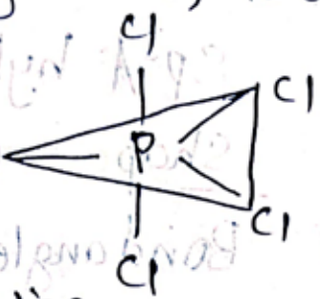
IMPORTANT FORMULAE & REACTIONS II YR:

CH:3: CHEMICAL BONDING: ** 4m.

(1) Hybridisation in PCl_5 molecule: sp^3d.
Structure: Trigonal bipyramidal.
Bondangle: 90°, 120°.



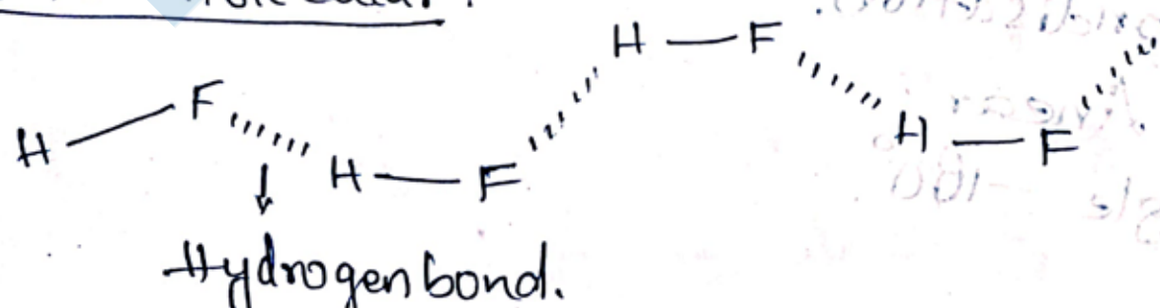
(2) Hybridisation in SF_6 molecule: ** 4m.
Hybridisation – sp^3d^2.
Structure/shape – Octahedral.
Bond angle: 90°.

(3) Example of co-ordinate bond: ** 4m.

Formation of ammonium ion.

(4) Different types of hydrogen bond: ** 4m

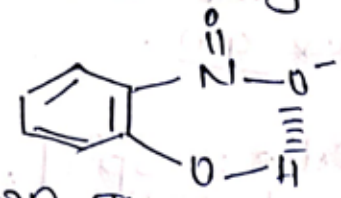
Intermolecular:



Hydrogen bond.

Intermolecular molecular.
hydrogen bond.

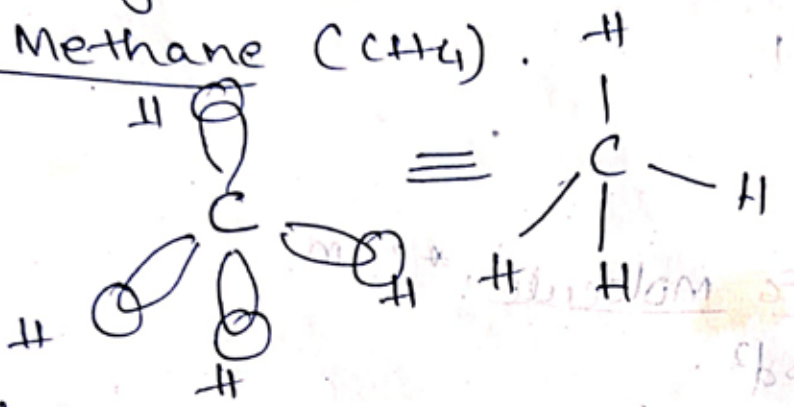
* Intramolecular hydrogen bond:



Hybridisation types: ~~* * * &M~~.

Sp³ hybridisation: (1S + 3P Orbitals overlapping).

