Reagent Chart

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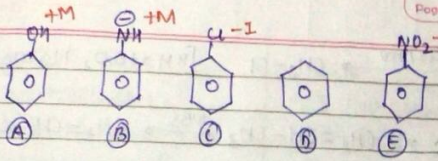
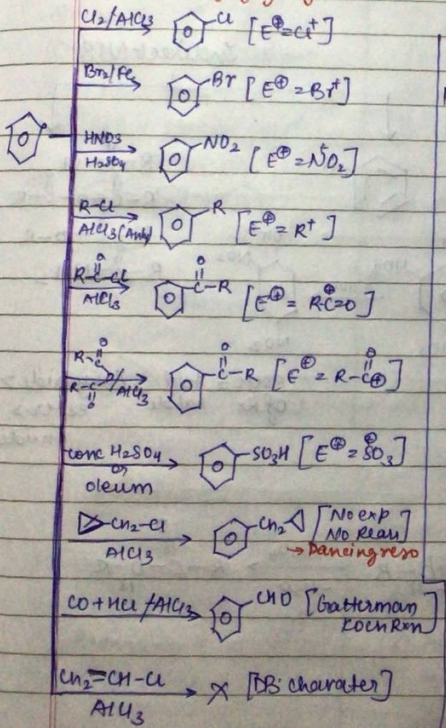
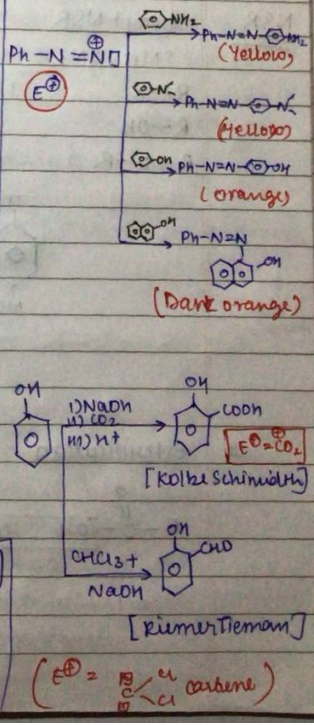
ESR



Rate = B > A > D > C > E

$E^{\oplus}$ waha jayega jaha e^- ज्यादा होगा





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FSR $CH_4 \xrightarrow{Cl_2/h\nu} CH_3-Cl$ [Hatab, Halogen lagao]

Allylic = $CH_2=CH-CH_3 \xrightarrow{NBS} CH_2=CH-CH_2-Br$

Benzylic = $Ph-CH_3 \xrightarrow{NBS} Ph-CH_2-Br$

NSR

Direct NSR

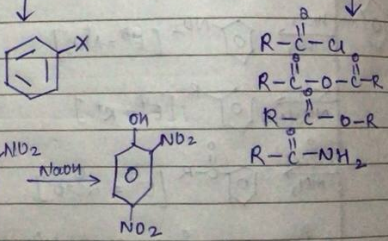
SN_1, SN_2

R–X

R–OH

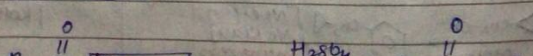
R–O–R

Indirect NSR



Rate of Rx = Acid halide > Anhydride > ester > Amide

 # Esterification



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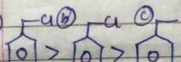
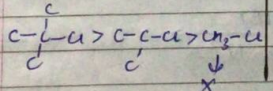
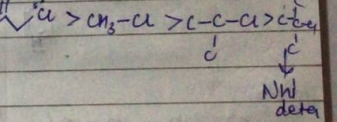
Direct NSR

S_N1

1. Unimolecular
2. Multiple step
3. Rearrange of $C^{\oplus}$
4. Racemic Mix
   100% Not possible
5. Weak $Nu^{\ominus}$
6. Polar Protic Solvent
7. Rate law = $[R-X]^1$
8. ROR $\propto$ stability of $C^{\oplus}$
9. 

   Stability: Rate a > b > c
10. 

