Vikasana CET-2013

Oxygen containing organic compounds-II

Phenol
Aldehydes & Ketones
Carboxylic Acids

PHENOL

Cumene process does not involve

1) Oxidation
2) Alkylation
3) Molecular rearrangement
4) Acylation

Explanation:

$$\text{Benzene} \xrightarrow{\text{alkylation}} \text{cumene} \xrightarrow{\text{oxidation}} \text{cumene hydroperoxide}$$

Ans: 4) Acylation

$$A \xrightarrow[0^\circ C]{NaNO_2/\ HCl} B \xrightarrow{\text{warm}} C$$

C on methylation gives cresol. A and B are

1) Sodium phenate and phenol
2) o-aminotoluene and nitrophenol
3) Aniline and benzenediazonium chloride
4) Chlorobenzene and phenol

Explanation:

C gives cresol on methylation. Hence C is phenol.

$$\underset{\text{(A)}}{\text{aniline}} \xrightarrow[0^\circ\text{C}]{\text{NaNO}_2\text{/ HCl}} \underset{\text{(B)}}{\begin{array}{l}\text{aqueous benzene}\\ \text{diazonium chloride}\end{array}} \xrightarrow{\text{warm}} \underset{\text{(C)}}{\text{phenol}}$$

Ans: 3) Aniline and benzenediazonium ` chloride

Phenol under appropriate conditions reacts with all except

1. Aqueous $NaHCO_3$
2. HCHO
3. PCl_5
4. Dilute HNO_3

Explanation:

HCHO + phenol - resin

PCl_5 + phenol - chlorobenzene

Dilute HNO_3 + phenol - o/p nitrophenol

$NaHCO_3$ + phenol - no reaction

Ans: 1) Aqueous $NaHCO_3$

$$\text{phenol} + X \xrightarrow{\text{conc. } H_2SO_4,\ \Delta} Z$$

Z is an acid-base indicator. ‘X’ is

1) β-naphthol
2) Phenolphthalein
3) Phthalic anhydride
4) Phthalic acid

Explanation:

Z is an acid-base indicator.

Phenol is used to prepare phenolphthalein an acid-base indicator. To get it phenol is condensed with phthalic anhydride.

Ans: 3) Phthalic anhydride

The wrong statement is

1) CO_2 can displace phenol from aqueous solution of sodium phenate.
2) Phenol is more acidic than alcohols due to resonance stabilisation of phenoxide ion.
3) Nitrophenol is more acidic than phenol due to –I and – R effect of NO_2 group.
4) Cresols are weaker acids than phenol due to resonance stabilization of phenoxide ion

Explanation:

Statements 1, 2, 3 are correct, 4 is partially correct. Cresols are weaker acids than phenol due to resonance **destabilization** of phenoxide ion.

Ans: 4) Cresols are weaker acids than phenol due to resonance stabilization of phenoxide ion

Functional group common to both aspirin and oil of wintergreen is

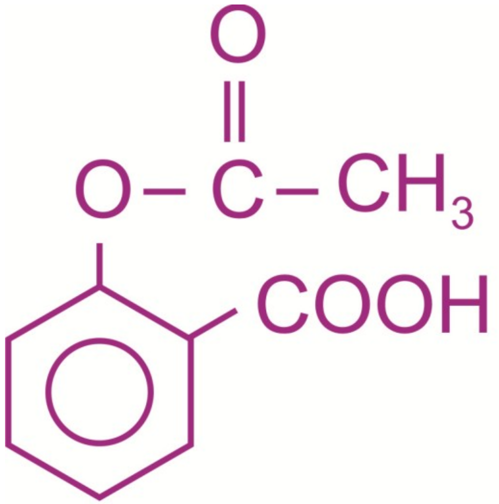
1) Carboxylic acid group

2) Ester linkage

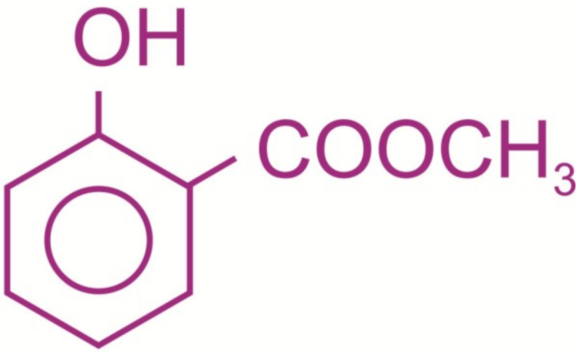
3) Ether linkage

4) Phenolic –OH group

Explanation:



aspirin



methyl salicylate

The structures clearly indicate that ester linkage is common to both.

Ans: 2) Ester linkage

The correct increasing order in the reactivity of the compounds towards electrophilic substitution reaction is

1) Nitrobenzene, benzene, toluene, phenol

2) Benzene, nitrobenzene, toluene, phenol

3) Toluene, benzene, nitrobenzene, phenol

4) Benzene, toluene, nitrobenzene, phenol

Explanation:

An electron withdrawing group ($-NO_2$) decreases electron density in benzene ring. An electron releasing group ($-CH_3$, $-OH$) increases electron density in benzene ring. $-OH >> -CH_3$.

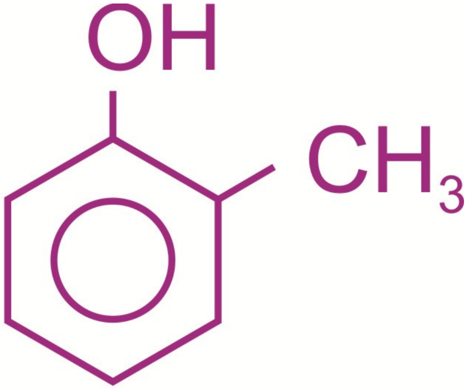
Ans: 1) Nitrobenzene, benzene, toluene, phenol

A compound (P) with formula C_7H_8O decolourises Br_2 water, and dissolves in aqueous NaOH. The compound could be

