightarrow{NaNO_2+HCl} Z \xrightarrow[C_2H_5OH]{\text{boiling}} \text{Tribromobenzene}$$

(a) Benzoic acid (b) Salicylic acid

(c) Phenol (d) Aniline

24. Amino group is *ortho*, *para* – directing for aromatic electrophilic substitution. On nitration of aniline, a good amount of *m*-nitroaniline is obtained. This is due to

(a) In nitration mixture, *ortho*, *para*-activity of NH_2 group is completely lost

(b) $-NH_2$ becomes $-NH_3^+$, which is *m*-directing

(c) $-NH_2$ becomes $-NH^+SO_4^-$; which is *m*-directing

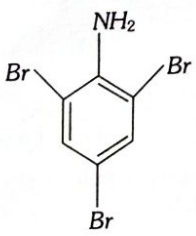
(d) $-NH_2$ becomes $NH^-NO_2^+$, which is *m*-directing

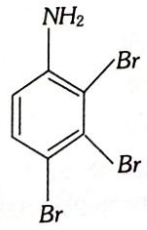
25. Methylamine reacts with HNO_2 to form.....

(a) $CH_3-O-N=O$ (b) CH_3-O-CH_3

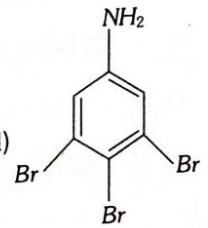
(c) CH_3OH (d) CH_3CHO

26. Aniline reacts with excess Br_2/H_2O to give the major product

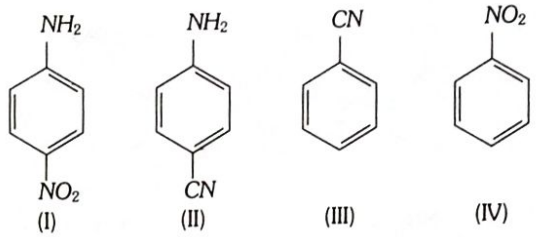
(a) 

(b) 

(c) 

(d) 

27. Reaction of aniline with $NaNO_2 + dil.HCl$ at $0°C$ followed by reaction with $CuCN$ yields



(I) (II) (III) (IV)

(a) (I) (b) (II)

(c) (III) (d) (IV)

5. Diazonium Salts

1. Azo dye is prepared by the coupling of phenol and

(a) Diazonium chloride (b) *o*-nitro aniline

(c) Benzoic acid (d) Chlorobenzene

2. Replacement of diazonium group by fluorine is known as

(a) Gattermann reaction (b) Sandmeyer reaction

(c) Balz–Schiemann reaction (d) Etard reaction

3. The reaction $Ar\overset{+}{N}_2Cl^- \xrightarrow{Cu/HCl} ArCl + N_2 + CuCl$ is named as.....

(a) Sandmeyer reaction (b) Gattermann reaction

(c) Claisen reaction (d) Carbylamine reaction

4. In Gattermann reaction, a diazonium group is replaced by X using Y. X and Y are

	X	Y
(a)	$Cl^{\ominus}$	Cu/HCl
(b)	$Cl^{\oplus}$	$CuCl_2/HCl$
(c)	$Cl^{\ominus}$	$CuCl_2/HCl$
(d)	Cl_2	Cu_2O/HCl

5. Identify the product in following order

$$\text{3,4,5-Tribromoaniline} \xrightarrow[\text{(ii) } H_3PO_2]{\text{(i) diazotization}}$$

(a) 3, 4,5 – tribromobenzene

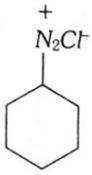
(b) 1, 2, 3 – tribromobenzene

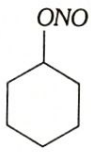
(c) 2, 4, 6 – tribromobenzene

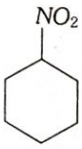
(d) 3, 4, 5 – tribromo nitro benzene

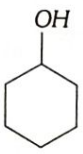
(e) 3, 4, 5 – tribromo phenol

6. Action of $NaNO_2 + \text{dil } HCl$ on $ArNH_2$ yields $ArN_2^+Cl^-$. A similar reaction with cyclohexylamine will yield

(a) 

(b) 

(c) 

(d) 

7. Which of the following compound will not undergo azo coupling reaction with benzene diazonium chloride

(a) Aniline (b) Phenol

(c) Anisole (d) Nitrobenzene

8. In the diazotisation of aniline with sodium nitrite and hydrochloric acid, an excess of hydrochloric acid is used primarily to

(a) Suppress the concentration of free aniline available for coupling

(b) Suppress hydrolysis of phenol

(c) Insure a stoichiometric amount of nitrous acid

(d) Neutralize the base liberated

9. The reagent (s) used for the conversion of benzene diazonium hydrogen sulphate to benzene is/are

(a) H_2O (b) $H_3PO_2 + H_2O$

(c) $H_2SO_4 + H_2O$ (d) $CuCl / HCl$

6. Different Nitrogen Containing Compound

1. When acetamide reacts with Br_2 and caustic soda, then we get

(a) Acetic acid (b) Bromoacetic acid

(c) Methyl amine (d) Ethyl amine

2. Which one of the following can produce hydrogen when treated with metallic sodium

(a) $(CH_3)_2NH$ (b) CH_3NH_2

(c) $C_6H_5NH_2$ (d) CH_3CONH_2

3. The treatment of acylazide $(RCON_3)$ with acidic or alkaline medium gives

(a) $RCONH_2$ (b) $R-NH_2$

(c) RCH_2NH_2 (d) $RCOCH_2NH_2$

4. $CH_3CH_2Br \xrightarrow[\Delta]{aq.KOH} A \xrightarrow[\Delta]{KMnO_4/H^+} B \xrightarrow[\Delta]{NH_3} C \xrightarrow[\text{alkali}]{Br_2} D$, "D" is