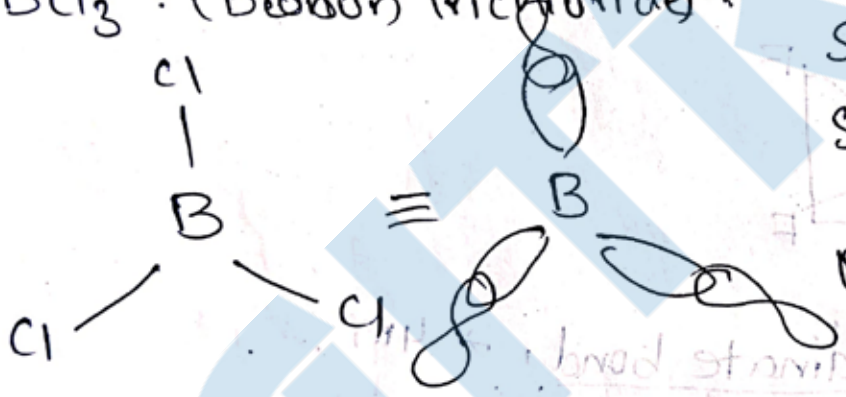
Ex: Methane (CH_4).



Sp^3 hybridisation
Shape: Tetrahedral.
Bondangle: 109° 28'

Sp^2 hybridisation: 1S + 2P → 3 sp hybrid Orbitals

BCl_3: (Boron trichloride).



Sp^2 hybridisation
Shape - Trigonal planar
Bondangle: 120°.

Sp hybridisation: 1S + 1P → 2p hybrid orbitals.

BeF_2: Beryllium difluoride.

F — Be — F

Sp hybridisation.
Shape - Linear.
Bond angle - 180°.

C:4 : STATES OF MATTER : *** VSAQ (2M)

① Boyles law : $p \propto \frac{1}{V}$.

② charles law : $V \propto T$.

③ Ideal Gas Equation : $pV = nRT$.

④ Values of Gas constant :

$R = 8.314 \times 10^7$ erg /mol/K.

⑤ Grahams law :

$r \propto \frac{1}{\sqrt{d}}$.

⑥ Daltons law of partial pressure :

$P_{Total} = P_1 + P_2 + P_2 + P_3 \ldots$

⑦ Kinetic Gas Equation

$Pv = \frac{1}{3} mn U_{mn}^2$.

⑧ Boltzmann constant :

$K = \frac{R}{N_0}$ $K = 1.38 \times 10^{-16}$ erg /K/molecule.

⑨ Kinetic energy (K.E)

$K.E = \frac{3}{2} nRT$ *** 2M.

C.5 : Stiochiomelry : ~~***~~ VSAQ

① Number of moles : $\frac{\text{weight}}{\text{Gram molecular weight}}$

② weight : No. of moles x Gram molecular weight.

③ No. of molecules : No. of moles x Avagadros number

④ Empirical formula = n x empirical weight.

$n = \frac{\text{molecular weight}}{\text{Empirical formula weight}}$ ** SAQ.

⑤ Molecular formula : $(\text{Empirical formula})_n$. ** SAQ

C.6 : Thermodynamics ** SAQ.

(1) **Hess law** : *** SAQ.

$$\Delta_r H = \Delta_r H_1 + \Delta_r H_2 + \Delta_r H_3 \cdots$$

(2) **Heat capacity** : ** SAQ

$C = q / d_T$. q = Heat absorbed.

$\boxed{C_p - C_v = R}$ d_T = Rise in Temperature

R = Gas Constant

C_p = Heat capacity at constant pressure

C_v = Heat capacity at constant volume.

Relation between C_p & C_v. **

(3) **Gibbs Energy** : $\Delta G = \Delta H - T\Delta S$. * VSAQ

ΔH : Change in Enthalpy

T = Temperature.

ΔS = Change in Entropy.

(4) **First law of Thermodynamics** * VSAQ.

$\Delta U = q + w$

q = Amount of heat supplied.

w = Amount of work done on system.

ΔU = Change in internal Energy.

(5) For Exothermic Reaction = −ve * VSAQ.

Endothermic Reaction = +ve

(6) **Intensive properties** — ~~depen~~ does not depend on Quantity of substance. Temp., density pressure. ** SAQ

(7) Extensive properties — depend on Quantity Mass, volume, Internal Energy.

** VSAQ / SAQ

Third Law of thermodynamics:

Entropy of pure & perfectly crystalline solid is zero as temperature approaches absolute zero.

$$S_T = \int_0^T \frac{C_p}{T} dT$$

1.7: Chemical Equilibrium: ** VSAQ.