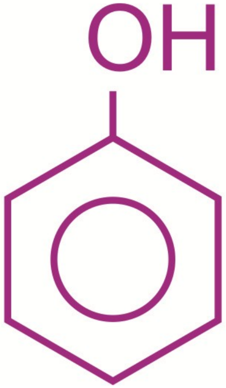
1)

2)

3)



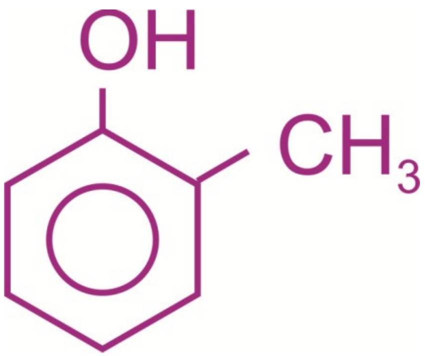
4)



Explanation:

An aromatic compound that dissolves in NaOH must be a phenol (or acid). Of the two phenols in (3) and (4) the molecular formula of (3) is C_7H_8O and that of (4) is C_6H_6O.

Ans: 3)



Salicylic acid and methyl salicylate can be best distinguished using

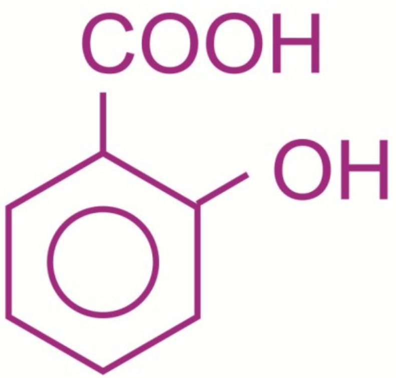
1) HCl

2) NaOH

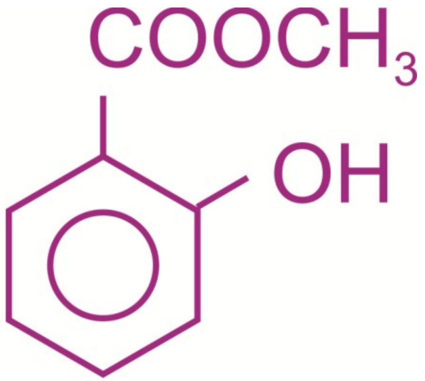
3) n–$FeCl_3$

4) $NaHCO_3$

Explanation:



salicylic acid



methyl salicylate

Both of them react with NaOH/ and n–$FeCl_3$
Both are phenols. But only salicylic acid (with –COOH group) reacts with $NaHCO_3$.

Ans: 4) $NaHCO_3$

The strongest acid among the following is

1) Acetic acid

2) Picric acid

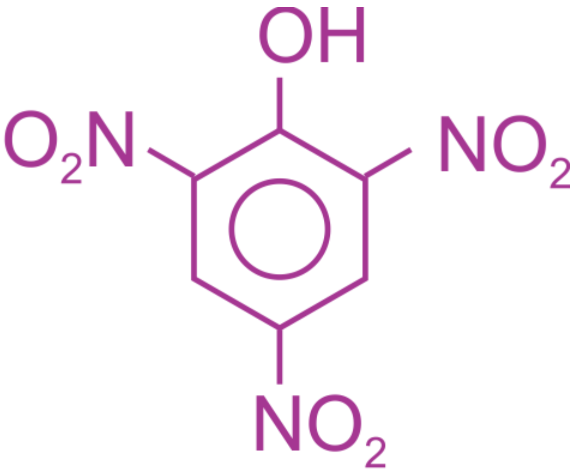
3) Carbonic acid

4) Salicylic acid

Explanation:

Acetic acid (CH_3COOH) is stronger than carbonic acid (H_2CO_3) Salicylic acid is stronger than acetic acid

But picric acid



is the strongest due to –R and –I effects of three $-NO_2$ groups.