(a) CH_3Br (b) CH_3CONH_2

(c) CH_3NH_2 (d) $CHBr_3$

5. Decreasing order of basicity is

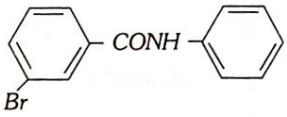
(1) CH_3CONH_2 (2) $CH_3CH_2NH_2$

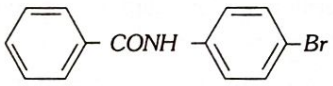
(3) $Ph-CH_2CONH_2$

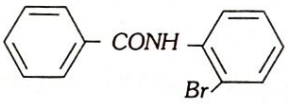
(a) 1 > 2 > 3 (b) 2 > 1 > 3

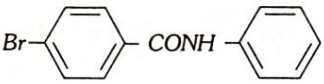
(c) 3 > 2 > 1 (d) None of these

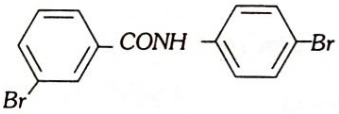
6. The major product in the reaction of *N*–phenylbenzamide with Br_2 / Fe is

(a) 

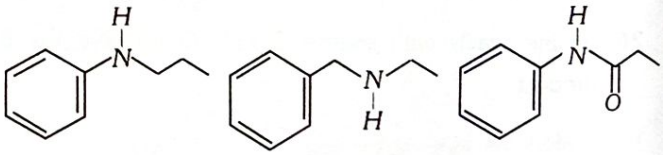
(b) 

(c) 

(d) 

(e) 

7. Which one of the following compound is most basic



(A) (B) (C)

(a) (A) (b) (B)

(c) (C) (d) All are equally basic

8. Within the list shown below, the correct pair of structures of alanine in pH ranges 2-4 and 9-11 is

(I) $H_3N^+ - CH(CH_3)CO_2H$

(II) $H_2N - CH(CH_3)CO_2^-$

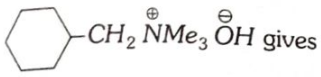
(III) $H_3N^+ - CH(CH_3)CO_2^-$

(IV) $H_2N^+ - CH(CH_3)CO_2H$

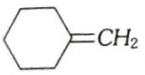
(a) I, II (b) I, III

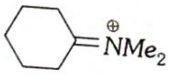
(c) II, III (d) III, IV

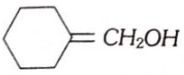
9. Thermal decomposition of

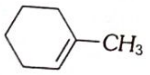


gives

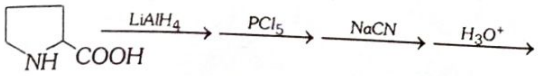
(a) 

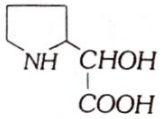
(b) 

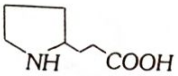
(c) 

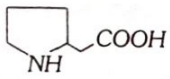
(d) 

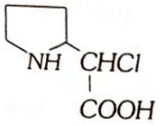
10. The end product in the following sequence of reaction



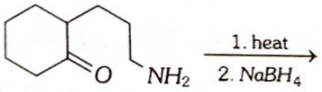
(a) 

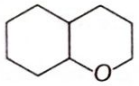
(b) 

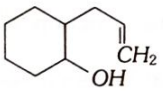
(c) 

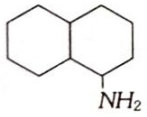
(d) 

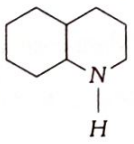
11. Identify the final product



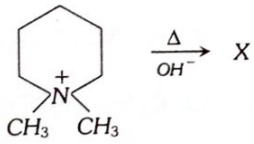
(a) 

(b) 

(c) 

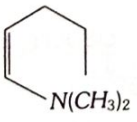
(d) 

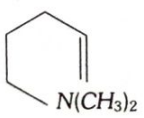
12. In the following reaction,

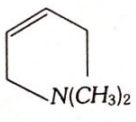


the organic product X has the structure

(a) 

(b) 

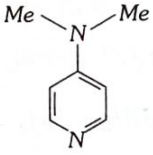
(c) 

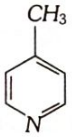
(d) 

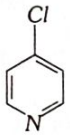
(e) 

13. Among the following substituted pyridines, the most basic compound is

(a) 

(b) 

(c) 

(d) 

7. IIT-JEE/ AIEEE

1. Benzamide on reaction with $POCl_3$ gives **[2004]**

(a) Aniline (b) Chlorobenzene

(c) Benzyl amine (d) Benzonitrile

2. Allyl isocyanide has **[1995]**

(a) 9 sigma bonds and 4 pi bonds

(b) 8 sigma bonds and 5 pi bonds

(c) 8 sigma bonds, 3 pi bonds and 4 non-bonding electrons

(d) 9 sigma bonds, 3 pi bonds and 2 non-bonding electrons

3. Which one of the following methods is neither meant for the synthesis nor for separation of amines **[2005]**

(a) Hinsberg method (b) Hofmann method

(c) Wurtz reaction (d) Curtius reaction

4. In the Hofmann bromamide degradation reaction, the number of moles of $NaOH$ and Br_2 used per mole of amine produced are **[2016]**

