ALCOHOLS, PHENOLS AND ETHERS

<table>
<tr><th>Q.No</th><th>Question</th><th>Marks</th></tr>
<tr><td colspan="3">Multiple Choice Question</td></tr>
<tr><td>Q.141</td><td>The pKa of phenol is lower than that of _____ which is a _____ acid than phenol.

A. ethanol, weaker
B. o-cresol, stronger
C. m-nitrophenol, weaker
D. p-nitrophenol, stronger</td><td>1</td></tr>
<tr><td>Q.142</td><td>Methoxy methane on treatment with excess hydrogen iodide yields

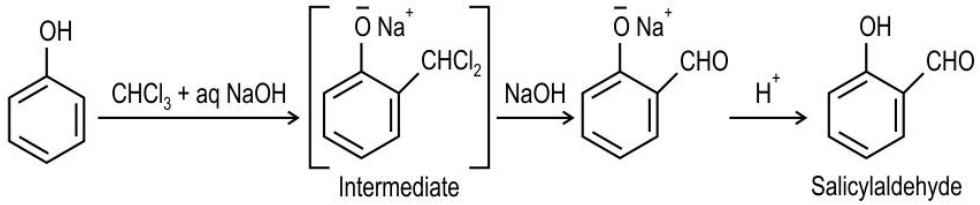
A. methanol as the only product.
B. an equimolar mixture of methyl iodide and methanol
C. methyl iodide as the only product
D. methanol as the major product with a little methyl iodide</td><td>1</td></tr>
<tr><td>Q.143</td><td>Anupam tabulated the time required for the reaction of different halogen halides with diethyl ether as follows:

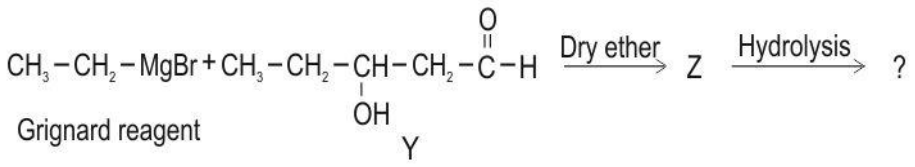
<table><tr><th>Halogen halide</th><th>HW</th><th>HX</th><th>HY</th></tr><tr><td>Time</td><td>1min</td><td>1min, 45sec</td><td>51 sec</td></tr></table>
Which of the following options correctly identifies the halide ions?

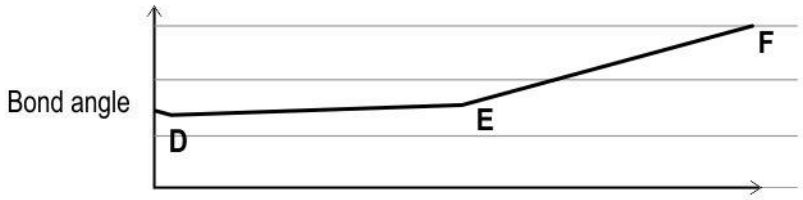
A. W = I^-, X = Br^-, Y = Cl^-
B. W = Cl^-, X = I^-, Y = Br^-
C. W = I^-, X = Cl^-, Y = Br^-
D. W = Br^-, X = Cl^-, Y = I^-</td><td>1</td></tr>
<tr><td>Q.144</td><td>The table below shows the number of hyperconjugation structures of three carbocations:

<table><tr><th>Carbocations</th><th>No. of hyperconjugation structures</th></tr><tr><td>P</td><td>3</td></tr><tr><td>Q</td><td>9</td></tr><tr><td>R</td><td>6</td></tr></table></td><td>1</td></tr>
</table>

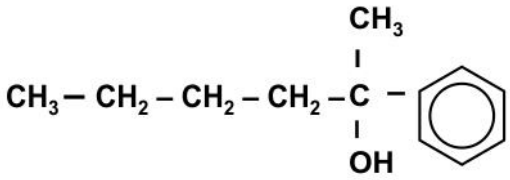
	Which of the following gives the correct arrangement for the increasing order of acidity of the alcohols derived from the respective carbocations? A. R < Q < P B. Q< R< P C. Q < P < R D. P < R <Q	
Q.145	Which of the compounds is expected to have the lowest pH? S: $CH_3CH_2CH_2OCH_2CH_3$ T: $CH_3CH_2CH_2CH_2OH$ U: $CH_3CH_2CH=CH_2OH$ V: CH_3OCH_3 A. S B. T C. U D. V	1
Q.146	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): The carbon–oxygen bond length in phenol is slightly less than that in methanol. Reason (R): The hybridised state of carbon to which oxygen is attached sp^3 in phenol. Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct but (R) is not the correct explanation of (A) C. (A) is true but (R) is false D. (A) is false but (R) is true	1
Q.147	Two statements are given below - one labelled Assertion (A) and the other labelled Reason (R). Assertion (A): The addition of diborane to alkene followed by treatment with alkaline H_2O_2 yields alcohols. Reason (R): Hydroboration is an addition reaction, where a C-C pi bond is broken, and two new single bonds to C are formed.	1