Ans: 2) Picric acid

Aldehydes and Ketones

The total number of isomeric aldehydes and ketones possible for C_8H_8O are

1) 2

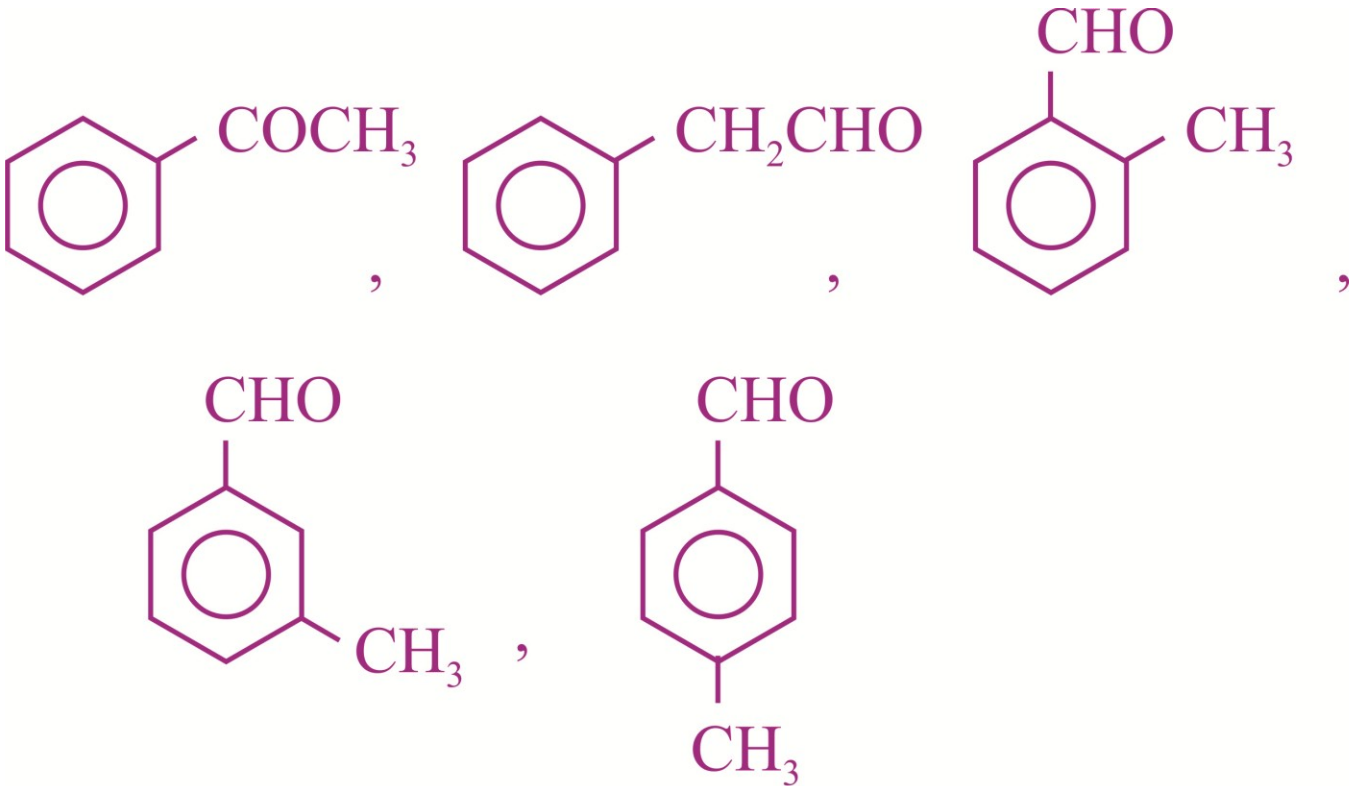
2) 3

3) 4

4) 5

Explanation:

For C_8H_8O we have



Ans: (4) 5

Propanone is obtained by the dehydrogenation of

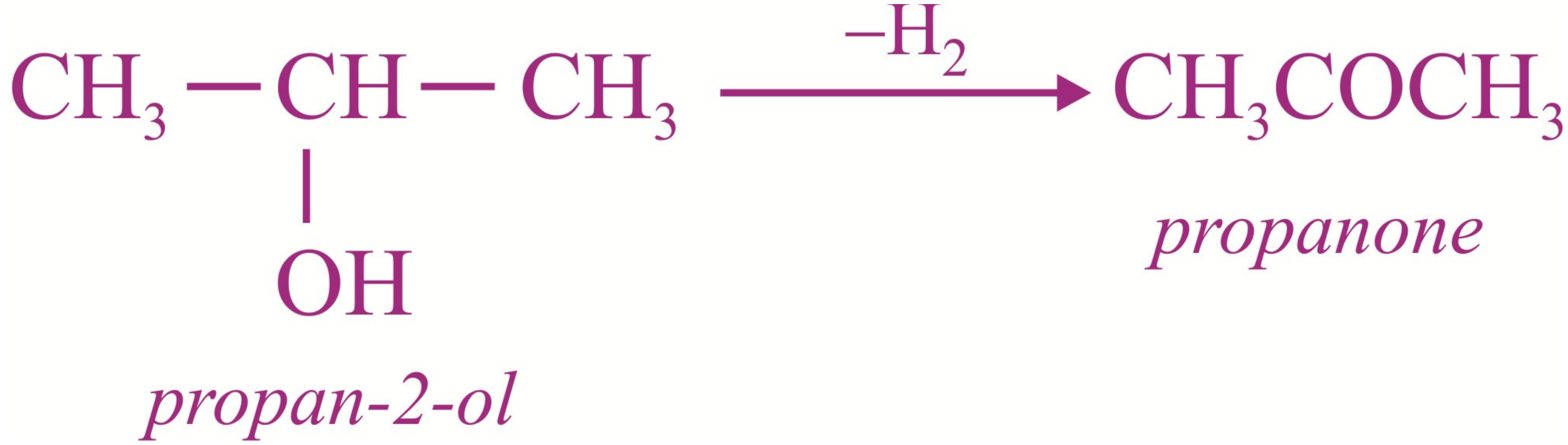
1) Propanal

2) Propan-2-ol

3) Propan-1-ol

4) Propanoic acid

Explanation:



$$\underset{\text{propan-2-ol}}{CH_3-\underset{\displaystyle OH}{\underset{|}{CH}}-CH_3} \xrightarrow{-H_2} \underset{\text{propanone}}{CH_3COCH_3}$$

Ans: (2) Propan-2-ol

Which one of these reacts with HCN to form a product that is chiral?

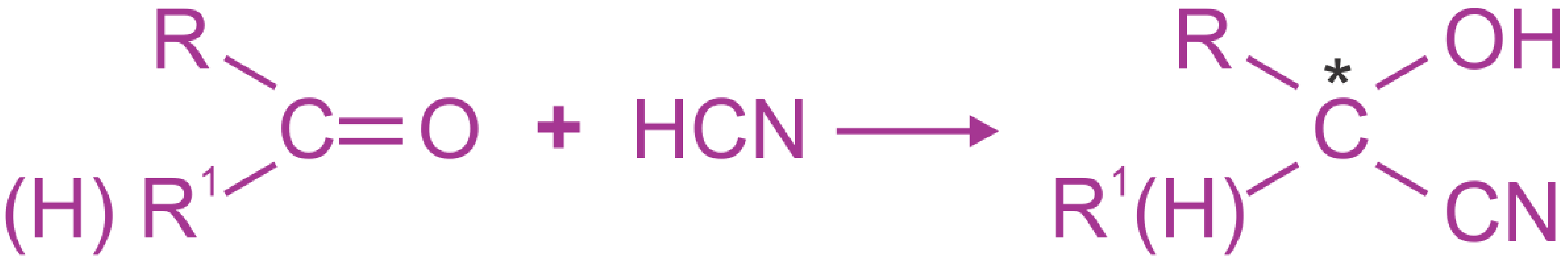
1) HCHO

2) CH_3COCH_3

3) C_6H_5CHO

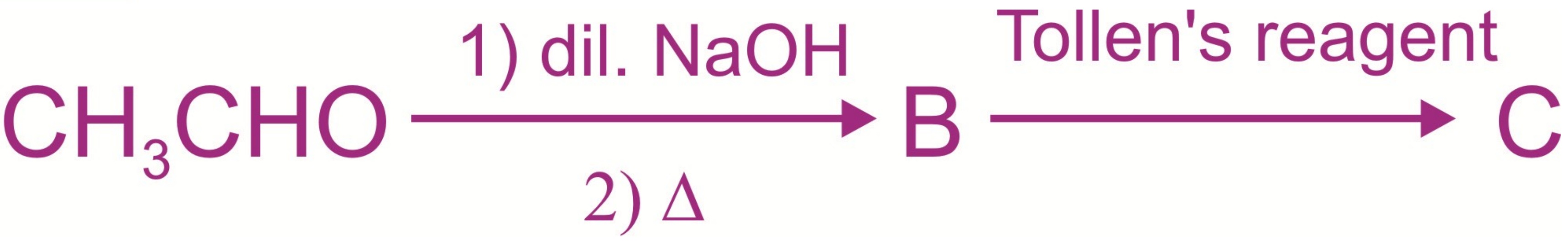
4) CH_3OCH_3

Explanation:



The product is chiral if R ≠ R^1, R ≠ H. So

Ans: (3) Benzaldehyde



$$CH_3CHO \xrightarrow[2)\ \Delta]{1)\ \text{dil. NaOH}} B \xrightarrow{\text{Tollen's reagent}} C$$

C is

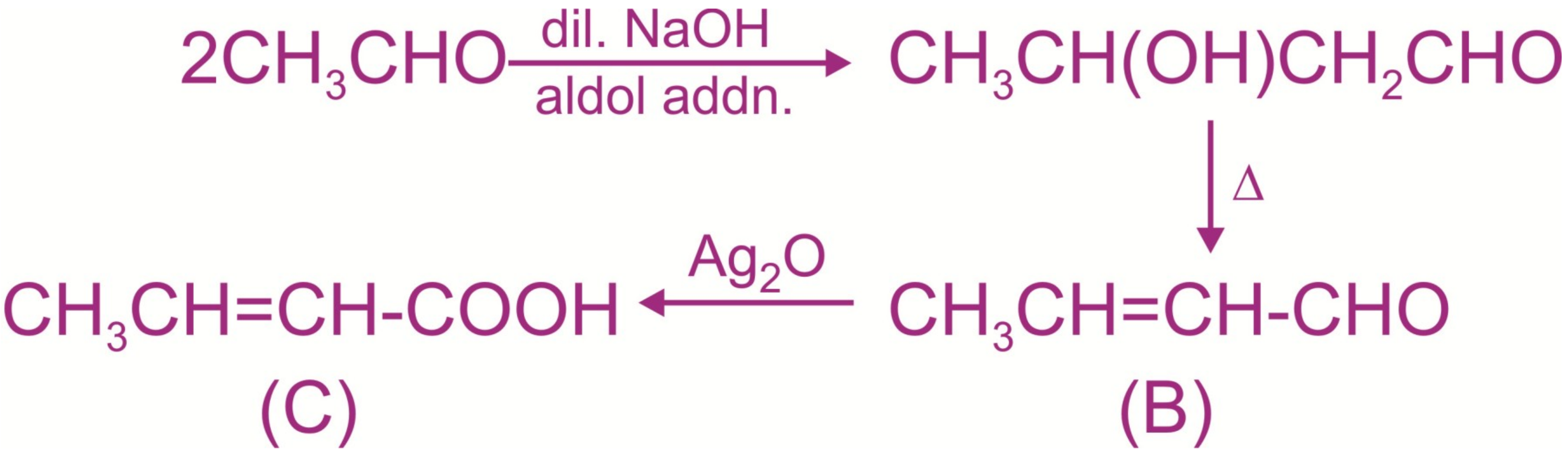
1) $CH_3CH = CH\ COOH$

2) $CH_3{-}CH(OH){-}CH(OH){-}COOH$

3) $CH_3CH = CH - CHO$

4) $CH_3CH_2CH_2COOH$

Explanation:



$$2CH_3CHO \xrightarrow[\text{aldol addn.}]{\text{dil. NaOH}} CH_3CH(OH)CH_2CHO$$

$$\downarrow \Delta$$

$$\underset{\text{(C)}}{CH_3CH{=}CH\text{-}COOH} \xleftarrow{Ag_2O} \underset{\text{(B)}}{CH_3CH{=}CH\text{-}CHO}$$

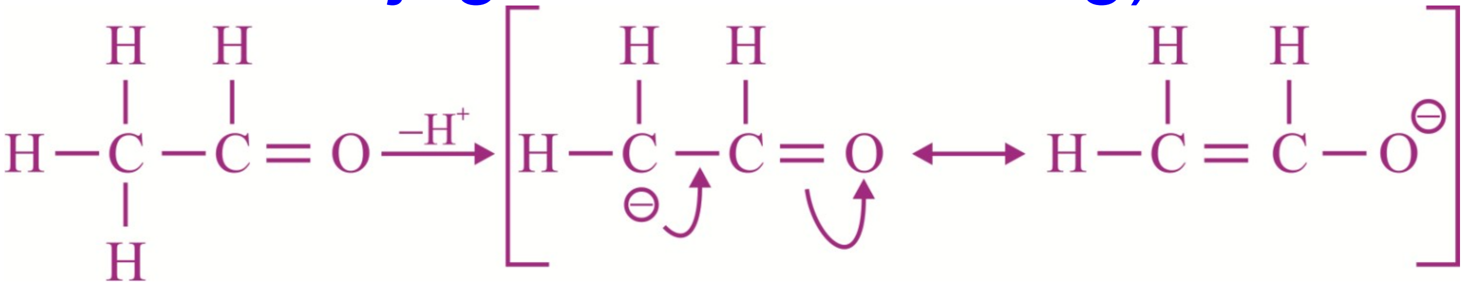
Ans: (1) $CH_3CH = CH\ COOH$

α–H atom is most acidic in

1) C_6H_5CHO
2) CH_3CH_2OH
3) CH_3CHO
4) CH_3COOH

Explanation:

α–H atom in aldehydes and ketones are more acidic than α–H atoms in alcohol (CH_3CH_2OH) or in carboxylic acids (CH_3–COOH) due to resonance stabilisation of carbanion. (weak base, its conjugate acid is strong)



Hence in the options given the answer is CH_3CHO

Ans. (3) CH_3CHO

Transfer of hydride ion is a key step in the reaction that occurs when conc.KOH reacts with

1) C_6H_5CHO

2) $CH_3–CHO$

3) $C_6H_5–COOH$

4) CH_3COOCH_3

Explanation:

All compounds in the options react with KOH, but hydride ion transfer is in Cannizzaro's reaction. Of the options given, only C_6H_5CHO gives this reaction.