(a) Four moles of $NaOH$ and two moles of Br_2

(b) Two moles of $NaOH$ and two moles of Br^2

(c) Four moles of $NaOH$ and one mole of Br_2

(d) One mole of $NaOH$ and one mole of Br_2

5. Which of the following reacts with $NaNO_2 + HCl$ to give phenol **[2000]**

(a) $C_6H_5CH_2NHCH_3$ (b) $(CH_3)_2NH$

(c) CH_3NH_2 (d) $C_6H_5NH_2$

6. In the chemical reaction,

$CH_3CH_2NH_2 + CHCl_3 + 3KOH \longrightarrow (A) + (B) + 3H_2O$,

the compound (A) and (B) are respectively **[2002, 07]**

(a) C_2H_5CN and $3KCl$

(b) $CH_3CH_2CONH_2$ and $3KCl$

(c) C_2H_5NC and K_2CO_3

(d) C_2H_5NC and $3KCl$

7. Which one of the following is the strongest base in aqueous solution **[2007]**

(a) Trimethylamine (b) Aniline

(c) Dimethylamine (d) Methylamine

8. On heating an aliphatic primary amine with chloroform and ethanolic potassium hydroxide, the organic compound formed is **[2014]**

(a) An alkanol (b) An alkanediol

(c) An alkyl Cyanide (d) An alkyl isocyanide

9. Considering the basic strength of amines in aqueous solution, which one has the smallest pK_b value **[2014]**

(a) $(CH_3)_2NH$ (b) CH_3NH_2

(c) $(CH_3)_3N$ (d) $C_6H_5NH_2$

10. Reaction of cyclohexanone with dimethylamine in the presence of catalytic amount of an acid forms a compound if water during the reaction is continuously removed. The compound formed is generally known as **[2005]**

(a) A Schiff's base (b) An enamine

(c) An imine (d) An amine

11. A compound with molecular mass 180 is acylated with CH_3COCl to get a compound with molecular mass 390. The number of amino groups present per molecule of the former compound is **[2013]**

(a) 2 (b) 5

(c) 4 (d) 6

12. The correct order of basicities of the following compounds is

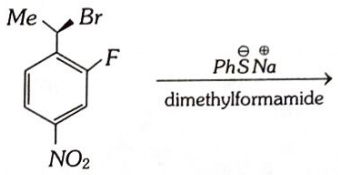
$CH_3-C(=NH)-NH_2$ (1) $\quad CH_3-CH_2-NH_2$ (2) $\quad (CH_3)_2NH$ (3)

$CH_3-\overset{O}{\overset{\|}{C}}-NH_2$ (4) **[2001]**

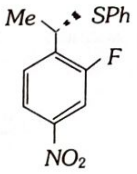
(a) $2 > 1 > 3 > 4$ (b) $1 > 3 > 2 > 4$

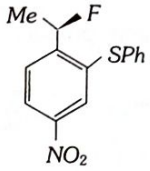
(c) $3 > 1 > 2 > 4$ (d) $1 > 2 > 3 > 4$

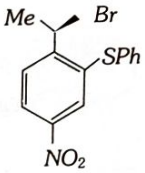
13. The major product of the following reaction is

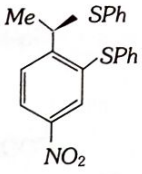


[2008]

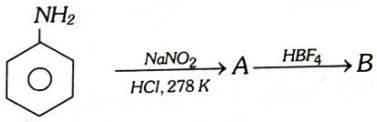
(a) 

(b) 

(c) 

(d) 

14. In the chemical reactions,



the compounds 'A' and 'B' respectively are **[2010]**

(a) Nitrobenzene and chlorobenzene

(b) Nitrobenzene and fluorobenzene

(c) Phenol and benzene

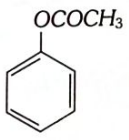
(d) Benzene diazonium chloride and fluorobenzene

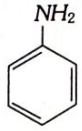
15. Among the following, the strongest base is **[2000; 2004]**

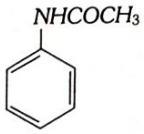
(a) $C_6H_5NH_2$ (b) $p-NO_2C_6H_4NH_2$

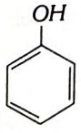
(c) $m-NO_2-C_6H_4NH_2$ (d) $C_6H_5CH_2NH_2$

16. Which of the following compounds will form significant amount of meta product during mono-nitration reaction **[2017]**

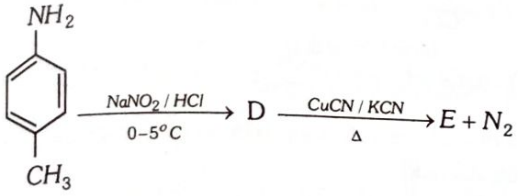
(a) 

(b) 

(c) 

(d) 

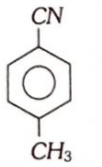
17. In the reaction



The product E is **[2015]**

(a) 

(b) 

(c) 

(d) 

18. Toluene is nitrated and the resulting product is reduced with tin and hydrochloric acid. The product so obtained is diazotised and then heated with cuprous bromide. The reaction mixture so formed contains **[2008]**

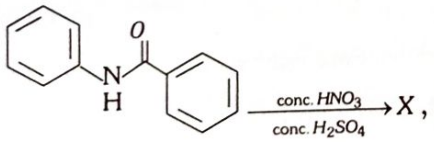
(a) Mixture of *o*-and *p*-dibromobenzenes

(b) Mixture of *o*-and *p*-bromoanilines

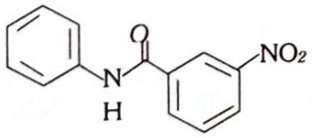
(c) Mixture of *o*-and *m*-bromotoluenes

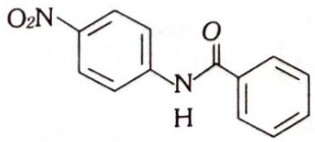
(d) Mixture of *o*-and *p*-bromotoluenes

