ADVANCED LEVEL CHEMISTRY PROBLEMS

ORGANIC SYNTHESIS

1. Write equations to show how the following compounds can be synthesised from

(a). Chlorocyclohexane to

(i). Cyclohexanol

(ii). 1,2-dibromocyclohexane

(iii). 2-bromocyclohexanol

(iv). Cyclohexene-1,2-diol

(v). $OHC(CH_2)_4CHO$

(vi). Cyclohexane

(b). Propan-2-ol to

(i). Propane

(ii). Propane-1,2-diol

(iii). 1,2-dibromopropane

(iv). 1-bromopropan-2-ol

(v). 2-chloropropane

(vii). 1-bromopropane.

(viii). Hexane

2. Write equations to show how ethanol can be converted to the following compounds. Include the conditions for the reactions in each case

(a). Ethane-1,2-diol

(b). 1,2-dichloroethane

(c). Ethanedioic acid

(d). methanal

(e). Polyethene

(f). Chloroethane

(g). 1,2-dibromoethane

(h). Butane

(i). 2-bromoethanol

(j). Ethane

3. Write equations to show how the following conversions can be made, and in each case, state the conditions for the reactions.

(a). Ethane from ethanol

(b). 2-phenylethanol to 1-phenylethane-1,2-diol

(c). Ethanal from butan-1-ol

(d). Ethyne to ethanedioic acid

(e).	Propan-1-ol	to	propane
(f).	But-2-yne	to	butane-2,3-diol
(g).	Cyclohexenol	to	cyclohexene-1,2-diol
(h).	1,2-dichloroethane	to	ethanol
(i).	Iodocyclohexane	to	1,2-diiodocyclohexane
(j).	2-bromopropane	to	propane-1,2-diol
(k).	Phenylethene	to	1-phenylethanol

4. Write equations to show how the following compounds can be synthesised from each of the following substances and in each case, indicate the conditions for the reactions.

(a). Ethanol to

(i). Benzene

(ii). Propyne

(iii). Propanone

(iv). But-2-yne

(v). Butanone

(vi). 1,1,2,2-tetrachloropropane

(b). 1,2-dichloroethane to

(i). Ethanol

(ii). Bromoethanol

(iii). Benzene

(iv). Butane

(v). Ethanal

(vi). 2,2-dibromopropane

5. Write equations to show how the following compounds can be synthesised from each of the following substances and in each case, indicate the conditions for the reactions.

(a). 1,2-dichloropropane to

(i). Propanone

(ii). 2,2-dichloropropane

(iii). Propan-2-ol

(iv). Butanone

(b). 1-bromo-1-phenylethane to

(i). Phenylethyne

(ii). Pheylpropyne

(iii). Phenylethanone

(iv). 1,1-dibromo-1-phenylethane

6. Write equations to show how the following conversions can be made, and in each case, state the conditions for the reactions.

(a).	Ethene	to	benzene
(b).	1,2-dichloroethane	to	methylbenzene
(c).	Ethyne	to	benzaldehyde
(d).	1,2-dibromoethane	to	benzaldehyde
(e).	Ethyne	to	benzenesulphonic acid
(f).	Benzene	to	benzaldehyde
(g).	Nitrobenzene	from	benzoic acid
(h).	Phenylethanone	from	ethene
(i).	Ethyne	to	ethylbenzene (phenylethane)
(j).	Chlorobenzene	from	ethanol
(k).	Bromobenzene	from	methylbenzene
(l).	Propan-2-ol	to	2-phenylpropane
(m).	Ethene	to	benzylcloride
(n).	Ethyne	to	methylcyclohexane
(o).	Chlorocyclohexane	from	1,2-dichloroethane
(p).	Benzoic acid	from	ethanol.

7. Write equations to show how the following compounds can be synthesised from each of the following substances and in each case, indicate the conditions for the reactions.

