Chapter_11

Alcohols, Phenols and Ethers

Practice Questions

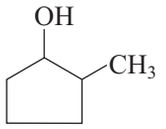
1. Which of the following alcohol contains C_{sp^3} — OH bond?

(a) Allylic alcohol *(b)* Vinylic alcohol
(c) Phenols *(d)* None of these

2. Vinylic alcohol contains

(a) —OH group attached to an sp^3-hybridised carbon atom
(b) —OH group attached to sp^3-hybridised carbon atom
(c) —OH group bonded to a carbon-carbon double bond
(d) —OH group attached to sp^3-hybridised carbon atom next to an aromatic ring

3. The IUPAC name of following structure is



(a) 2-methyl hydroxy cyclopentane.
(b) 2-hydroxy 2-methyl cyclopentane
(c) 2-methylcyclopentanol
(d) cyclopentylmethane

4. In ethers, the two bond pairs and two lone pairs of electrons on oxygen are arranged in a

(a) planar arrangement
(b) tetrahedral arrangement
(c) trigonal bipyramidal arrangement
(d) linear arrangement

5. The reagent(s) used for the reduction of aldehydes and ketone into alcohols is/are

(a) finely divided metals such as Pt/Pd/Ni
(b) sodium borohydride
(c) lithium aluminium hydride
(d) All of the above

6. Which of the following reagent is used to reduce carboxylic acids to primary alcohols?

(a) Pd *(b)* *R*—OH
(c) $LiAlH_4$ *(d)* Ni

7. The reaction of Grignard reagent with carbonyl compound is a nucleophilic addition reaction. This reaction on hydrolysis produces

(a) ester *(b)* alcohol
(c) carboxylic acid *(d)* ether

8. $CH_3CH_2—\underset{\underset{Ph}{|}}{\overset{\overset{OH}{|}}{C}}—CH_3$ cannot be prepared by

(a) $CH_3CH_2COCH_3 + PhMgX$
(b) $PhCOCH_3 + CH_3CH_2MgX$
(c) $PhCOCH_2CH_3 + CH_3MgX$
(d) $HCHO + PhCH(CH_3)CH_2MgX$

9. Which of the following hydrocarbon is used for world wide production of phenol?

(a) *Iso*-butylbenzene *(b)* *Iso*-propylbenzene
(c) *Iso*-pentylbenzene *(d)* None of these

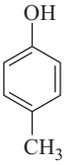
10. Alcohols and phenols react with active metals to yield

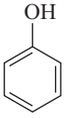
(a) alkoxides/phenoxides *(b)* hydrogen gas
(c) nitrogen *(d)* Both *(a)* and *(b)*

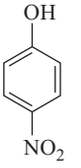
11. Arrange the following compounds in the decreasing order of acidity.

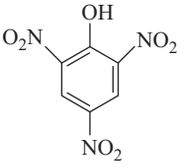
(a) $H_2O > HC\equiv CH > ROH$
(b) $H_2O > ROH > HC\equiv CH$
(c) $HC\equiv CH > ROH > H_2O$
(d) $HC\equiv CH > H_2O > ROH$

12. Which one is the most acidic compound?

(a) 

(b) 

(c) 

(d) 

13. Phenols show the cleavage of C— O bond with

(a) Na *(b)* K
(c) Zn *(d)* Ca

14. A primary alcohol with molecular formula C_3H_8O on reaction with (X) forms C_3H_7Br. The halide formed on reaction with (Y) gives alkane (C_6H_{14}). Here, X and Y respectively are

(a) HBr and HCN *(b)* HBr and Na, ether
(c) Br_2 and CH_3CN *(d)* Br_2 and $KMnO_4$

15. Identify an appropriate reagent for the conversion of alcohol to carboxylic acid.

(a) PCC *(b)* Anhydrous CrO_3
(c) Cu/573 K *(d)* $KMnO_4/H^{\oplus}$

16. Phenol on reaction with conc. HNO_3 produces

(a) *o*-nitrophenol *(b)* *p*-nitrophenol
(c) 2, 4, 6-trinitrophenol *(d)* *m*-nitrophenol

17. Phenol on reaction with Zn followed by distillation gives 'X'. Which on reaction with CH_3COCl, $AlCl_3$ gives Y. Final product Y is

(a) acetophenone *(b)* benzophenone
(c) diphenyl *(d)* methyl salicylate

18. Which of the following is also known as wood spirit?

(a) Ethanol *(b)* Propanol
(c) *Methanol* *(d)* *Butanol*

19. $X + H_2 \xrightarrow[200\text{-}300\ atm,\ 573\text{-}673\ K]{Y} CH_3OH$

What is X and Y in the given reaction?