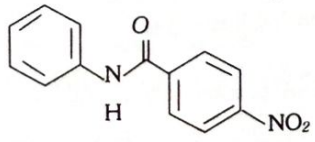
19. In the following reaction

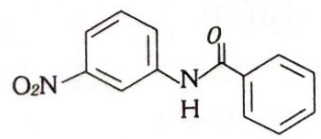


the structure of the major product 'X' is **[2007]**

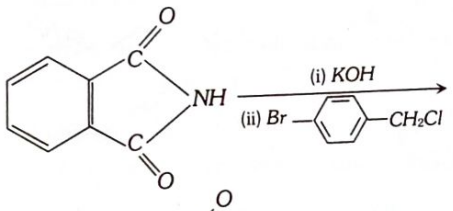
(a) 

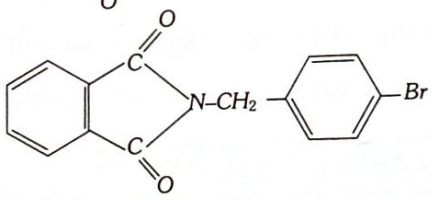
(b) 

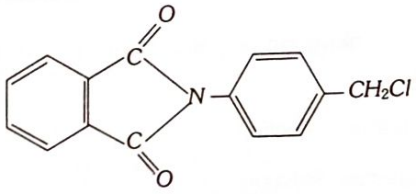
(c) 

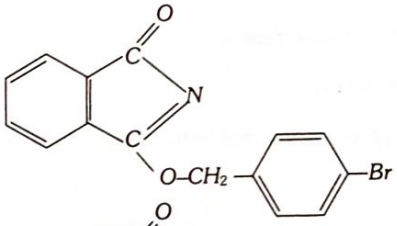
(d) 

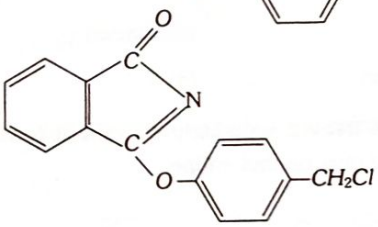
20. The major product of the following reaction is **[2011]**



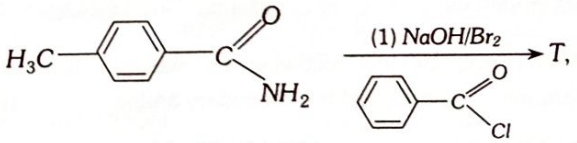
(a) 

(b) 

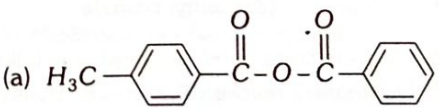
(c) 

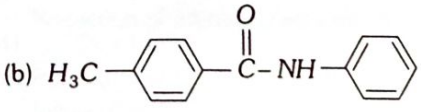
(d) 

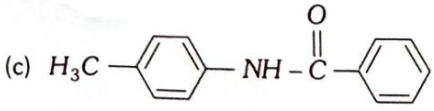
21. In the reaction

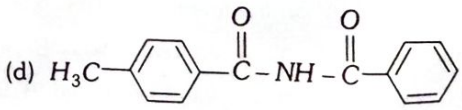


the structure of the Product T is **[2010]**

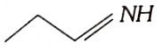
(a) 

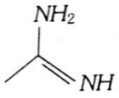
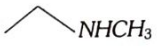
(b) 

(c) 

(d) 

22. The increasing order of basicity of the following compounds is

(i)  (ii) 

(iii)  (iv) 

[2018]

(a) (ii) < (i) < (iv) < (iii) (b) (iv) < (ii) < (i) < (iii)

(c) (i) < (ii) < (iii) < (iv) (d) (ii) < (i) < (iii) < (iv)

8. NEET/ AIPMT/ CBSE-PMT

1. Phenyl isocyanides are prepared from which of the following reactions **[1999]**

(a) Rosenmund's reaction

(b) Carbylamine reaction

(c) Reimer-Tiemann reaction

(d) Wurtz reaction

2. Amides may be converted into amines by reaction named after **[1999]**

(a) Perkin (b) Claisen

(c) Hoffmann (d) Kolbe

3. Acetamide is treated separately with the following reagents. Which would give methyl amine **[2010]**

(a) PCl_5 (b) $NaOH + Br_2$

(c) Sodalime (d) Hot conc. H_2SO_4

4. Which one of the following on reaction with lithium aluminium hydride yields a secondary amine **[2007]**

(a) Nitroethane (b) Methylisocyanide

(c) Acetamide (d) Methyl cyanide

5. Indicate which nitrogen compound amongst the following would undergo Hoffmann's reaction (i.e. reaction with Br_2 and strong KOH) to furnish the primary amine ($R-NH_2$) **[1989]**

(a) $R-\overset{O}{\overset{\|}{C}}-NH.CH_3$ (b) $R-\overset{O}{\overset{\|}{C}}-O.NH_4$

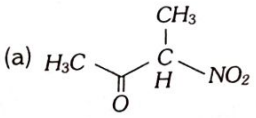
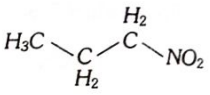
(c) $R-\overset{O}{\overset{\|}{C}}-NH_2$ (d) $R-\overset{O}{\overset{\|}{C}}-NHOH$

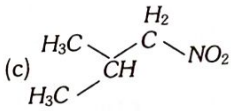
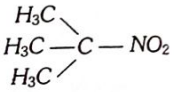
6. An organic compound 'A' on treatment with NH_3 gives 'B', which on heating gives 'C' . 'C' when treated with Br_2 in the presence of KOH produces ethylamine. Compound 'A' is **[2011]**