S_N2

1. Bimolecular
2. Single step
3. No rearrangement
4. Inverted Product
5. strong $Nu^{\ominus}$
6. Polar Aprotic Solvent
7. Rate = $[R-X]^1[Nu^{\ominus}]^1$
8. ROR $\propto \frac{1}{\text{steric Repulsion}}$
9. Rate of S_N2
10. 

Elimination

E1

1. Unimolecular
2. Multiple step
3. Rearrang-t of $C^{\oplus}$
4. High temp.

E2

1. Bimolecular
2. Single step
3. Anti coplanar TS
4. High temp.

SN^1	E^1
Low Temp	High Temp

SN^2	E_2
Rate $\propto$ $\frac{1}{SH}$	$3^\circ > 2^\circ > 1^\circ$
$1^\circ > 2^\circ$ Halide	Halide

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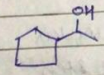
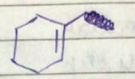
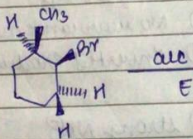
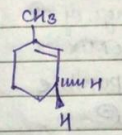
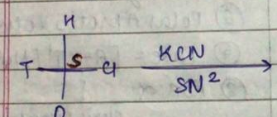
Q 1

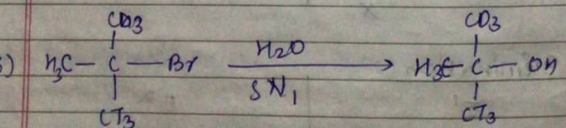
1)  $\xrightarrow[E^1]{H_2SO_4/170^\circ C}$  (Ring Expansion)

2)  $\xrightarrow[E^2]{\text{alc KOH}}$ 

3) 

4) $R-OH \xrightarrow[SN^2]{SOCl_2}$  $R-Cl$

5) $R-O-R' \xrightarrow[SN^1 \text{ or } SN^2]{HI/HBr}$

6) 

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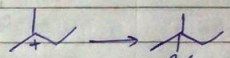
EAR

Rate of Rxn (Rate = B > A > C)

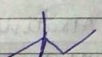
(a) $Ph-CH=CH_2 \xrightarrow{H^+} Ph-\overset{\oplus}{C}H-CH_3$ (Reso +aH)

(b) $CH_3-O-CH=CH_2 \xrightarrow{H^+} CH_3-O-\overset{\oplus}{C}H-CH_3$ (स्थिर Reso +aH)

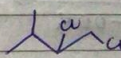
(c) $CH_3-CH=CH_2 \xrightarrow{H^+} CH_3-\overset{\oplus}{C}H-CH_3$ (aH)

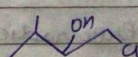
HBr →  → Rearrangement of C⊕ [HBr, HI, HCl]

Alkene or Alkyne

dil H_2SO_4 / H^+/H_2O →  [Rearrangement of C⊕]

$Hg(OAc)_2/H_2O$ / $NaBH_4$ →  [No Rearrangement]

Cl_2/CCl_4 →  [Anti Addⁿ]

Cl_2/H_2O →  [Anti Addⁿ]

1) BH_3 / 2) H_2O_2/OH^- → 

[$OH^{\ominus}$ ko less crowded carbon pe add karna, ulta alcohol banana hai]

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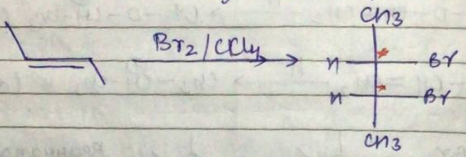
CAR [Cis, ~~Trans~~ Anti, addition, Racemic] symm
CAT [Cis, Anti, Threo] unsymm
TAM [Trans, Anti, Meso] sym
TAE [Trans, Anti, Erythro] unsymm



Test for unsaturation

$CH_3-CH=CH-CH_3 \xrightarrow[KMnO_4]{1\%\ Alkaline} CH_3-\underset{OH}{CH}-\underset{OH}{CH}-CH_3$
[Syn addⁿ]

FAB

$CH_3-CH=CH-Ph \xrightarrow[R-OOR]{HBr} CH_3-\underset{Br}{CH}-\underset{H}{CH}-Ph$