	X	Y
(a)	CO_2,	$ZnO - CrO_3$
(b)	CO,	$ZnO - Cr_2O_3$
(c)	CO_2,	$ZnO - Cr_2O_3$
(d)	CO,	$ZnO - CrO_3$

20. The action of zymase is inhibited during fermentation if the percentage of alcohol formed exceeds

(a) 5% *(b)* 7%
(c) 10% *(d)* 14%

21. Williamson's synthesis involves which of the following type of mechanism when attack of an alkoxide ion on primary alkyl halide takes place?

(a) S_N1 *(b)* S_N2
(c) E1 *(d)* E2

22. Among the following sets of reactants which one produces anisole?

(a) CH_3CHO, $RMgX$
(b) C_6H_5OH, NaOH, CH_3I
(c) C_6H_5OH, neutral $FeCl_3$
(d) $C_6H_5 - CH_3$, CH_3COCl, $AlCl_3$

23. Select the correct increasing order of boiling point.

(a) *n*-pentane, ethoxyethane, butan-1-ol
(b) ethoxyethane, *n*-pentane, butan-1-ol
(c) butan-1-ol, *n*-pentane, ethoxyethane
(d) ethoxyethane, butan-1-ol, *n*-pentane

24. The order of reactivity of hydrogen halides with ether is as follows :

(a) HBr > HI > HCl *(b)* HCl > HBr > HI
(c) HI > HBr > HCl *(d)* HCl > HI > HBr

25. Ethers are treated with an aqueous solution of I in order to remove peroxides from it. Identify the 'I' from the following options.

(a) KI *(b)* Br_2
(c) KCNS *(d)* $Na_2S_2O_3$

ANSWERS

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

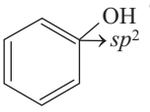
Hints & Solutions

1. (*a*) Allylic alcohol contains C , —OH bond.

$$CH_2=CH-CH_2OH$$
$$\downarrow$$
$$sp^3$$

Other given alcohols contain C_{sp^2}—OH bond.

(b) Vinylic alcohol $CH_2=\underset{\uparrow sp^2}{CH}-OH$

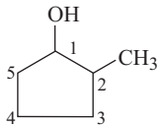
(c) Phenol 

2. (*c*) Vinylic alcohols contain —OH group bonded to a carbon-carbon double bond, i.e. to a vinylic carbon or to an aryl carbon. It is as follows :

$$H_2C=CH-OH$$

Vinylic alcohol

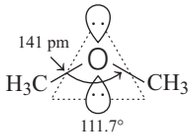
3. (*c*) The IUPAC name of the given structure is 2-methyl cyclopentanol



Cyclic alcohols are named using the prefix cyclo and considering the —OH group attached to C-1.

4. (*b*) In ethers, the four electron pairs, i.e. the two bond pairs and two lone pairs of electrons on oxygen are arranged approximately in a tetrahedral arrangement.

e.g.



5. (*d*) Aldehydes and ketones are reduced to the corresponding alcohols by the addition of hydrogen in the presence of catalysts (catalytic hydrogenation).

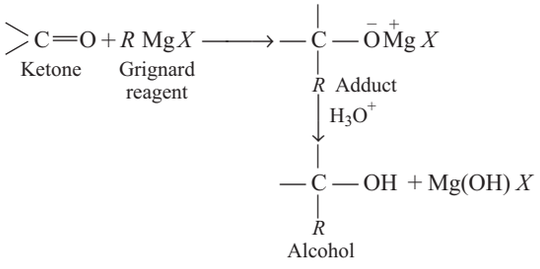
The usual catalyst is finely divided metals such as platinum, palladium or nickel. Alcohols are also prepared by treating aldehydes and ketones with sodium borohydride ($NaBH_4$) or lithium aluminium hydride ($LiAlH_4$).