(a) $CH_3-\underset{CH_3}{\underset{|}{CH}}COOH$ (b) CH_3CH_2COOH

(c) CH_3COOH (d) $CH_3CH_2CH_2COOH$

7. Which one of the following nitro-compounds does not react with nitrous acid **[2016]**

(a)  (b) 

(c)  (d) 

8. In the reaction

$$CH_3CN + 2[H] \xrightarrow[Ether]{HCl} X \xrightarrow[H_2O]{Boiling} Y;$$

the term Y is **[1999]**

(a) Acetone (b) Ethyl amine

(c) Acetaldehyde (d) Dimethyl amine

9. Reaction of nitrous acid with aliphatic primary amine in the cold gives **[1994]**

(a) A diazonium salt (b) An alcohol

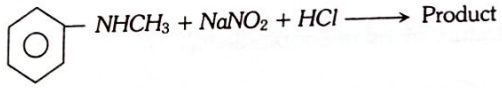
(c) A nitrite (d) A dye

10. The product formed by the reaction of an aldehyde with a primary amine is **[2016]**

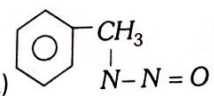
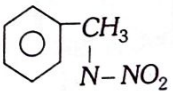
(a) Schiff base (b) Ketone

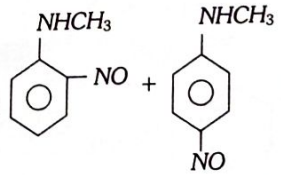
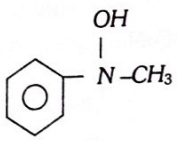
(c) Carboxylic acid (d) Aromatic acid

11. Predict the product



[2009]

(a)  (b) 

(c)  (d) 

12. Correct order of increasing basicity is **[1992]**

(a) $NH_3 < C_6H_5NH_2 < (C_2H_5)_2NH < C_2H_5NH_2 < (C_2H_5)_3N$

(b) $C_6H_5NH_2 < NH_3 < (C_2H_5)_3N < (C_2H_5)_2NH < C_2H_5NH_2$

(c) $C_6H_5NH_2 < NH_3 < C_2H_5NH_2 < (C_2H_5)_3N < (C_2H_5)_2NH$

(d) $C_6H_5NH_2 < (C_2H_5)_3N < NH_3 < C_2H_5NH_2 < (C_2H_5)_2NH$

13. An organic compound $(C_3H_9N)(A)$, when treated with nitrous acid, gave an alcohol and N_2 gas was evolved. (A) on warming with $CHCl_3$ and caustic potash gave (C) which on reduction gave isopropylmethylamine. Predict the structure of (A) **[2012]**

(a) $\begin{matrix} CH_3 \\ CH_3 \end{matrix}\!\!>\!CH-NH_2$ (b) $CH_3CH_2-NH-CH_3$

(c) $CH_3-\underset{\displaystyle CH_3}{\overset{\displaystyle |}{N}}-CH_3$ (d) $CH_3CH_2CH_2-NH_2$

14. Electrolytic reduction of nitrobenzene in weakly acidic medium gives **[2005]**

(a) Aniline (b) Nitrosobenzene

(c) *N*-phenylhydroxylamine (d) *p*-hydroxylaniline

15. The electrolytic reduction of nitrobenzene in strongly acidic medium produces **[2015]**

(a) Anoxybenzene (b) Azobenzene

(c) Aniline (d) p-Aminophenol

16. Which of the following is more basic than aniline **[2006]**

(a) *p*-nitroaniline (b) Benzylamine

(c) Diphenylamine (d) Triphenylamine

17. Which of the following statements about primary amines is 'False' **[2010]**

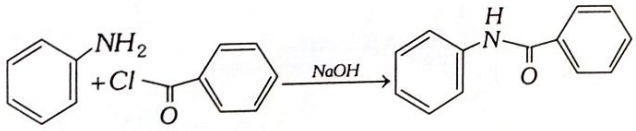
(a) Alkyl amines are stronger bases than ammonia

(b) Alkyl amines are stronger bases than aryl amines

(c) Alkyl amines react with nitrous acid to produce alcohols

(d) Aryl amines react with nitrous acid to produce phenols

18. The following reaction



is known by the name **[2015]**

(a) Friedel-Craft's reaction

(b) Perkin's reaction

(c) Acetylation reaction

(d) Schotten-Baumen reaction

19. The correct statement regarding the basicity of arylamines is **[2016]**

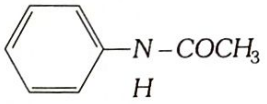
(a) Arylamines are generally less basic than alkylamines because the nitrogen lone-pair electrons are delocalized by interaction with the aromatic ring π electron system

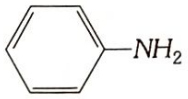
(b) Arylamines are generally more basic than alkylamines because the nitrogen lone-pair electrons are not delocalized by interaction with the aromatic ring π electron system.

(c) Arylamines are generally more basic than alkylamines because of aryl group.