⇒ $Br^{\cdot}$ ko add karke $\dot{C}$ [Free radical] ki stability check karna hai

NAR

$H-\overset{O}{\overset{\|}{C}}-H > CH_3-\overset{O}{\overset{\|}{C}}-H > Ph-\overset{O}{\overset{\|}{C}}-H > H_3C-\overset{O}{\overset{\|}{C}}-CH_3$

Rate of Rxn $\propto \frac{1}{\text{Steric Repuln}} \propto$ Intensity of +ve charge

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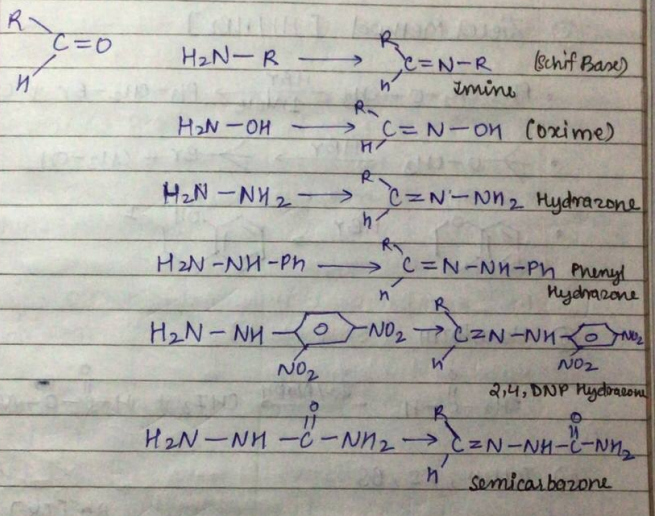
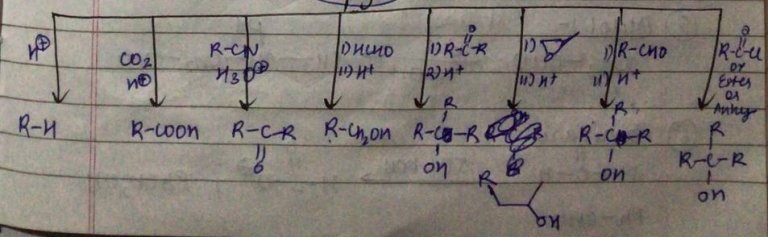
Nucleophile Addition Elimination

[अरे ओ Aldehyde जरा बाहर निकल]



GRIGNARD Reagent

(RMgX)



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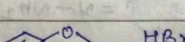
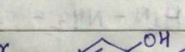
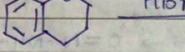
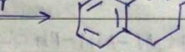
NAME RXN

Williamson Ether

① $R-O^{\ominus} + CH_3-Cl \xrightarrow{SN^2} R-O-CH_3$

$CH_3-CH_2-X \xrightarrow{SN^2} R-O-Et$

② Ziesel Method [HI / HBr]

- $Ph-CH_2-O-CH_3 \xrightarrow[1\,mole]{HBr} Ph-CH_2-Br + CH_3OH$
-  $\xrightarrow{HBr}$  $+ CH_3-OH$
-  $\xrightarrow{HBr}$ 

③ Haloform (3αH Must)

$CH_3-\overset{O}{\overset{\|}{C}}-H \xrightarrow{I_2/NaOH} CHI_3 + H-\overset{O}{\overset{\|}{C}}-O^{\ominus}Na^{\oplus}$

④ Tollen, FS, BS

$R-CHO \xrightarrow[BS]{T,\ FS} R-COOH +$ Ag [TR] / Cu_2O [BS] / Cu_2O [FS]

⑤ Aldol :- (at least 1αH)

$CH_3-CHO \xrightarrow[NaOH]{dil} CH_3-\underset{OH}{CH}-CH_2-CHO$

⑥ Canizaro

$H-\overset{O}{\overset{\|}{C}}-H \xrightarrow{50\%\ KOH} H-\overset{O}{\overset{\|}{C}}-O^{\ominus} + PhCH_2OH$