① Ionic product of water: $K_w = [H^+][OH^-]$.

② Equalibrium constant

Relation ship between K_p & K_c.

$K_p = K_c (RT)^{\Delta n}$.

Δn = no. of moles of gaseous products − no. of moles of gaseous Reactants.

③ Homogenous Equilibrium: ** VSAQ.

All reactants and products in same phase.

Ex: $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$.

$Fe^{3+}(aq) + SCN^-(aq) \rightleftharpoons Fe(SCN)^{2-}(aq)$

** VSAQ.

④ Heterogenous Equilibrium:

All reactant and products in different phase.

Ex: $H_2O(l) \rightleftharpoons H_2O(g)$.

** VSAQ

⑤ Bronsted Base:

proton acceptor. $NH_3 + H^+ \rightleftharpoons NH_4^+$.

$B^- + H^+ \rightleftharpoons BH^+$

⑥ Lewis acid: (Electron acceptor). ** VSAQ.

Substance accepts electron

Ex: CO_3^{3+}, Mg^{2+}, BF_3, H^+.

SAQ.

① Relation between K_p & K_c.

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

$K_p = K_c(RT)^{\Delta n}$ $\quad \Delta n = 2-(4) = -2$.

$K_p = K_c(RT)^{-2}$ $\quad \Delta n = 2-(4) = -2$.

$(K_p < K_c)$

② Conjugate acid base pair: SAQ.

Conjugate acid: proton acceptor.

$CH_3COO^- + H^+ \longrightarrow CH_3COOH$

Base — Conjugate acid

Conjugate Base: proton donar

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

conjugate base.

Conjugate acid - Base pair: SAQ.

$HCl_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+ + Cl^-_{(aq)}$

Acid — Base — Conjugate acid — conjugate base.

$CH_3COOH + NH_3 \rightleftharpoons CH_3COO^- + NH_4^+$

Acid — Base — Conjugate acid — Conjugate base!

③ Conjugate acid-base pair:

	C.A	C.B
ⓐ OH^-	H_2O	O^{2-}
H_2O	H_3O^+	OH^-
HCO_3^-	H_2CO_3	CO_3^{-2}
H_2O_2	H^+ (Accepts H^+)	HO_2^- (looses H^+)

(4) pH of 0.01 M solution.

$pH = -\log(H^+) = -\log(0.01) = -(-2) = 2$.

C-8: Hydrogen:

(a) Electron deficient hydrides. (less electrons at central atom).
Ex: B_2H_6, $Al(CH_3)_n$.

(b) Electron precise hydrides. (Sufficient electrons)
Ex: CH_4, C_2H_6

(c) Electron rich hydrides. (Electron rich).
NH_3, $H_2\ddot{O}$: $H\ddot{F}$

(2) Oxidation & Reduction of H_2O_2:

Oxidation Reactions:

(a) $2Fe^{2+} + 2H^+_{(aq)} + H_2O_2 \xrightarrow{\text{Oxidation}} 2Fe^{3+} + 2H_2O_{(l)}$.
(Acid medium)

(b) $Mn^{2+} + H_2O_2 + 2OH^- \xrightarrow[\text{Basic medium}]{\text{Oxidation}} Mn^{2+} + 2H_2O$

Reduction Reaction:

(a) $HOCl + H_2O_2 \xrightarrow{\text{Acid medium}} H_3O^+ + Cl^- + O_2$.

(b) $I_2 + H_2O_2 + 2OH^- \xrightarrow{\text{Basic medium}} 2I^- + 2H_2O + O_2$

Hydrides:

(a) Ionic hydrides: LiH, BeH_2.

(b) Interstitial hydrides: LaH_2 (2.87), YbH_2 (2.55), $TiH_{(1.5-1.8)}$

Hardness of water ** SAQ

① Hard water: $2C_{17}H_{35}COONa + M^{2+} \xrightarrow{\text{hard water}} (C_{17}H_{35}COO)_2M\downarrow + 2Na^+$

② Removal of hard water:

ⓐ Ion Exchange method:

$2NaZ + M^{2+} \longrightarrow MZ_2 + 2Na^+$

ⓑ Calgon method *** ($M = Mg, Ca$).