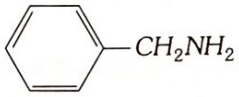
(d) Arylamines are generally more basic than alkylamines, because the nitrogen atom in arylamines is sp hybridized

20. Which of the following compounds is most basic **[2011]**

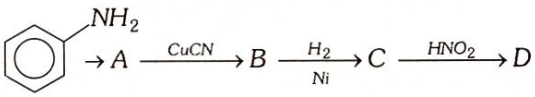
(a) 

(b) 

(c) 

(d) 

21. Aniline in a set of reactions yielded a product D



The structure of product D would be **[2005]**

(a) $C_6H_5CH_2NH_2$ (b) $C_6H_5NHCH_2CH_3$

(c) C_6H_5NHOH (d) $C_6H_5CH_2OH$

22. Method by which aniline cannot be prepared is **[2015]**

(a) Hydrolysis of phenylisocyanide with acidic solution

(b) Degradation of benzamide with bromine in alkaline solution

(c) Reduction of nitrobenzene with H_2/Pd in ethanol

(d) Potassium salt of phthalimide treated with chlorobenzene followed by hydrolysis with aqueous $NaOH$ solution

23. Carbylamine test is done by heating alcoholic KOH with **[1992]**

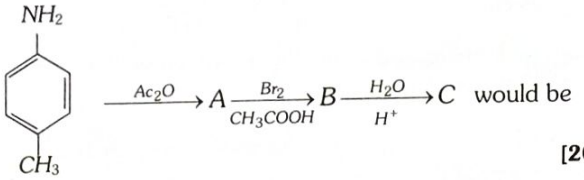
(a) Chloroform and silver powder

(b) Trihalogen methane and primary amine

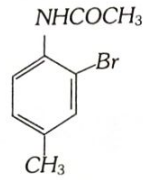
(c) Alkyl halide and primary amine

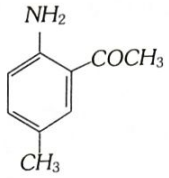
(d) Alkyl cyanide and primary amine

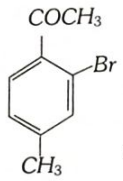
24. The final product C, obtained in this reaction

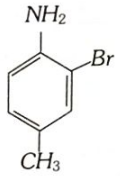


would be **[2003]**

(a) 

(b) 

(c) 

(d) 

25. Nitration of aniline in strong acidic medium also gives *m* – nitroaniline because **[2018]**

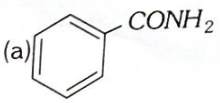
(a) In spite of substituents nitro group always goes to only *m* – position

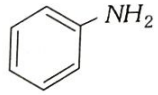
(b) In electrophilic substitution reactions amino group is meta directive

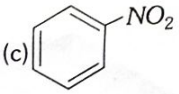
(c) In absence of substituents nitro group always goes to *m* – position

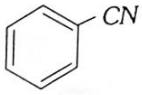
(d) In acidic (strong) medium aniline is present as anilinium ion

26. A given nitrogen-containing aromatic compound A reacts with *Sn/HCl*, followed by HNO_2 to give an unstable compound B. B, on treatment with phenol, forms a beautiful coloured compound C with the molecular formula $C_{12}H_{10}N_2O$. The structure of compound A is **[2016]**

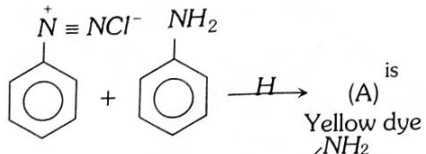
(a) 

(b) 

(c) 

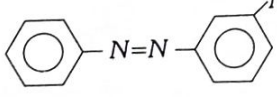
(d) 

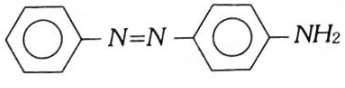
27. In the following reaction, the product (A)

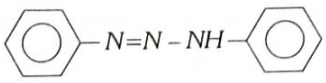


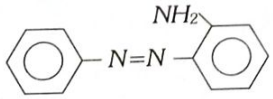
is **[2014]**

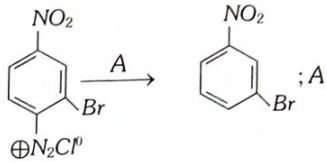
Yellow dye

(a) 

(b) 

(c) 

(d) 

28. In the reaction  ; A is **[2013]**

(a) H^+/H_2O (b) $HgSO_4/H_2SO_4$

(c) Cu_2Cl_2 (d) H_3PO_2 and H_2O

29. Which of the following will be most stable diazonium salt $RN_2^+X^-$ **[2014]**

(a) $CH_3CH_2N_2^+X^-$ (b) $C_6H_5CH_2N_2^+X^-$

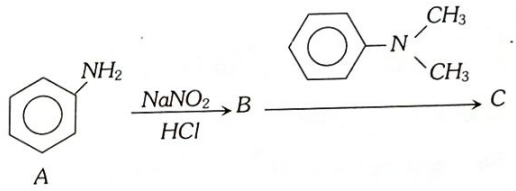
(c) $CH_3N_2^+X^-$ (d) $C_6H_5N_2^+X^-$

30. Diazo-coupling is useful to prepare some **[1994]**

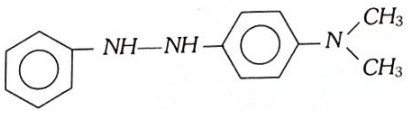
(a) Pesticides (b) Proteins

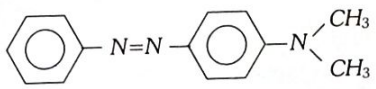
(c) Dyes (d) Vitamins

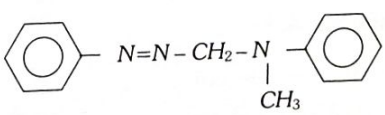
31. In a reaction of aniline, a coloured product C was obtained

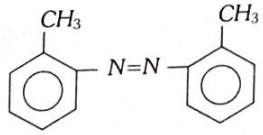


The structure of C would be **[2004, 2010]**

(a) 

(b) 

(c) 

(d) 

32. The number of structural isomers possible from the molecular formula C_3H_9N is **[2015]**

(a) 4 (b) 5

(c) 2 (d) 3

33. The correct order of reactivity towards the electrophilic substitution of the compounds aniline (I) benzene (II) and nitrobenzene (III) is **[2003]**