6. (*c*) Carboxylic acids are reduced to primary alcohols in excellent yields by lithium aluminium hydride ($LiAlH_4$), a strong reducing agent.

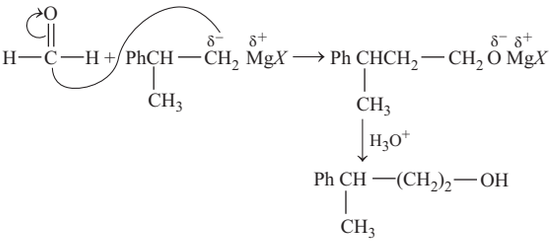
The reaction is as follows :

$$R\text{COOH} \xrightarrow[\text{(ii) } H_2O]{\text{(i) } LiAlH_4} R\text{CH}_2\text{OH}$$

7. (*b*) The first step of the reaction is the nucleophilic addition of Grignard reagent to the carbonyl group to form an adduct. Hydrolysis of this adduct yields an alcohol.

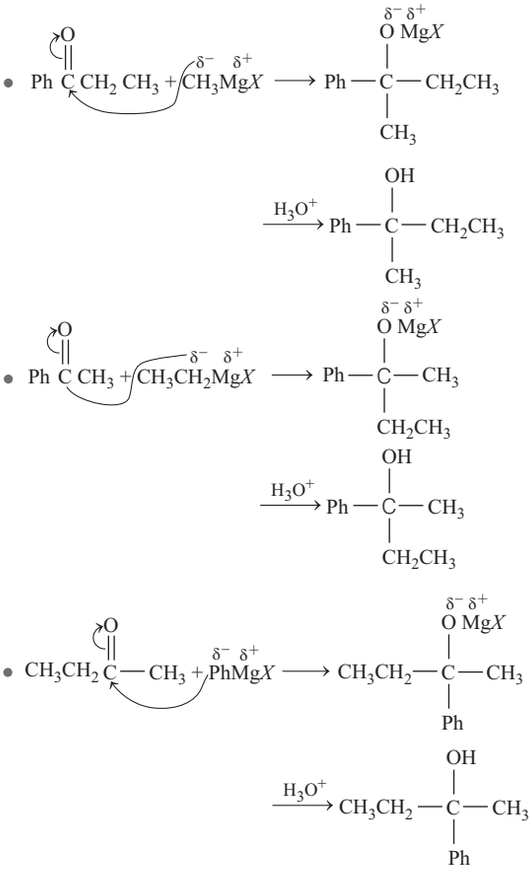


8. (*d*) $CH_3CH_2-\underset{\text{Ph}}{\overset{\text{OH}}{\overset{|}{\underset{|}{C}}}}-CH_3$ cannot be prepared by HCHO and $PhCH(CH_3)CH_2MgX$. This can be easily illustrated by following reaction.



The obtained product is not the required substance. While option (a), (b) and (c) can readily prepare the required substance.

The reactions are as follows :



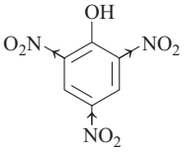
11. (*b*) A stronger acid displaces a weaker acid from its salt. Since, H_2O displaces *R*OH from $R\bar{O}\overset{+}{N}a$ and both H_2O and alcohol displace acetylene from sodium acetylide.

Therefore, water is the strongest acid followed by alcohol, while acetylene is the weakest acid as shown below :

$$H_2O > R\text{OH} > HC\equiv CH$$

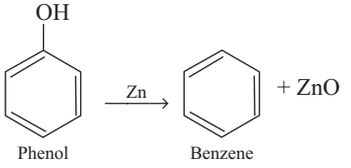
12. (*d*) Picric acid (2, 4, 6-trinitrophenol), i.e. option (d) is more acidic than given compounds due to the presence of three strong electron withdrawing groups (—NO_2 group) at *ortho* and *para*-positions.

It is due to the effective delocalisation of negative charge in phenoxide ion.



(*A*)

13. (*c*) The reactions involving cleavage of C—O bond take place only in alcohols. Phenols show the cleavage of C—O reaction only with zinc. Reaction involved is as follows :



Phenol Benzene

14. (*b*) According to the reaction conditions given in the question, *X* is HBr and *Y* is Na, ether.