(a). Ethanoic to

- (i). Ethane-1,2-diol
- (ii). Bromoethane
- (iii). Ethyne
- (iv). Methanal
- (v). Methanol

(b). Chloroethane to

- (i). Ethanoic acid
- (ii). Ethyne
- (iii). Ethanedioic acid
- (iv). Ethyl ethanoate
- (v). Ethanal

(vi). Chloromethane

(vii). Propene

(vi). Ethane-1,2-diol

(vii). Chloropropane

8. Write equations to show how the following compounds can be synthesised from each of the following substances and in each case, indicate the conditions for the reactions.

(a). Ethanol to propanenitrile

(b). Ethyne to 2-methylpropanenitrile

(c). Cyclohexanol to

(d). 2-chloro-2-methylpropane to 3-methylbutanenitrile

9. Write equations to show how the following compounds can be synthesised from each of the following substances and in each case, indicate the conditions for the reactions.

(a). 2-chloropropane to

(i). Propanone

(ii). Propyne

(iii). 1-bromopropane

(iv). But-2-yne

(b). Ethyne to

(i). Phenylethanoic acid

(ii). Ethyl benzoate

(iii). Cyclohexanol

(iv). Propan-2-ol

(v). Propan-1-ol

(vi). Propane1,2-diol

10. Write equations to show how the following conversions can be made, and in each case, state the conditions for the reactions.

(a). Propan-2-ol to propanal

(b). Cyclohexene to cylohaxanone

(c). 1-bromopropane to propanone

(d). 2-chloropropane to propanal

(e). Ethene to hexane-1,6-dioic acid

(f). Benzene to cyclohexene

(g).	Benzene	to	methoxycyclohexane (cyclohexyl methyl ether)
(h).	Ethanal	to	propanone
(i).	Chloromethane	to	propanal
(j).	Methanol	to	1-bromopropan-2-ol
(k).	1-phenylethanol	to	2-phenylethanol
(l).	Methanol	to	2-methylpropan-2-ol
(m).	Methanol	to	2-methylpropene
(n).	Benzene	to	phenol
(o).	Ethyne	to	methoxybenzene (methyl phenyl ether)
(p).	Phenol	to	benzenesulphonic acid
(q).	Benzene	to	2,4,6-tribromophenol
(r).	1,2-dibromoethane	to	cyclohexylmethanol
(s).	Benzene	to	phenyl ethanoate
(t).	Cyclohexanol	to	cyclohexylmethanol
(u).	Ethene	to	butanedioic acid

11. Write equations to show how the following compounds can be synthesised from benzene and in each case, indicate the conditions for the reactions.

(a). 2-hydroxy-2-phenylpropanenitrile

(b). 1-bromo-1-phenylethane

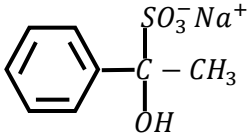
(c). Phenylethene

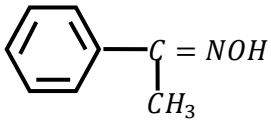
(d). 1-phenylethane-1,2-diol

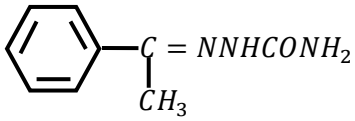
(e). 1-bromo-2-phenylethane

(f). Phenylethyne

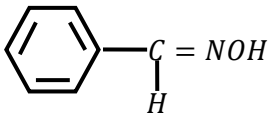
(g). Poly(phenylethene)

(h). 

(i). 

(j). 

12. Write equations to show how the following conversions can be made, and in each case, state the conditions for the reactions.