(a) I > II > III (b) III > II > I

(c) II > III > I (d) I < II > III

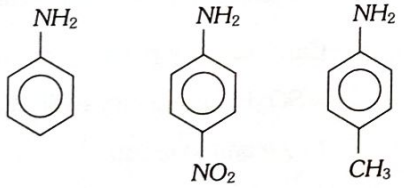
34. Match the compounds given in **List I** with their characteristic reactions given in **List II**. Select the correct option

List I (Compounds)	**List II** (Reactions)
1. $CH_3CH_2CH_2CH_2NH_2$	(i) Alkaline hydrolysis
2. $CH_3C \equiv CH$	(ii) With KOH (alcohol) and $CHCl_3$ produces bad smell
3. $CH_3CH_2COOCH_3$	(iii) Gives white ppt. with ammoniacal $AgNO_3$
4. $CH_3CH(OH)CH_3$	(iv) With Lucas reagent cloudiness appears after 5 minutes **[2010]**

(a) 1 (ii), 2 (i), 3 (iv), 4 (iii) (b) 1 (iii), 2 (ii), 3 (i), 4 (iv)

(c) 1 (ii), 2 (iii), 3 (i), 4 (iv) (d) 1 (iv), 2 (ii), 3(iii), 4 (i)

35. The correct increasing order of basic strength for the following compounds is **[2017]**

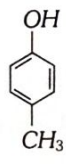
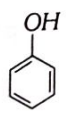


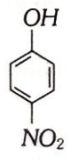
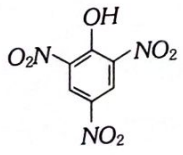
(I) (II) (III)

(a) II < III < I (b) III < I < II

(c) III < II < I (d) II < I < III

36. Which one is the most acidic compound **[2017]**

(a)  (b) 

(c)  (d) 

9. AIIMS

1. Aromatic nitriles ($ArCN$) are not prepared by reaction **[2004]**

(a) $ArX + KCN$ (b) $ArN_2^+ + CuCN$

(c) $ArCONH_2 + P_2O_5$ (d) $ArCONH_2 + SOCl_2$

2. Nitroso amines ($R_2N - N = O$) are soluble in water. On heating them with concentrated H_2SO_4 they give secondary amines. The reaction is called **[1998]**

(a) Perkin's reaction

(b) Fittig's reaction

(c) Sandmeyer's reaction

(d) Liebermann's nitroso reaction

3. Among the following which one does not act as an intermediate in Hoffmann rearrangement **[2005]**

(a) $RNCO$ (b) $RCO\ddot{N}$

(c) $RCO\ddot{N}HBr$ (d) RNC

4. Identify the product Z in the series

$$CH_3CN \xrightarrow{Na+C_2H_5OH} X \xrightarrow{HNO_2} Y \xrightarrow[H_2SO_4]{K_2Cr_2O_7} Z$$

[1983]

(a) CH_3CHO (b) CH_3CONH_2

(c) CH_3COOH (d) CH_3CH_2NHOH

5. $CH_3 - CH_2C \equiv N \xrightarrow{X} CH_3CH_2CHO$. The compound X is **[2008]**

(a) $SnCl_2 / HCl / H_2O$, boil

(b) $H_2 / Pd - BaSO_4$

(c) $LiAlH_4$ / ether

(d) $NaBH_4$ / ether/ H_3O^+

6. When primary amine is heated with CS_2 in presence of excess mercuric chloride, it gives isothiocyanate. This reaction is called **[2007]**

(a) Hofmann bromide reaction

(b) Hofmann mustard oil reaction

(c) Carbylamine reaction

(d) Perkin reaction

7. The reaction between a primary amine, chloroform and few drops of alcoholic KOH is known as **[1998]**

(a) Cannizzaro reaction

(b) Carbylamine reaction

(c) Wurtz's reaction

(d) Reimer-Tiemann reaction

8. The compound which on reaction with aqueous nitrous acid or HNO_2 at low temperature produces an oily nitrosoamine is **[2008]**

(a) Diethylamine (b) Ethylamine

(c) Aniline (d) Methylamine

9. Which of the following chemicals are used to manufacture methyl isocyanate that caused "Bhopal Tragedy"

(i) Methylamine (ii) Phosgene

(iii) Phosphine (iv) Dimethylamine **[2005]**

(a) (i) and (iii) (b) (iii) and (iv)

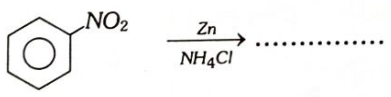
(c) (i) and (ii) (d) (ii) and (iv)

10. The rate determining step for the preparation of nitrobenzene from benzene is **[2001]**

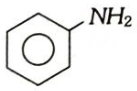
(a) Removal of $\overset{+}{N}O_2$ (b) Removal of $\overset{+}{N}O_3$

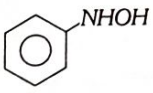
(c) Formation of $\overset{+}{N}O_2$ (d) Formation of $\overset{+}{N}O_3$

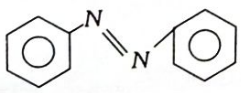
11. What is the product obtained in the following reaction

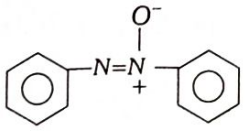


[2003]

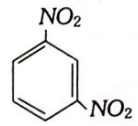
(a) 

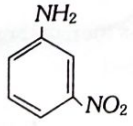
(b) 

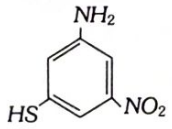
(c) 

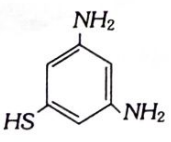
(d) 