The complete reaction sequence is as follows :

$$\underset{\text{Propanol}}{CH_3CH_2CH_2OH} \xrightarrow{HBr(X)} \underset{\text{Propyl bromide}}{CH_3CH_2CH_2Br} \xrightarrow[\text{Wurtz reaction}]{\text{Na, ether } (Y)} \underset{\text{Hexane}}{CH_3(CH_2)_4CH_3}$$

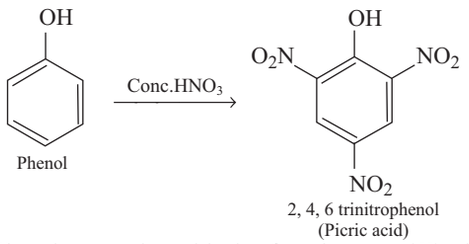
15. (*d*) Strong oxidising agent such as acidified $KMnO_4$ is used for conversion of alcohol to carboxylic acid.

The reaction is as follows :

$$\underset{\text{Alcohol}}{RCH_2OH} \xrightarrow[[O]]{\text{Oxidation}} \underset{\text{Aldehyde}}{RCHO} \longrightarrow \underset{\text{Carboxylic acid}}{RCOOH}$$

16. (*c*) With conc. HNO_3, phenol is converted to 2,4,6-trinitrophenol (picric acid). The product is commonly known as picric acid.

Reaction is as follows :

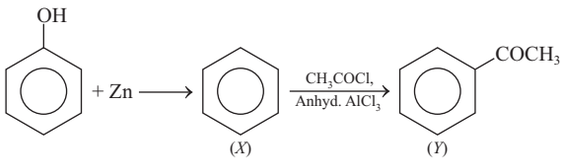


Phenol

2, 4, 6 trinitrophenol (Picric acid)

17. (*a*) Phenol on reaction with zinc form benzene (*X*) which on further reaction with CH_3COCl, $AlCl_3$ gives acetophenone (*Y*).

Complete reaction is as follows :



(*X*) (*Y*)

18. (*c*) Methanol, (CH_3OH), is known as 'wood spirit' as it is produced by destructive distillation of wood.

19. (*b*) '*X*' is CO and '*Y*' is ZnO-Cr_2O_3. Given reaction involves the production of methanol by catalytic hydrogenation of carbon monoxide at high pressure and temperature in the presence of ZnO-Cr_2O_3 catalyst. Reaction is as follows :

$$\underset{\text{Water gas}}{CO(X) + 2H_2} \xrightarrow[\substack{200\text{-}300 \text{ atm}\\ 573\text{-}673 \text{ K}}]{\text{ZnO-}Cr_2O_3\ (Y)} \underset{\text{Methyl alcohol}}{CH_3OH}$$

21. (*b*) Williamson's synthesis involves S_N2 mechanism when attack of an alkoxide ion on primary alkyl halide takes place. In this mechanism, the incoming nucleophile interacts with alkyl halide causing the carbon halide bond to break while forming a new carbon —OH bond. Reaction is as follows :

$$\overset{+}{R}\text{—}\overset{-}{X} + R\overset{-}{O}\overset{+}{Na} \xrightarrow{S_N2} ROR + NaX$$

23. (*a*) The weak polarity of ethers do not appreciably affect their boiling points which are comparable to those of the alkanes of comparable molecular masses but are much lower than the boiling point of alcohols. Therefore, the correct increasing order of boiling point is :

	n-pentane		Ethoxyethane		Butan-1-ol
Boiling point	309.1	<	307.6	<	390

24. (*c*) The order of reactivity of hydrogen halides with ether is as follows. HI > HBr > HCl. The cleavage of ethers take place with concentrated HI or HBr at high temperature.

25. (*a*) Ethers are treated with an aqueous solution of KI (I) in order to remove peroxides from it. Ether peroxide oxidises KI into I_2 and itself gets reduced to ether.

$$2I^- \longrightarrow I_2 + 2e^-$$

$$\text{Ether peroxide} + 2e^- \longrightarrow \text{Ether} + O_2$$