$Ph-CHO$

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Oxidation

① $CH_3-CH(OH)_2 \longrightarrow C-COOH$

② $CH_3-CH(OH)-CH_3 \longrightarrow C-C(=O)-C$

Reagent :- $KMnO_4$, $K_2Cr_2O_7$, H_2CrO_4

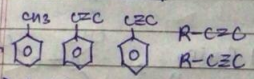
③ $R-CH(OH)_2 \xrightarrow[\text{or PDC}]{\text{PCC}} R-CHO$

$\boxed{1^\circ \text{Alc}}$

④ HIO_4 [Selective]

CH_2-OH | CH_2-OH $\quad$ CH_2-OH | $C=O$ | H $\quad$ CH_2-OH | $C=O$ | R

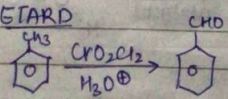
⑤ Hot $H^{\oplus}$ $KMnO_4$



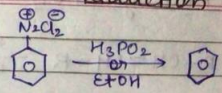
$R-C=C$
$R-C\equiv C$

sabko acid me karega

⑥ ETARD



Reduction

① 

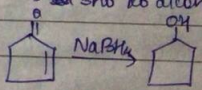
② $R-CHO$, $R-C(=O)-R \xrightarrow[\text{or } NH_2-NH_2/KOH]{\text{Zn Hg/HCl}}$ Alkane

③ Red P/HI → जो Jo Bhi taraega Alkane banjaega.

④ $LiAlH_4/H_2O$ [Alkene/Alykne chorke sabko]

Exception $Ph-CH=CH-CHO$
↓ $LiAlH_4$
$Ph-CH_2-CH_2-CH_2-OH$

⑤ $NaBH_4$ [Acid Halide, Aldehyde, ketone]
→ 3no ko alcohol

Exception. 

⑥ DIBAL [cynanide, ester]
↓ ko
[aldehyde]

⑦ $R-CN \xrightarrow[\text{Na/EtOH}]{\text{Red}} R-CH_2NH_2$

Mendius

COMPLETE REDUCTION

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① Hydrogenation

$$R-CH=CH-R \xrightarrow[\text{catalyst}]{H_2/} R-CH_2-CH_2-R$$

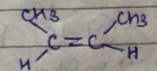
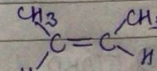
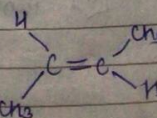
$$R-C\equiv C-R \xrightarrow[\text{catalyst}]{H_2/} R-CH_2-CH_2-R$$

Catalyst:- Pt or Pd ⟶ Hydrogenation at RT
Ni* ⟶ at Temp ↑ [Sabatier Sendrens]
Raney Ni ⟶ Room Temp
[Ni alloy in NaOH]

Syn addition Reduce all polar as well as non polar
[except carboxylic Acid]

⇒ Rate of Hydrogenation $\propto \frac{1}{\text{Steric Repulsion}}$

* $CH_3-C\equiv C-CH_3$

- $H_2/Pd\ BaSO_4$ (Rosenmund) → 
- $H_2/Pd\ CaCO_3$ (Lindlar catalyst) → 
- $Na/liq.\ NH_3$ (Birch Redⁿ) → 

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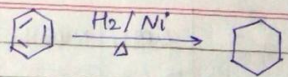
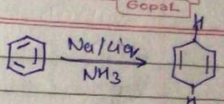
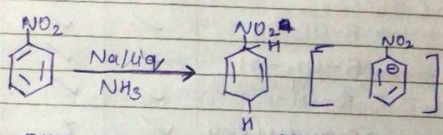
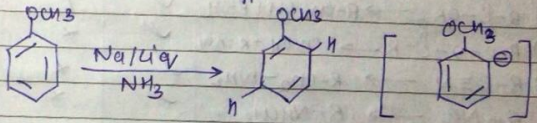
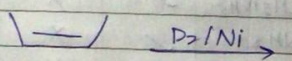
① 