	Which of the following is correct? A. Both (A) and (R) are correct and (R) is the correct explanation of (A) B. Both (A) and (R) are correct but (R) is not the correct explanation of (A) C. (A) is true but (R) is false D. (A) is false but (R) is true	
Q.148	On oxidation, an alcohol gave a product X which reduced Tollens' reagent. Which of the following could the alcohols be? P) $CH_3 - CH_2 - CH_2OH$ Q) $CH_3 - CH_2 - CHOH - CH_3$ R) $CH_3 - CH_2 - C(CH_3)_2 - OH$ A. only P B. only P or Q C. only Q or R D. any of P, Q or R	1
Q.149	Identify the electrophile in the following reaction.  A. $^-CCl_3$ B. $:CCl_2$ C. $^+CHCl_2$ D. ^+CHO	1
	Free Response Questions/Subjective Questions	
Q.150	2-Methyl-but-2-ene $[(CH_3)_2 - C = CH - CH_3]$ is reacted with water in the presence of an acid catalyst. (a) Predict and write the structures of the major and minor products formed in the reaction. (b) Give the reaction mechanism to explain the formation of the major product.	4
Q.151	Neha knows that aldehydes react with a Grignard reagent to give a secondary alcohol as the final product. She carried out the reaction sequence shown below to prepare 2,5-dihydroxyheptane.	3

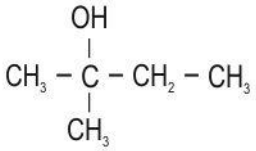
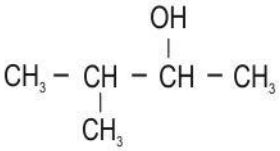
	 She was surprised to find that she did not obtain the final product she expected. (a) Give the possible reason for the expected final product not being formed. (b) Write the structures of the two final products Neha would have obtained.	
Q.152	Phenol reacts with dil. HNO_3 at low temperature. The products are separated into two beakers. Zainab and Christine recorded the boiling of the compounds as given in the tables below: Christine's readings: **Beaker** / **Boiling point**: 1 / 489 K; 2 / 387 K Zainab's readings: **Beaker** / **Boiling point**: 1 / 387 K; 2 / 489 K If beaker 1 contains p-nitrophenol and beaker 2 o-nitrophenol, identify the student whose data collection is correct. Give a reason for your answer.	3
Q.153	Anupam wanted to prepare alcohol using methyl magnesium bromide. He took three different compounds P, Q, and R. -Compound P forms an alcohol with molecular formula C_2H_6O. -Compounds Q and R are isomers with the molecular formula C_3H_6O. -Compound Q does not form any silver mirror with Tollen's reagent. (a) Give the IUPAC name of compound P. (b) Give the IUPAC names of the compounds formed from Q and R. (c) Write the reaction showing the formation of the primary and tertiary alcohols.	5

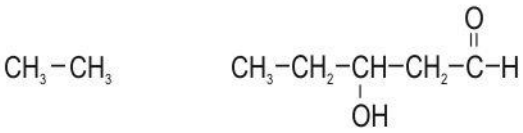
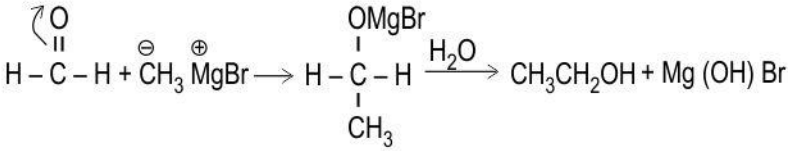
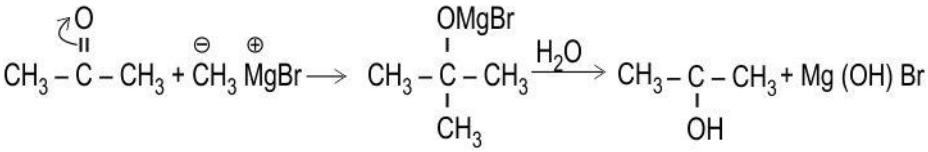
<table>
<tr><td></td><td>(d) Name the mechanism of the reaction of compound R with methyl magnesium bromide. Show the step for the formation of a secondary alcohol.</td><td></td></tr>
<tr><td>Q.154</td><td>Complete the table by comparing between Benzyl alcohol and Phenol:
<table><tr><th></th><th>Benzyl alcohol</th><th>Phenol</th></tr><tr><td>Hybridisation of the C-atom to which oxygen is attached to</td><td></td><td></td></tr><tr><td>C-O-H bond angle is 109^0 because</td><td></td><td></td></tr></table></td><td>2</td></tr>
<tr><td>Q.155</td><td>Susmita tabulated the graph given below showing the variation of bond angles of three compounds.
 