$M^{2+} + Na_6P_6O_{18}^{2-} \longrightarrow [Na_2MP_6O_{18}]^{2-} + 2Na^+$

($M = Mg$ & Ca).

C-9: S-BLOCK ELEMENTS:

① Magnesium metal burnt in air ** VSAQ

$2Mg + O_2 \longrightarrow 2MgO$.

$3Mg + N_2 \longrightarrow Mg_3N_2$

② Plaster of paris: ** VSAQ.

$2(CaSO_4 \cdot 2H_2O) \longrightarrow CaSO_4 \cdot H_2O + 3H_2O$

Gypsum. Plaster of paris

C-10: Boron family:

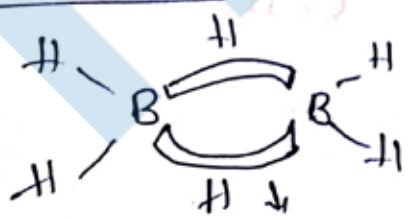
① * Borazine ($B_3N_3H_6$): Inorganic benzene. * VSAQ

② Borax Bead Test: * SAQ

$Na_2B_4O_7 \cdot 10H_2O \longrightarrow Na_2B_4O_7 \longrightarrow 2NaBO_2$

Sodium metaborate. $+ B_2O_3$.

③ Diborane: * SAQ



Banana Bond.

* Preparation of Diborane: ** SAQ.

(a) $BF_3 + 3LiAlH_4 \longrightarrow 2B_2H_6 + 3LiF + 3AlF_3$
Boron trifluoride

(b) Oxidation:
$2NaBH_4 + I_2 \longrightarrow B_2H_6 + 2NaI + H_2$

C.11: Group-14 Elements:

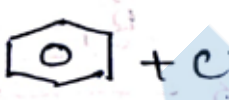
(1) Producer Gas: ** VSAQ. (Mixture of $CO + N_2$).
$2C + O_2(g) + 4N_2(g) \longrightarrow 2CO + 4N_2(g)$
(g) producer gas.

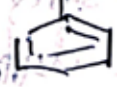
(2) Synthesis Gas: ** VSAQ.
(Mixture of $CO + H_2$).
$C + H_2O \xrightarrow[473-1273K]{} CO(g) + H_2(g)$.
Syn gas.

(3) Effect of water on Tin: ** VSAQ.
$Sn + 2H_2O \xrightarrow{\Delta} SnO_2 + 2H_2$.

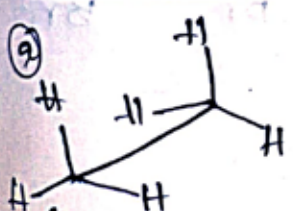
(4) ZSM-5: (Zeolite):
Zeolite convert alcohol directly into Gasoline.

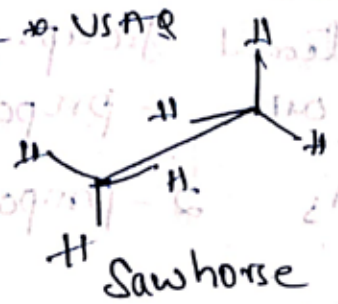
CH:13: Organic chemistry: ** VSAQ.

(1)  + CH_3Cl $\xrightarrow{AlCl_3}$  + HCl.
Benzene — Methyl benzene.

(2) Nitrobenzene preparation: ** VSAQ.
 + HNO_3 $\xrightarrow[\text{conc}]{\text{conc}}$ H_2SO_4  Nitrobenzene.

(3) Conformations of Ethane: ** VSAQ

(a) 
Saw horse — Newmans projection
Eclipsed forms

(b) 
Sawhorse — Newmann.
Staggered form.

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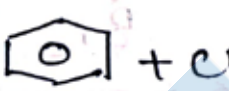
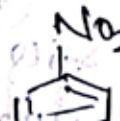
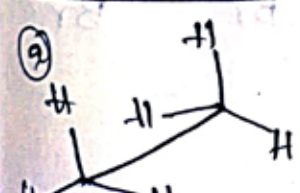
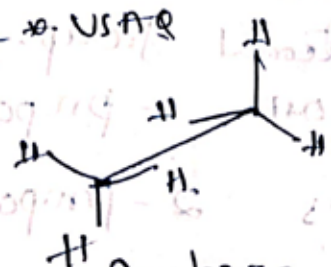
(1)  + $CH_3Cl_3 \xrightarrow{AlCl_3}$  + HCl.
Benzene
Methyl benzene.
** VSAQ.