12. The major product (70% to 80%) of the reaction between *m*-dinitrobenzene with NH_4HS is **[1997]**

(a) 

(b) 

(c) 

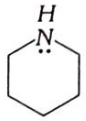
(d) 

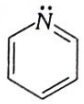
13. Aniline on treatment with conc. HNO_3 + conc. H_2SO_4 mixture yields **[1992]**

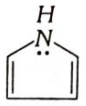
(a) *o*- and p-nitroanilines (b) *m*-nitroanilines

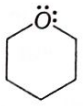
(c) A black tarry matter (d) No reaction

14. The strongest base is **[2004]**

(a) 

(b) 

(c) 

(d) 

15. Among the following the weakest base is **[2003]**

(a) $C_6H_5CH_2NH_2$ (b) $C_6H_5CH_2NHCH_3$

(c) $O_2NCH_2NH_2$ (d) CH_3NHCHO

10. Assertion and Reason

1. Assertion : Benzene diazonium chloride does not give tests for nitrogen.

Reason : N_2 gas lost during heating. **[AIIMS 1999]**

2. Assertion : Amines are basic in nature.

Reason : Presence of lone pair of electron on nitrogen atom. **[AIIMS 1999]**

3. Assertion : Sulphanilic acid exists as dipolar ion whereas *p*-aminobenzoic acid does not.

Reason : Carboxyl group being more acidic than $-SO_3H$ group can easily transfer a H^+ to the amino group.

4. Assertion : In Hoffmann bromamide reaction, the amine formed has one carbon atom less than the parent 1° amide.

Reason : *N*-methyl acetamide undergoes Hofmann bromamide reaction.

5. Assertion : Me_3N reacts with BF_3 whereas Ph_3N does not.

Reason : The electron pair on nitrogen atom in Ph_3N is delocalised in the benzene ring and is not available to boron in BF_3.

6. Assertion : *p*-Anisidine is weaker base than aniline.

Reason : $-OCH_3$ group in anisidine exerts $-R$ effect.

7. Assertion : Anilinium chloride is more acidic than ammonium chloride.

Reason : Anilinium ion is resonance stabilized.

[AIIMS 2006]

8. Assertion : Aniline hydrogen sulphate on heating forms a mixture of ortho and para aminobenzene sulphonic acids.

Reason : The sulphonic acid group is electron withdrawing. **[AIIMS 1996]**

9. Assertion : $p-O_2N-C_6H_5COCH_3$ is prepared by Friedel Crafts acylation of nitrobenzene.

Reason : Nitrobenzene easily undergoes electrophilic substitution reaction.

[AIIMS 2005]

10. Assertion : Alkyl isocyanides in acidified water give alkyl formamides.

Reason : In isocyanides, carbon first acts as a nucleophile then as an electrophile.

[AIIMS 2005]

11. Assertion : Amines are more basic than esters and ethers.

Reason : Nitrogen is less electronegative than oxygen. It is in better position to accommodate the positive charge on the proton. **[AIIMS 2007]**

12. Assertion : Nitrobenzene is used as a solvent in Friedel-Craft's reaction.

Reason : Fusion of nitrobenzene with solid KOH gives a low yield of a mixture of $o-$ and $p-$ nitro phenols. **[AIIMS 2008]**

32. Amines – Answers Keys

1. Preparation of Nitrogen Containing Compounds

1	b	2	a	3	a	4	b	5	c
6	b	7	b	8	c	9	d	10	b
11	b	12	c	13	d	14	b	15	c
16	b	17	c	18	d	19	c	20	c

2. Properties of Nitrogen Containing Compounds

1	c	2	b	3	c	4	a	5	e
6	a	7	d	8	d	9	a	10	b
11	b	12	e	13	b	14	c	15	b
16	a	17	d	18	c	19	a	20	d
21	a	22	c	23	d	24	c	25	b
26	a	27	a	28	a	29	b	30	c
31	b	32	a	33	a	34	b	35	a
36	c	37	c	38	a	39	a		

3. Aromatics Nitro Compound

1	c	2	b	3	a	4	a	5	a
6	c	7	b	8	c	9	c	10	b
11	c								

4. Aniline

1	c	2	b	3	b	4	d	5	d
6	c	7	a	8	b	9	a	10	a
11	d	12	b	13	c	14	c	15	a
16	b	17	c	18	d	19	b	20	c
21	b	22	a	23	d	24	b	25	c
26	a	27	c						

5. Diazonium Salts

1	a	2	c	3	b	4	a	5	b
6	d	7	d	8	a	9	b		

6. Different Nitrogen Containing Compound

1	c	2	d	3	b	4	c	5	b
6	b	7	b	8	a	9	a	10	c
11	d	12	c	13	b				

7. IIT-JEE/ AIEEE

1	d	2	d	3	c	4	c	5	d
6	d	7	c	8	d	9	a	10	b
11	b	12	b	13	a	14	d	15	d
16	b	17	c	18	d	19	b	20	a
21	c	22	a						

8. NEET/ AIPMT/ CBSE-PMT

1	b	2	c	3	b	4	b	5	c
6	b	7	d	8	c	9	b	10	a
11	a	12	d	13	a	14	a	15	d
16	b	17	d	18	d	19	a	20	d
21	d	22	d	23	b	24	d	25	d
26	c	27	b	28	d	29	d	30	c
31	b	32	a	33	a	34	c	35	d
36	d								

9. AIIMS

1	a	2	d	3	d	4	c	5	a
6	b	7	b	8	a	9	c	10	c
11	b	12	b	13	c	14	a	15	d

10. Assertion and Reason

1	a	2	a	3	c	4	c	5	a
6	d	7	c	8	d	9	d	10	a
11	a	12	b						