Ans: (1) C_6H_5CHO

Which one of the statements is wrong?

1) Benzaldehyde on nitration forms m-nitrobenzaldehyde

2) Acetaldehyde can be prepared by dehydration of ethanol

3) All methyl ketones answers iodoform reaction

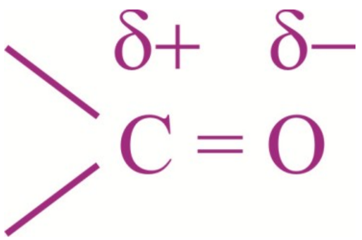
4) Carbonyl compounds undergo nucleophilic addition reaction.

Explanation:

–CHO group is EWG, meta directing

$C_2H_5OH \xrightarrow{-H_2O} CH_2=CH_2$ (wrong statement)

CH_3COR are methyl ketones answer iodoform reaction.



undergoes NSR
Because C end is electrophilic.

Ans: (2) acetaldehyde can be prepared by dehydration of ethanol.

Fehling’s solution helps to distinguish between

1) Glucose and fructose
2) Benzaldehyde and acetophenone
3) Acetaldehyde and benzaldehyde
4) Aldehydes and ketones

Explanation:

All monosaccharides, all aliphatic aldehydes reduce Fehling's solution.

But ketones and aromatic aldehydes do not.

Ans: (3) acetaldehyde and benzaldehyde

An organic compound [P] on reduction with Zn-Hg / conc.HCl forms a hydrocarbon. The functional group in the compound P could be

1) Ester

2) Alcohol

3) Carboxylic acid

4) Ketone

Explanation:

This is Clemmensen’s reduction given best by ketones.

Ans: (4) Ketone

Match the items in column A to items in B

Column A	Column B
A) $H{-}CHO \xrightarrow{\text{conc.KOH}}$	p) Condensation reaction
B) $CH_3CHO \xrightarrow{NH_2NH_2}$	q) Electrophilic substitution
C) $CH_3COCH_3 \xrightarrow{HCN}$	r) Disproportionation reaction
D) C_6H_5CHO [redacted]	s) Nucleophilic addition

1)A-s, B-r, C-q, D-p 3) A-r, B-p, C-s, D-q

2)A-s, B-q, C-r, d-p 4) A-r, B-p, C-q, D-s

Explanation:

$H–CHO \xrightarrow{KOH}$ Cannizzaro's reaction – disproportionation reaction

$CH_3CHO \xrightarrow{NH_2NH_2}$ condensation reaction

$CH_3COCH_3 \xrightarrow{HCN}$ nucleophilic addition

$C_6H_5CHO \xrightarrow{N.Mix}$ electrophilic substitution

Ans: (3)

A-r, B-p, C-s, D-q

Products obtained are the same when compounds A and B are treated separately with caustic soda. Compounds A and B could be

1) CH_3COOH and CH_3COCl

2) C_6H_5CHO and $C_6H_5COOC_6H_5$

3) H–CHO and H–$COOCH_3$

4) CH_3CHO and CH_3COOH

Explanation:

CH_3COOH & CH_3COCl give CH_3COONa / H_2O CH_3COOH / NaCl

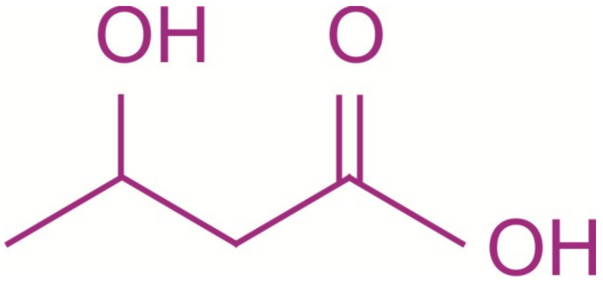
C_6H_5CHO & $C_6H_5COOC_6H_5$ give $C_6H_5CH_2OH$/ C_6H_5COONa and C_6H_5COONa/ C_6H_5OH

H–CHO & H–$COOCH_3$ give H–COONa/ CH_3OH and H–COONa/ CH_3OH

$CH_3CHO \rightarrow$Aldol : $CH_3COOH \rightarrow CH_3COONa$

Ans: (3) H–CHO and $HCOOCH_3$

Carboxylic Acids

IUPAC name of  is

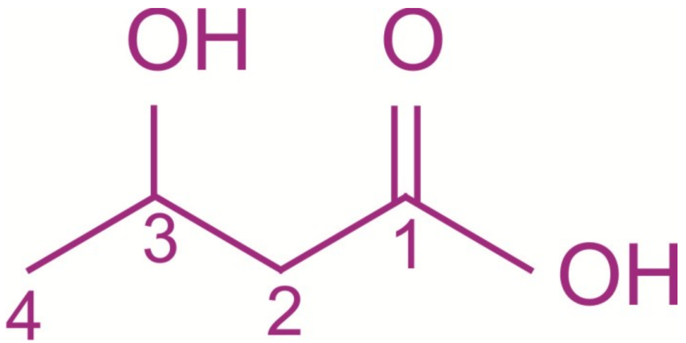
1) 2-hydroxybutanoic acid

2) 3-hydroxybutanoic acid

3) 3,4-dihydroxybutanone

4) 1,4-dihydroxybutanone

Explanation:



Identify the functional group –COOH and –OH. Least number to carbon of –COOH group.

Numbering as shown above.

Ans: (2) 3-hydroxybutanoic acid

The acid that has the highest pKa value is

1) $Cl–CH_2COOH$

2) CH_3COOH

3) $H–COOH$

4) CH_3CH_2COOH

Explanation:

Weaker the acid, higher is the pKa value. Chlorine increases acid strength. Alkyl groups decreases acid strength. C_2H_5 group decreases acid strength more than CH_3.