(2) Nitrobenzene preparation:
 + $HNO_3 \xrightarrow[\text{conc.}H_2SO_4]{\text{Cone}}$  Nitrobenzene.
** VSAQ.

(3) Conformations of Ethane: ** VSAQ

(a) 
Saw horse

Newmann projection
Eclipsed form

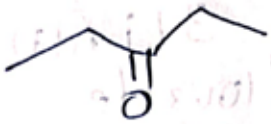
(b) 
Saw horse

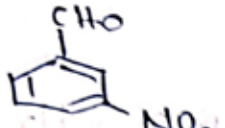
Newmann.
Staggered form.

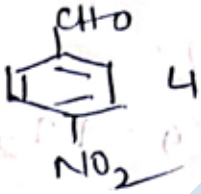
④ IUPAC Names :

(a) $CH_3-CH_2-CH_2-CH=CH_2$ ⇒ 1-Pentene.

(b)  ⇒ 2-pentanone

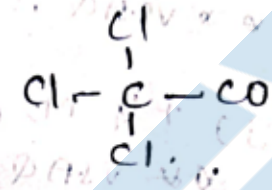
 3-pentanone

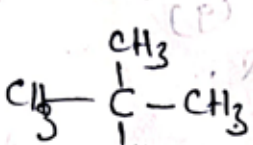
(c)  3-nitro benzaldehyde. (or) m-nitro benzaldehyde

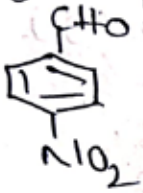
 4-Nitrobenzaldehyde. (or) p-nitro benzaldehyde.

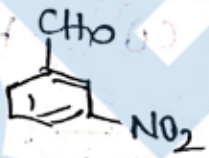
(d)

⑤ Write Structures —

(a) Trichloro ethanoic acid — 

(b) Neopentane : 

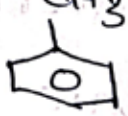
(c) p-nitrobenzaldehyde: 

(d)  m-nitrobenzaldehyde

~~* SAQ~~

(1) $CaC_2 \xrightarrow{2H_2O}$ ~~A~~ $\xrightarrow[\text{metal}]{\text{red hot}}$ B $\xrightarrow{AlCl_3+CHCl_3}$ C.

$CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$

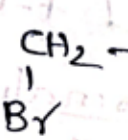
$C_2H_2 \xrightarrow[\text{metal}]{\text{red hot}}$  (A) (B) Benzene $\xrightarrow{AlCl_3/CHCl_3}$  Methyl benzene.

acetylene

(A)

(2) ~~* SAQ.~~ Ethylene $\xrightarrow[Br_2/CCl_4]{}$ A $\xrightarrow{Alc.KOH}$ B $\xrightarrow{Br_2}$ C

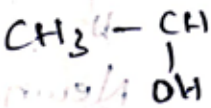
$CH_2=CH_2$

$Br-CH_2-CH_2-Br \xrightarrow{Alc.KOH}$ (A) $CH\equiv CH$ (B) $\xrightarrow{Br_2}$ 

(3) Positional isomerism : ~~* SAQ~~

(a) Same mol. formula but differ in position of functional group.

* $CH_3-CH_2-CH_2-OH$ 1-propanol

*  2-propanol

(b) Functional group isomerism: SAQ

same mol. formula but different functional groups.

$CH_3-\overset{O}{\overset{\|}{C}}-CH_3$ Propanone

$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-H$ propanal.

LAQ: 8M * . (Optinal. can be left in Optinal).

Preparation of Ethane:

(a) $C_2H_4 + H_2 \xrightarrow{Pt/Pd/Ni} C_2H_6$ (Hydrogenation).
Ethene → Ethane

(b) $C_2H_5Cl + H_2 \xrightarrow{Zn/H^+} C_2H_6 + HCl$ (Reduction).
chloro Ethane → Ethane.