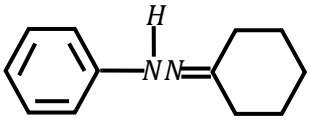
(a). Ethene to 

(b). But-2-ene to ethene

(c). 2-bromopropane to $CH_3CH_2\overset{H}{\overset{|}{C}} = NNHCONH_2$

(d). Propanone to 2-methylpropanenitrile

(e). Ethanal to methanal

(f). Benzene to 

(g). 2-chloropropane to 2,2-dichloropropane

(h). 2,2-dibromopropane ` to $(CH_3)_2C = NNHCONH_2$

(i). Ethanol to butane-1,3-diol

(j). Ethene to 1,3-dichlorobutane

13. Write equations to show how the following compounds can be synthesised from each of the following substances and in each case, indicate the conditions for the reactions.

(a). Ethene to

(i). Ethanoyl chloride

(ii). Ethanoic acid

(iii). Ethyl ethanoate

(iv). Benzoic acid

(v). Propanoic acid

(vi). Methanoic acid

(vii). Ethanamide

(viii). Ethanamine

(ix). Propanamine

(b). Nitrobenzene to

(i). Phenylmethanamine

(ii). Benzoic acid

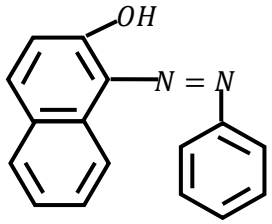
(iii). Cyclohexanamine

(iv). Methylbenzene

(v). 3-phenylpropanoic acid

(vi). 1,3,5-tribromophenol

(vii). 4-hydroxyazobenzene

(viii). 

14. Write equations to show how the following compounds can be synthesised from each of the following substances and in each case, indicate the conditions for the reactions.

(a). Propene to

(i). 2,2-dimethylpropanedioic acid

(ii). Propan-2-amine

(iii). Ethanamine

(iv). 2-methylpropanoic acid

(v). 2-methylpropan-1-amine

(vi). 2-methylbutan1,4-diol

(vii). 2-chlorobutanamine

(b). Methylbenzene to

(i). Iodobenzene

(ii). 2-phenylethanol

(iii). Phenol

(iv). Phenylethanoic acid

(v). Phenylmethanamine

(vi). Cyclohexanamine

(vii). Phenylamine

15. Write equations to show how the following conversions can be made,

(a).	Benzene	to	N-methyl-N-phenylamime
(b).	Methyl benzoate	from	phenylmethanol
(c).	Benzene	to	1-phenylpropane
(d).	Aniline (Phenylamine)	to	4-bromoaniline
(e).	Cyclohexene	from	nitrobenzene
(f).	Benzene	to	2-phenylpropanoic acid
(g).	Phenylethene	to	2-phenylpropan-1-amine
(h).	Propene	to	2-methylpropene
(i).	Benzene	to	cyclohexylmethanamine
(j).	Nitrobenzene	to	methoxybenzene
(k).	1-phenylethanol	to	2-phenylethanamine
(l).	Benzoic acid	to	2-phenylethanamine

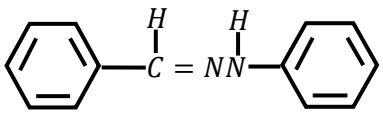
16. Write equations to show how the following conversions can be made

(a).	Propanone	from	methanol
(b).	Ethene	to	propane-1,2-diol
(c).	Chlorobenzene	to	(chloromethyl)benzene [Benzyl chloride]
(d).	(Bromomethyl)benzene	to	2-phenylethanol
(e).	Phenol	to	cyclohexylmethanol
(f).	Cyclohexane-1,2-diol	from	aniline
(g).	Phenylamine	to	2-hydroxy-2-phenylpropan-1-amine
(h).	Benzene	to	2-phenylpropanedioic acid
(i).	Chloroethane	to	1,1-dicloroethane
(j).	Phenol	to	phenylethene
(k).	Ethene	to	2-hydroxypropanoic acid
(l).	Benzene diazonium chloride	to	2-phenylpropan-1,2-diol
(m).	1,2-dibromoethane	to	1,1-dichloro-1-phenylethane

17. Write equations to show how the following conversions can be made, and in each case, state the conditions for the reactions.