Ans: 4) CH_3CH_2COOH

Alkanenitrile on complete hydrolysis forms an/a

1) Ester

2) Carboxylic acid

3) Amide

4) Primary amine

Explanation:

Alkanenitrile means R–CN.

R–CN on complete hydrolysis forms a carboxylic acid.

$$R\text{–}CN \longrightarrow R\text{–}COOH$$

(Partial hydrolysis gives an amide, $R\text{–}CO\text{–}NH_2$)

Ans: (2) carboxylic acid

Ammonium ethanoate $\xrightarrow{\Delta}$ P. P is

1) Ethanamide

2) Ethanoic acid

3) Ethanal

4) Ethanamine

Explanation:

Ammonium ethanoate is CH_3COONH_4.

$$CH_3COONH_4 \xrightarrow{\Delta} \underset{\text{ethanamide}}{CH_3CONH_2} + H_2O$$

Ans: (1) Ethanamide

An acid on dehydration forms CO and on decarboxylation liberates hydrogen gas. The acid is

1) **CH_3–COOH**

2) 

$$\begin{array}{c}\mathrm{COOH}\\ |\\ \mathrm{COOH}\end{array}$$

3) **H–COOH**

4) **H_2CO_3**

Explanation:

Decarboxylation of CH_3COOH gives CH_4.

But H_2CO_3 gives H_2O.

Decarboxylation of $H_2C_2O_4$ and H–COOH gives H_2

Dehydration of $H_2C_2O_4$ gives CO & CO_2

Dehydration of H–COOH gives CO, H_2CO_3 gives CO_2

Ans: (3) H–COOH

Acetic acid is converted into acetyl chloride using

1) Cl_2

2) CH_3Cl

3) HCl

4) PCl_5

Explanation:

$$CH_3COOH \xrightarrow{?} CH_3COCl$$

Replace –OH by Cl.

This is done best by PCl_5

Cl cannot replace –OH, it replaces only –H!

CH_3Cl/ HCl do not react with CH_3COOH

Ans: (4) PCl_5

Methyl magnesium iodide reacts with acetic acid to form

1) CH_3COOCH_3
2) CH_4
3) CH_3OH
4) CH_3I

Explanation:

CH_3MgI has CH_3 end as negative end of dipole

$\overset{\delta-}{CH_3}-\overset{\delta+}{Mg}-I$

As a strong nucleophile or as a strong base - CH_3 end reacts with acidic compounds like H_2O, HCl, CH_3COOH, NH_3, alcohols to form CH_4.

$\overset{\delta-}{CH_3}MgI + CH_3CO\overset{\delta-}{O}-\overset{\delta+}{H} \longrightarrow CH_4$

In general $\overset{\delta-}{R}-MgX + \overset{\delta+}{H}\,\overset{\delta-}{A}$ (acidic compound) $\longrightarrow R-H$

Ans: (2) CH_4

Chemicals used to convert CH_3Br into acetic acid are

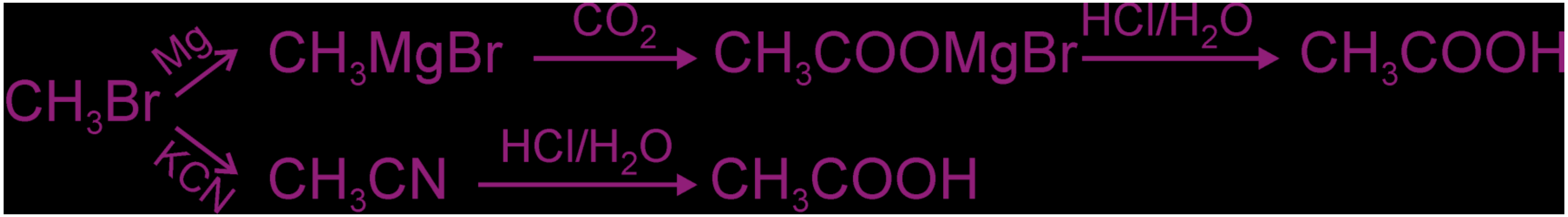
1) Mg/ dry ether, H–CHO, HCl/ H_2O
2) Alc. KCN, $LiAlH_4$, HCl / H_2O
3) Mg/ dry ether, CO_2, HCl / H_2O
4) Alc. KCN, Mg/ dry ether, HCl/ H_2O

Explanation:

$$CH_3Br \longrightarrow \longrightarrow \longrightarrow CH_3COOH$$

This combines reaction of haloalkanes with preparation of carboxylic acid.

Two ways:



$$CH_3Br \xrightarrow{Mg} CH_3MgBr \xrightarrow{CO_2} CH_3COOMgBr \xrightarrow{HCl/H_2O} CH_3COOH$$

$$CH_3Br \xrightarrow{KCN} CH_3CN \xrightarrow{HCl/H_2O} CH_3COOH$$

Ans: (3) Mg/ dry ether, CO_2, HCl/H_2O

Acetic acid is obtained by the acid hydrolysis of all except

1) CH_3COCH_3

2) $CH_3COOC_2H_5$

3) CH_3CN

4) CH_3COCl

Explanation:

This involves nucleophilic substitution reaction of acid derivatives.

$$CH_3-CO-X \xrightarrow[+\,^{-}OH]{-X} CH_3COOH$$

(2), (3), (4) are acid derivatives of acetic acid, hence can be hydrolysed. But (1) is acetone, it is not an acid derivative.

Ans: (1) CH_3COCH_3

The statement that is NOT true is

1) Functional isomer of ethanoic acid is methyl methanoate.

2) Acetate ion has two equivalent resonating structures

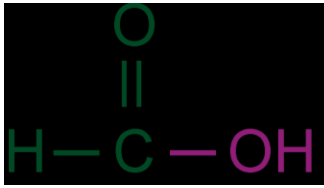
3) Formic acid can reduce Tollen’s reagent due to HCO– group in it.

4) Acetic acid reacts with $SOCl_2$ to form methyl chloride.

Explanation:

CH_3COOH & $HCOOCH_3$ are functional isomers.