② 

③ 

④ 

⑤ 

⑤ LiAlH$_4$ and NaBH$_4$

→ LAH is strong reducing agent than NaBH$_4$
→ LAH reduce all polar π Bond while NaBH$_4$ reduce 3 [R-$\overset{O}{\overset{\|}{C}}$-Cl , R-CHO , R-$\overset{O}{\overset{\|}{C}}$-R]

$$R-CHO \xrightarrow{LAH/D_2O} R-CH_2-OD$$

$$Ph-NO_2 \xrightarrow{LiAlH_4} Ph-N=N-Ph$$

③ Stephen Reduction

$$R-C\equiv N \xrightarrow{SnCl_2/HCl} R-CH=NH \xrightarrow{H_3O^+} R-CHO$$

		$LiAlH_4$	$NaBH_4$	H_2/Ni
(1)	$R-\overset{O}{\overset{\|}{C}}-X \longrightarrow R-CH_2-OH$	✓	✓	✓
(2)	$R-\overset{O}{\overset{\|}{C}}-H \longrightarrow R-CH_2-OH$	✓	✓	✓
(3)	$R-\overset{O}{\overset{\|}{C}}-R \longrightarrow R-\overset{OH}{\overset{\|}{C}}H-R$	✓	✓	✓
(4)	$R-\overset{O}{\overset{\|}{C}}-OR \longrightarrow R-CH_2-OH + R-OH$	✓	✗	✓
(5)	$R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R \longrightarrow R-CH_2OH + R-CH_2OH$	✓	✗	✓
(6)	$R-C\equiv N \longrightarrow R-CH_2-NH_2$	✓	✗	✓
(7)	$R-NC \longrightarrow R-NHCH_3$	✓	✗	✓
(8)	$R-\overset{O}{\overset{\|}{C}}-NH_2 \longrightarrow R-CH_2-NH_2$	✓	✗	✓
(9)	$R-NO_2 \longrightarrow R-NH_2$	✓	✗	✓
(10)	$R-\overset{O}{\overset{\|}{C}}-OH \longrightarrow R-CH_2-OH$	✓	✗	✗
(11)	$R-N=NH \longrightarrow R-NH-NH_2$	✓	✗	✓
(12)	$R-N=O \longrightarrow R-NH_2$	✓	✗	✓
(13)	$\diagup\!=\!\diagdown \longrightarrow \diagup\!-\!\diagdown$	✗	✗	✓
(14)	$-C\equiv C- \longrightarrow -\overset{H}{\overset{\|}{C}}-\overset{H}{\overset{\|}{C}}-$	✗	✗	✓

(11) DIBAL-H $\quad R-\overset{O}{\overset{\|}{C}}-OR \text{ or } R-C\equiv N \xrightarrow[2)\ H_3O^{\oplus}]{1)\ DIBAL} R-CHO$

(5) Mendius $\quad R-C\equiv N \text{ or } R-NC \xrightarrow{Na/Et-OH} R-CH_2-NH_2$

(6) Reduction of oxime $\quad R-CH=N-OH \xrightarrow[\text{or } Na/Et-OH]{LiAlH_4} R-CH_2-NH_2$

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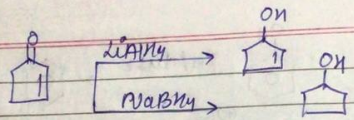
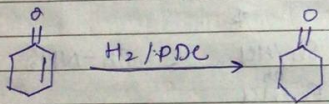
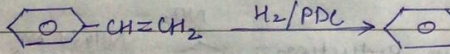
1) 

2) $Ph-CH=CH-\overset{H}{\underset{|}{C}}=O$ $\xrightarrow{LiAlH_4}$ $Ph-CH_2-CH_2-CH_2-OH$

$\xrightarrow{NaBH_4}$ $Ph-CH=CH-CH_2-OH$

3) 

4) 

(13) Red P/HI [All into Alkane except alkene/Alkyne]

$R-CHO,\ R-\overset{O}{\overset{\|}{C}}-R \longrightarrow RCH_3,\ R-\overset{H}{\underset{H}{C}}-R$

(14) Clemension Reduction.