(a).	1-chloropropane	to	ethanamine
(b).	N-methylethanamine	from	ethanol
(c).	1,2-dibromoethane	to	ethanamide
(d).	Ethyne	to	cyclohexanecarboxylic acid
(e).	Methylbenzene	to	cyclohexylmethanamine
(f).	Methylbenzene	to	cylohexanamine
(g).	Methanol	to	2-methylpropene
(h).	Benzene	to	2-phenylpropan-2-ol
(i).	Methanol	to	propyne
(j).	Ethanol	to	cyclohexene

18. Write equations to show how the following conversions can be made, and in each case, state the conditions for the reactions.

(a).	Propan-2-ol	to	ethanol
(b).	But-2-ene	to	nitrobenzene
(c).	Ethanol	to	methylcyclohexane
(d).	Ethanol	to	1,4-dichlorobutane
(e).	Benzene	to	2-phenylpropan-1-ol
(f).	1-phenylethanol	to	2phenylpropan-1-amine
(g).	Methylbenzene	to	phenylmethanamine
(h).	Methanol	to	butane
(i).	Ethene	to	

19. Write equations to show how the following conversions can be made, and in each case, state the conditions for the reactions.

(a). 2,2-dimethylpropanediol from propan-2-ol

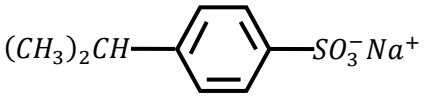
(b). Chlorocyclohexane to 1,6-dicbromohexane

(c). Phenylmethanol to phenylethene

(d). Ethene to phenyl ethanoate

(e). Methanol to 1,1-dibromoethane

(f). Ethanol to but-2-ene

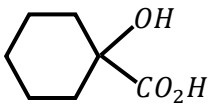
(g). Ethanol to 

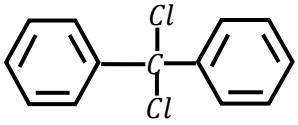
(h). $CH_3(CH_2)_4CH_3$ from 2-chloropropane

(i). 1,3,5-tribromobenzene from benzene

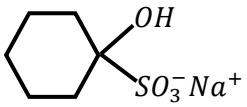
20. Write equations to show how the following conversions can be made, and in each case, state the conditions for the reactions.

(a). Propenoic acid from 1,2-dibromoethane

(b).  from bromobenzene

(c). Ethene to 

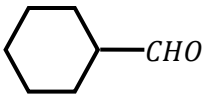
(d). Ethanoic acid to butanedioic acid

(e). Nitrobenzene to 

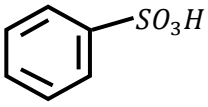
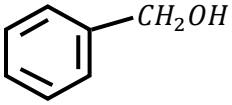
(f). Propan-2-ol to 2-hydroxy-2-methylpropanoic acid

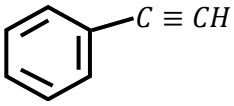
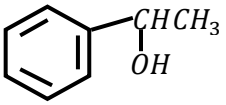
(g). Propanoic acid to 2-hydroxybutanoic acid

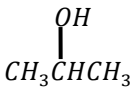
21. Write equations to show how the following conversions can be made, and in each case, state the conditions for the reactions.

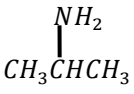
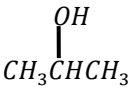
(a).	Benzene	to	biphenyl
(b).	Ethene	from	ethylmagnesium chloride
(c).	Ethanamide	to	propanoic acid
(d).	Propanal	to	1,2-dibromopropane
(e).	Propanal	to	2,2-dichloropropane
(f).	Propanone	to	propanal
(g).	Propanal	to	propanone
(h).	Propanone	to	1,1-dichloropropane
(i).	Propanone	to	$CH_3CH_2CH = NOH$
(j).	Propanone	to	propan-1-ol
(k).	Benzene	to	phenylhydrazine
(l).	Cyclohexanol	to	