$CH_3-\overset{\overset{O}{\|}}{C}-O^{\ominus} \longleftrightarrow CH_3-\overset{\overset{O^{\ominus}}{|}}{C}=O$ are equivalent.



$H-\overset{\overset{O}{\|}}{C}-OH$ has aldehydic group. Hence reduces Tollens reagent.

$CH_3COOH + SOCl_2 \longrightarrow CH_3COCl$ not CH_3Cl

Ans: (4) Acetic acid reacts with $SOCl_2$ to form methyl chloride.

The compound that does not condense with

is

1) phenol

2) aniline

3) benzaldehyde

4) cresol

Explanation: Phenols and aryl amines like aniline condense with BDC to form azo dyes.

Among the options, phenol, aniline and cresol give azo dyes with BDC. But benzaldehyde does not.

Ans: 3) Benzaldehyde

The alcohol that does NOT yield a carbonyl compound on dehydrogenation is

1) $CH_3CH(OH)CH_3$

2) $(CH_3)_3C{-}OH$

3) $C_6H_5CH\,(OH)CH_3$

4) $C_6H_5CH_2OH$

Explanation:

Primary alcohol [choice (4)] on dehydrogenation forms an aldehyde.

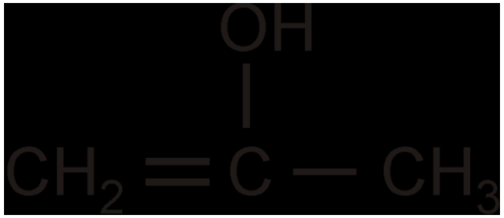
Secondary alcohols [choices (1) and (3)] on dehydrogenation forms a ketone.

Tertiary alcohol [choice (2)] do not undergo dehydrogenation but undergoes dehydration to form an alkene.

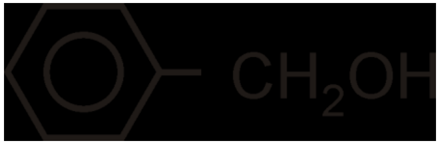
Ans: (2) $(CH_3)_3C\text{–}OH$

The enol that is exceptionally stable is

1) $CH_2=CHOH$

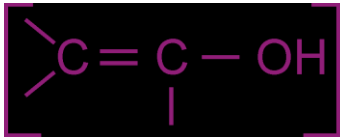
2) 

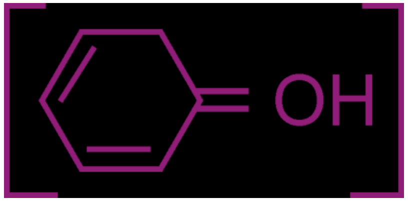
$CH_2=C(OH)-CH_3$

3) 

4) 

Explanation:

Enol is one that has –OH group attached to sp^2 hybridised carbon 

Generally enol of aliphatic series are unstable. Their keto forms is more stable. Choice (1) and (2) are unstable. Choice (3) $C_6H_5CH_2OH$ is not an enol. Choice (4) is phenol, is an enol. It is stable because in enol form it is aromatic and highly resonance stabilised. Its keto form  is not aromatic and is highly unstable.

Ans: (4) phenol

Aldol type condensation is possible between

1) H–CHO and CH_3CHO

2) H–CHO and C_6H_5CHO

3) C_6H_5CHO and $C_6H_5COC_6H_5$

4) $(CH_3)_3CCHO$ and H–CHO

Explanation:

Aldol condensation is possible if aldehyde or ketone has α–H atom/s.

Among the choices gives (1) option alone has CH_3CHO which has α–H atom. Hence can undergo aldol condensation with H–CHO.

Ans: 2) H–CHO and CH_3CHO.

$CH_3COCH_3 \xrightarrow{I_2/NaOH} X + Y$. X and Y are

1) $CH_3I + CH_3COONa$

2) $CH_3COI + CH_3OH$

3) $CH_3COCI_3 + NaI$

4) $CHI_3 + CH_3COONa$

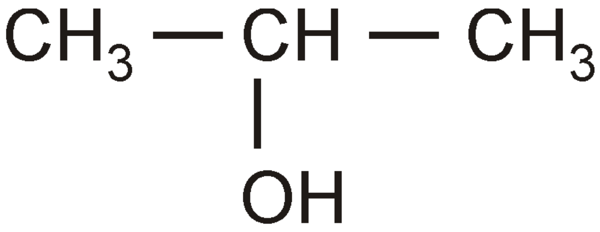
Explanation:

CH_3COCH_3 with I_2 / NaOH gives iodoform (CHI_3) and also forms CH_3COONa.

$$CH_3COCH_3 + 3I_2 + 4NaOH \longrightarrow CHI_3 + CH_3COONa + 3NaI + 3H_2O$$

Ans: 4) $CH_3I + CH_3COONa$

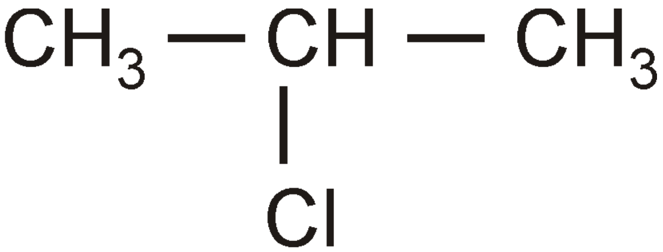
Iodoform test is not answered by

1) 

$CH_3-\underset{OH}{\underset{|}{CH}}-CH_3$

2) $CH_3CH_2CH_2OH$

3) CH_3CH_2OH

4) 

$CH_3-\underset{Cl}{\underset{|}{CH}}-CH_3$

Explanation:

Iodoform test / reaction / reaction with NaOI to yield CHI_3 is given by all methyl ketones (CH_3COR), all secondary alcohols of type $CH_3CH(OH)R$ and alkyl halides of type $CH_3CH(X)R$.

Ethyl alcohol (CH_3CH_2OH) will answer iodoform test. But $CH_3CH_2CH_2OH$ will not answer iodoform test.