Reactions of ethane:

(a) $C_2H_6 + Cl_2 \xrightarrow{h\nu} C_2H_5Cl + HCl$ (chlorination)
Ethane → Ethyl chloride

(b) $C_2H_6 + 3O_2 \xrightarrow{(CH_3COO)_2Mn} CH_3COOH + 2H_2O$ (Oxidation).
Ethane → Acetic acid.

(c) Pyrolysis.

$C_2H_6 \xrightarrow{500^\circ C} C_2H_4 + H_2$
Ethylene.

(2) ** LAQ **

Preparation of acetylene:

(a) $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$
Calcium carbide → acetylene.

(b) Dehydrohalogenation:

$CH_2Br-CH_2Br + KOH \longrightarrow H-C=C-H \xrightarrow{NaNH_2} C_2H_2 + NaBr + NH_3$
(Br)

(c)

* * *

Reactions of acetylene:

(a) $C_2H_2 + H_2O \xrightarrow[1\%\ HgSO_4]{30\%\ H_2SO_4} CH_2=\overset{OH}{\underset{|}{C}}H \rightleftharpoons CH_3CHO$

Acetylene. Acetaldehyde.

(b) $CH\equiv CH + H_2 \xrightarrow{Pt/Pd/Ni} H_3C-CH_3$

hydrogen.

(c) Reaction with halogen:

$HC\equiv CH + X_2 \xrightarrow{CCl_4}$

$H-\overset{Br}{\underset{Br}{C}}-\overset{Br}{\underset{Br}{C}}-H + Br_2 \longrightarrow$

(d) Reaction with HX: (Hydrogen halide):

$HC\equiv CH + HBr \longrightarrow H_2C=\underset{H}{\overset{|}{C}}-Br \longrightarrow CH_3-CHBr_2$

1, 1 - Dibromo ethane.

(e) Reaction with Ammonical $AgNO_3$ & $CuCl_2$:

$HC\equiv CH + Cu_2Cl_2 + 2NH_4OH \longrightarrow Cu-C\equiv C-Cu \downarrow + 2NH_4Cl + 2H_2O$

cuprous acetylide.

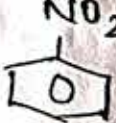
**** & AIS:

Preparation of Benzene and Reactions:

(a) $3C_2H_2 \xrightarrow{\text{red hot iron tube}}$  (or) C_6H_6.

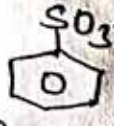
Reactions:

Nitration:

 + Conc. $HNO_3 \xrightarrow{Conc.\ H_2SO_4}$ 

Benzene. Nitrobenzene. Nitrobenzene.

Sulphonation:

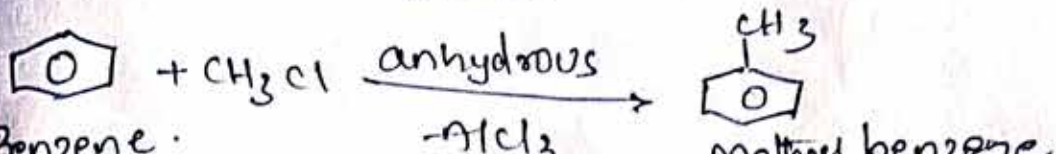
 + Conc. $H_2SO_4 \xrightarrow{\Delta}$ 

Benzene sulphonic acid

Chlorination: (Halogenation):

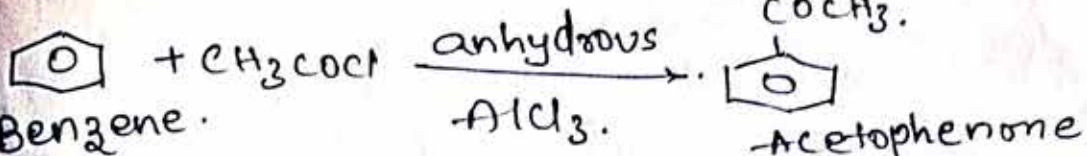
 + $Cl_2 \xrightarrow[\text{anhydrous}]{\cancel{AlCl_3}}$  + HCl.

(d) Friedal crafts alkylation:



Benzene. Methyl benzene

(e) Friedal Craft acylation:



Benzene. Acetophenone.

==xx==