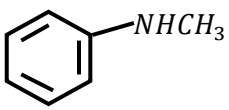
22. Write equations to show how the following compounds can be synthesised. [**UNEB 2019**]

(a).  from  (4½ marks)

(b).  from  (3½ marks)

(c).  from CH_3CH_2COOH (3½ marks)

(d).  from  (03 marks)

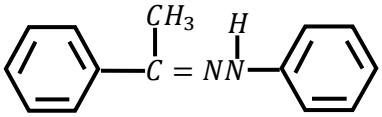
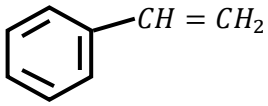
(e).  from $HC \equiv CH$ (5½ marks)

23. Write equations to show how the following compounds can be synthesised. [**UNEB 2018**]

(a). Benzene from chlorobenzene (04 marks)

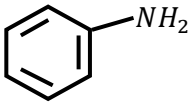
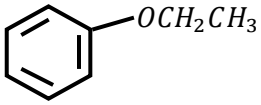
(b). But-2-yne from but-2-ol. (4½ marks)

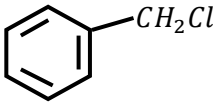
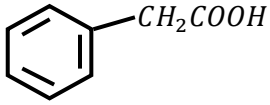
(c). CH_3COCH_3 from $CH_3CH_2CH_2OH$. (05 marks)

(d).  from  (4½ marks)

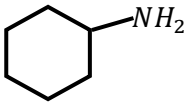
(e). $CH_3CH_2CH_2CH_3$ from CH_3CH_2OH. (02 marks)

24. Write equations to show how the following compounds can be synthesised. [**UNEB 2016**]

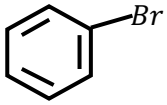
(a).  to  (05 marks)

(b).  to  (03 marks)

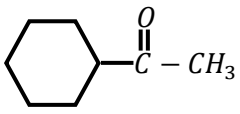
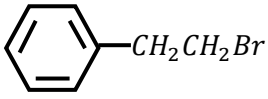
(c). $CH_3CH = CHCH_3$ to $CH_3COCHCH_3$. (03 marks)

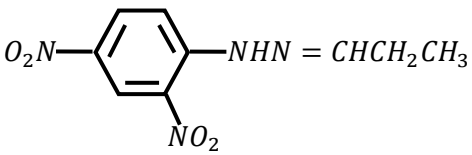
(d).  to  (04 marks)

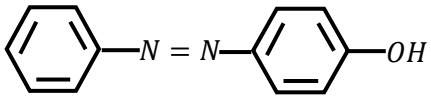
(e). $CH_3CH = CH_2$ to $CH_3C \equiv CH$ (revised) (03 marks)

(f).  to  (02 marks)

25. Write equations to show how the following compounds can be synthesised. [**UNEB 2014**]

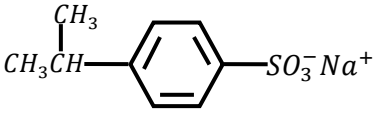
(a).  from  (05 marks)

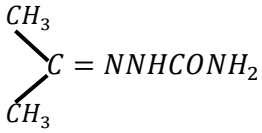
(b).  from $CH_3CH_2CH_2Br$ (04 marks)

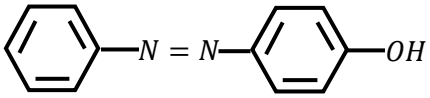
(c).  from  (06 marks)

(d). $CH_3CH_2C \equiv CCH_3$ from CaC_2 (05 marks)

26. Write equations to show how the following compounds can be synthesised. [**UNEB 2012**]

(a). Benzene to  (04 marks)

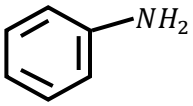
(b). Propan-2-ol to  (03 marks)