$R-CHO$, $R-\overset{O}{\overset{\|}{C}}-R$ $\xrightarrow{Zn/Hg\ HCl}$ $R-CH_3$, $R-CH_2-R$

(15) Wolf Kishner [NH_2-NH_2/KOH]

Aldehyde, Ketone $\longrightarrow$ Alkane

COMPLETE OXIDATION

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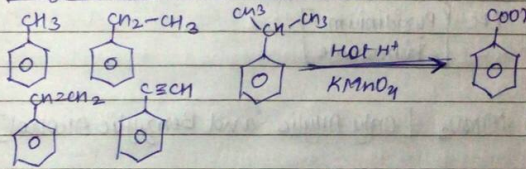
① Ozonolysis
② Tollen's Reagent
③ Benedict solution
④ Fehling solution
⑤ Baeyer's Reagent
⑥ Benzene side chain oxidation.

a) 

b) $R-CH=CH-R \xrightarrow{[O]} R-COOH$

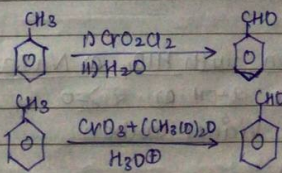
c) $R-C(R)=C(H)-H \xrightarrow{[O]} R-COOH + CO_2$

d) $R-C\equiv CH \xrightarrow{[O]} R-COOH + CO_2$

e) $R_2C=CH_2 \xrightarrow{[O]} R_2C=O + CO_2$

f)  $\xrightarrow{[O]}$ No Benzoic Acid.

⑦ ETARD



⑧ Oxidation of Alcohol

- Strong Oxidising → [1° Alc → Acid; 2° Alc → Ketone; 3° Alc → no oxidation]
  - $H^+ / KMnO_4$
  - $H^+ / K_2Cr_2O_7$
  - H_2CrO_4
- Jones Reagent ← (CrO_3 + aq. H_2SO_4 + Acetone)

- Mild oxidising → 1° Alc → Aldehyde
  2° Alc → Ketone
  3° Alc → No Rxn.

Cu/300°C
CrO_3/  [Collen's Reagent]
PCC
PDC [Pyridinium Dichromate]

(9) MNO_2 [only Allylic and Benzylic Alcohol]

orange ← Cr^{+6}

	PCC	PDC	Cu/300°C	$KMnO_4$	$K_2Cr_2O_7$
(10) CH_3-CH_2-OH	CH_3-CHO	CH_3CHO	CH_3CHO	CH_3COOH	CH_3COOH (green)
$CH_3-CH(CH_3)-OH$	$C-C(=O)-C$	$C-C(=O)-C$	$C-C(=O)-C$	$C-C(=O)-C$	$C-C(=O)-C+C$
$CH_3-C(CH_3)_2-OH$	X	X	$C=C(CH_3)_2$ Dehydration	X	X

(11) Oxidation with HIO_4 or $NaIO_4$
at least 2-OH or 2 >=O or 1-OH and >=O should be at vicinal carbon.

(a) $CH_2(OH)-CH_2(OH) \xrightarrow[1\,mole]{HIO_4} 2\,HCHO$

(b) $CH_2(OH)-CH(OH)-CH_2(OH) \xrightarrow[1\,mole]{HIO_4} HCHO,\ C(=O)(CH_2OH) \xrightarrow[1\,mole]{HIO_4} HCHO,\ HCOOH,\ HCHO$

(c) Glucose $\longrightarrow$ 5HCOOH + HCHO

(12) oxidation with SeO_2 : $-CH_2 > -CH_3$

$$CH_3-CHO \xrightarrow{SeO_2} H-\underset{\underset{O}{\|}}{C}-\underset{\underset{O}{\|}}{C}-H$$

$$CH_3-\overline{CH}-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow{\quad '' \quad} CH_3-\underset{\underset{O}{\|}}{C}-\underset{\underset{O}{\|}}{C}-CH_3$$

(13) Popoff Rule :- $-\overset{\overset{O}{\|}}{C}-$ goes with smaller Alkyl grp

$$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_2-CH_3 \xrightarrow{[O]} CH_3-\overset{\overset{O}{\|}}{C} + CH_2-CH_2-CH_3$$

$$\downarrow \qquad\qquad \downarrow$$

$$CH_3-COOH \qquad CH_3-CH_2-COOH$$