Ans: 2) $CH_3CH_2CH_2OH$

A coordination compound is not a main component in

1) Fehling’s solution

2) Tollens reagent

3) Sodium nitroprusside

4) 2, 4 DNPH

Explanation:

Fehling's solution has Cu^{+2} as tartarate complex. Tollens reagent has Ag^{+1} as ammonia complex. Sodium nitroprusside is $Na_2\,[Fe(CN)_5NO]$. 2,4 DNPH is not a complex compound.

Ans: 4) 2, 4-DNPH

Acetic acid is converted into acetone by

1) pyrolysis of its calcium salt
2) pyrolysis of its sodium salt
3) pyrolysis of its calcium salt with calcium formate
4) pyrolysis of its ammonium salt

Explanation:

Acetone is obtained by dry distillation of calcium acetate.

Ans: 1) Pyrolysis of its calcium salt.

X (vapours) $\xrightarrow{\Delta,\ Cu}$ Y + H_2.

Y fails to undergo addition reaction with saturated solution of $NaHSO_3$. X is

1)1 - phenylethanol

2) 2-phenylethanol

3) benzyl alcohol

4) phenylethanal

Explanation: Aromatic ketones due to steric hindrance do not react with sodium bisulphite. So Y must be an aromatic ketone and X must be a secondary alcohol.

1-phenylethanol $C_6H_5CH(OH)CH_3$ is a secondary alcohol.

On dehydrogenation it gives $C_6H_5COCH_3$ (acetophenone) which does not react with $NaHSO_3$.

Ans: 1-phenylethanol

$$P \xrightarrow{\text{Clemmensen's reduction}} Y.$$

Y is also obtained by the hydrogenation of benzene.

P is

1) cyclohexanol

2) cyclohexanone

3) benzaldehyde

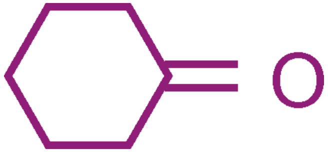
4) hexanone

Explanation:

Benzene on hydrogenation forms cyclohexane. (Y) is cyclohexane.

Ketones on Clemmensen’s reduction gives respective hydrocarbons.

So X must be a ketone and it must be



(cyclohexanone)

Ans: 2) cyclohexanone

Conversion of $R{-}CO{-}A \xrightarrow[+Y^{-}]{-A^{-}} R{-}CO{-}Y$

is a nucleophilic substitution reaction. The reaction is fastest when ‘A’ is

1) –OH

2) –Cl

3) –OR

4) $-NH_2$

Explanation:

‘A’ must be a weak nucleophile, a good leaving group. A good leaving group is also a weak base, a conjugate of a strong acid. Converting –OH, –Cl, –OR, $-NH_2$ into their conjugate acids, we get H_2O, HCl, ROH, NH_3. HCl is a strong acid. ∴ Cl^- must be a good leaving group, weak nucleophile.

Ans: 2) –Cl

Acetophenone on oxidation yields

1) acetic acid and phenol
2) benzoic acid and phenol
3) benzoic acid and carbon dioxide
4) acetic acid and benzoic acid

Explanation:

$$\underset{\text{Acetophenone}}{C_6H_5COCH_3} \xrightarrow{\text{oxidation}} \underset{\text{benzoic acid}}{C_6H_5COOH} + \underset{\text{carbon dioxide}}{CO_2}$$

Ans: 3) Benzoic acid and carbon dioxide

A family of compounds that can exhibit metamerism is

1) aldehyde

2) ketone

3) carboxylic acid

4) ester

Explanation:

Metamerism is exhibited by compounds having a functional group that is bivalent.

They are ether (R–O–R), ketone (–CO–) and 2° amine (–NH–).

Ans: (2) Ketone

Which one of the following has a carboxylic acid group

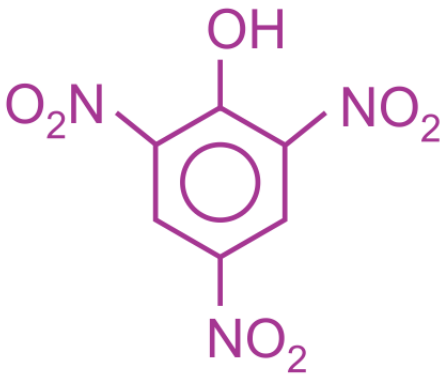
1) picric acid

2) aspirin

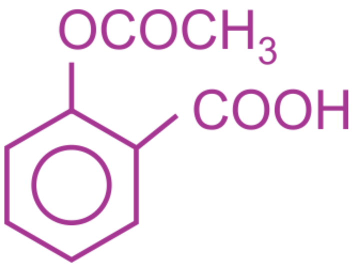
3) ascorbic acid

4) carbolic acid

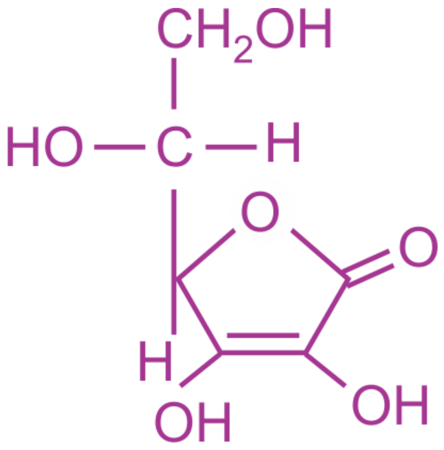
Explanation:



picric acid



aspirin



ascorbic acid

carbolic acid

The structures clearly indicate that the correct answer is aspirin.

Ans: (2) Aspirin

Acetaldehyde and vinyl alcohol are

1) tautomers

2) geometric isomers

3) enantiomers

4) not isomers

Explanation:

Tautomerism is dynamic isomerism due to shift in H atom from position 1 to 3, vice versa. This is shown by aldehydes and ketones with at least 1 α–H atom.

$$\overset{3}{CH_2} = \overset{2}{CH} - \overset{1}{OH} \rightleftharpoons CH_3 - CHO$$

enol and keto forms are tautomers

Ans: 1) Tautomers

Thank You!

WISH YOU ALL THE BEST