(c). Nitrobenzene to  (5½ marks)

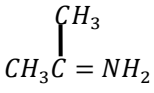
(d). 2-chloropropane to $CH_3CH_2CH_2NH_2$ (4½ marks)

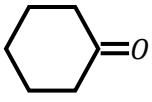
(e). Ethene to $CH_3COOCH_2CH_3$ (03 marks)

27. Write equations to show how the following compounds can be synthesised. [**UNEB 2008**]

(a).  from benzoic acid (5½ marks)

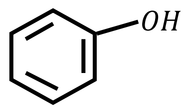
(b). $CH_3C \equiv CH$ from ethene (5½ marks)

(c).  from ethanol (05 marks)

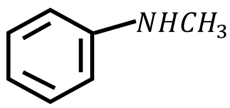
(d).  from cyclohexene (04 marks)

28. Write equations to show how the following compounds can be synthesised. [**UNEB 2007**]

(a). $CH_3C \equiv CH$ from propan-2-ol (5½ marks)

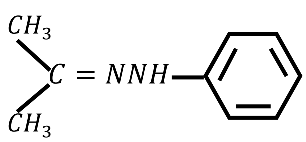
(b).  from benzene (3½ marks)

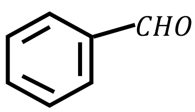
(c). CH_3COCl from ethene (04 marks)

(d).  from benzene (04 marks)

(e). $CH_3CO_2CH_3$ from bromoethane (04 marks)

29. Write equations to show how the following compounds can be synthesised. [**UNEB 2006**]

(a).  from propene (05 marks)

(b).  from benzene (02 marks)

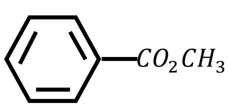
(c). $CH_3CH_2C \equiv CH$ from ethanol (7½ marks)

(d). $CH_3CH_2NH_2$ from ethanal (03 marks)

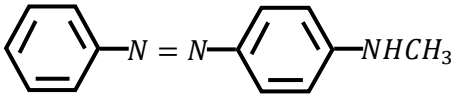
(f). $CH_3CO_2CH_3$ from ethene (2½ marks)

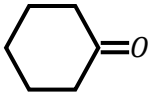
30. Write equations to show how the following compounds can be synthesised. [**UNEB 2004**]

(a). $CH_3CH_2OCH_2CH_3$ from ethene (04 marks)

(b).  from benzene (05 marks)

(c). $CH_2CH_2CH\ CH_2$ (with $HNCH_2CH_3$ on CH) from but-2-ene (02 marks)

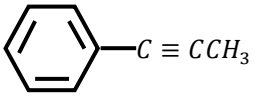
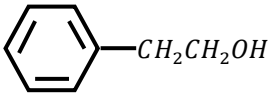
(d).  from benzene (06 marks)

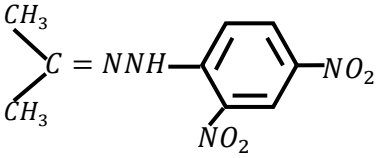
(e).  from bromocyclohexane (03 marks)

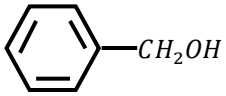
31. Write equations to show how the following compounds can be synthesised. [**UNEB 2002**]

(a). $CH_3CH_2CH_2CO_2H$ from propan-2-ol. (04 marks)

(b). $CH_3CH_2CH_3$ from 1-bromobutane (04 marks)

(c).  from  (06 marks)

(d).  from propene. (3½ marks)

(e).  From benzene. (2½ marks)

32. Write equations to show how the following compounds can be synthesised. [**UNEB 2001**]

(a). Benzoic acid from benzene (2½ marks)

(b). Hexane from 1-bromopropane (01 mark)

(c). Ethyne from ethanol (4½ marks)

(d). Propanoic acid from bromoethane (02 marks)

(e). Aminomethane from ethene (5½ marks)

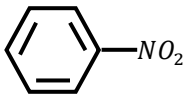
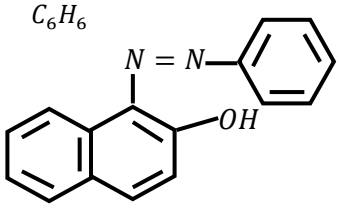
(f). Methylethanoate from bromoethane (4½ marks)

33. Write equations to show how the following compounds can be synthesised. [**UNEB 2000**]

(a). CH_3CH_2I to $CH_3CH_2COOH.$ (03 marks)

(b). $CH_3CH_2CH_2OH$ to $CH_3\overset{\overset{O}{\|}}{C}CH_3$ (05 marks)

(c). $C_6H_5CH_2OH$ to C_6H_6 (03 marks)

(d).  to  (5½ marks)

(e). $CH_3\overset{\overset{Br}{|}}{C}HCH_3$ to $CH_3\overset{\overset{OH}{|}}{\underset{\underset{CH_3}{|}}{C}}-SO_3^-Na^+$ (3½ marks)

34. Write equations to show how the following compounds can be synthesised. [**UNEB 1998**]

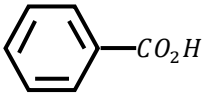
(a). $CH_3CH_2CH_2Cl$ to $CH_3CH_2CH_2CH_2NH_2$ (04 marks)

(b). $CH_3CH_2CH_2OH$ to $CH_3CH_2CH_2COOH$ (06 marks)

(c). CH_3CH_2COOH to $CH_3CH_2NH_2$ (04 marks)

(d). $CH_3CH=CH_2$ to $CH_3CH_2CH_3CH_2Br$ (06 marks)

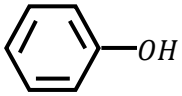
35. Write equations to show how the following compounds can be synthesised. [**UNEB 1998**]

(a).  from benzene (05 marks)

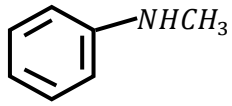
(b). $CH_3CH_2NH_2$ from $CH_3CH_2CONH_2$ (01 mark)

(c). $CH_3C\equiv CH$ from propene (05 marks)

(d). $CH_3CH_2COCH_3$ from $CH_3CH=CHCH_3$ (04 marks)

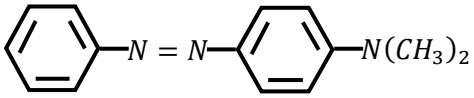
(e).  from benzene (05 marks)

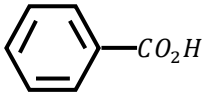
36. Write equations to show how the following compounds can be synthesised. [**UNEB 1997**]

(a).  from benzene (04 marks)

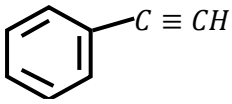
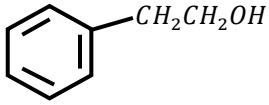
(b). $CH_3C \equiv CCH_3$ from $CH_3CHBrCH_2CH_3$ (05 marks)

(c). CH_3CONH_2 from ethene (04 marks)

(d).  from nitrobenzene (4½ marks)

(e).  from bromobenzene (2½ marks)

37. Write equations to show how the following compounds can be synthesised. [**UNEB 1987**]

(a).  to  (05 marks)

(b). $CH_3\overset{\overset{Br}{|}}{C}HCH_3$ to $CH_3CH_2\overset{\overset{O}{\|}}{C}CH_3$ (05 marks)

(c). $CH_3CH_2CH_2CH_2I$ to $CH_3CH_2CH_3$ (05 marks)

(d). CH_3CHO to $CH_3CH_2NH_2$ (05 marks)

BEFORE YOU START, ASK YOURSELF "IS IT WORTH IT?" *NOT* "WILL IT BE EASY?"