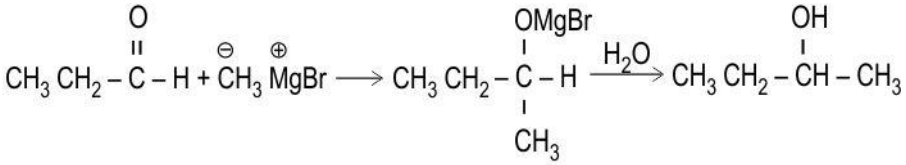
The compounds taken by Susmita are ethanol, phenol, and diethyl ether.
Look at the image and answer the questions that follow:
(a) Which compounds are most LIKELY to be D, E, F?
(b) Arrange the compounds in the decreasing order of C-O bond length.
(c) Complete the table:
<table><tr><th>Compound</th><th>D</th><th>E</th><th>F</th></tr><tr><td>percentage of s-character</td><td></td><td></td><td></td></tr></table></td><td>4</td></tr>
<tr><td>Q.156</td><td>Propene is subjected to two different reactions:
(i) reaction with water followed by acidic hydrolysis
(ii) reaction with diborane followed by oxidation with hydrogen peroxide in aqueous sodium hydroxide
State the following about the products formed in the two reactions:
(a) the molecular formulae
(b) the functional group present in the molecules
(c) the difference between the two products</td><td>4</td></tr>
</table>

Q.157	To prepare n-propyl ethyl ether, Kavita heats a mixture of n-propyl alcohol and ethyl alcohol in the presence of concentrated sulphuric acid. Is this a good method to prepare the product? Give reasons to your answer.	2
Q.158	Write the structure of all the products formed when n-propyl alcohol is heated with ethyl alcohol in the presence of concentrated sulphuric acid.	3
Q.159	2-phenyl-2-hexanol can be prepared by reacting a Grignard reagent and a ketone.  2 – phenyl - 2 – hexanol Write the structures of: (i) the two Grignard reagents that can be used (ii) the two ketones that can be used	4
Q.160	An alcohol has the formula $C_5H_{11}OH$. Draw the structural formulae of any one of its isomers that is: (i) a primary alcohol and has a IUPAC name based on propane (ii) a secondary alcohol and has a IUPAC name based on butane (iii) a tertiary alcohol	3

Answer Key and Marking Scheme

Q.No	Answers	Marks
Q.141	A. ethanol, weaker	1
Q.142	C. methyl iodide as the only product	1
Q.143	D. W = Br^-, X = Cl^-, Y = I^-	1
Q.144	B. Q< R< P	1
Q.145	C. U	1
Q.146	C. (A) is true but (R) is false	1
Q.147	A. Both (A) and (R) are correct and (R) is the correct explanation of (A)	1
Q.148	A. only P	1
Q.149	B. $:CCl_2$	1
Q.150	(a) 1 mark each for the correct structures as:  Major product  Minor product (b) 0.5 marks each for the following: - The reaction takes place in 3 steps. - In the 1st step, the C3 carbon atom is protonated in preference to C2 to form the more stable carbocation C2. - In the 2nd step, the carbocation undergoes nucleophilic attack by water. - In the third step, deprotonation occurs to give the alcohols shown in (a) as the major and minor products	4
Q.151	(a) The Grignard reagent reacts with the alcohol group on the molecule Y to form the hydrocarbon. (b) 1 mark each for the following:	3

	 1 2	
Q.152	p-nitrophenol is expected to have a higher boiling point than o-nitrophenol. So, Christine has recorded correct data. [1] - o-nitrophenol shows intramolecular hydrogen bonding thus it is expected to have a lower boiling point in comparison to p-nitrophenol. [1] - p-nitrophenol shows extensive intermolecular bonding and so it has a higher boiling point due to the association of the molecules. [1]	3
Q.153	(a) Methanal. *[Give 0.5 marks for the correct answer]* (b) The IUPAC name of the compound obtained from Q is 2-methylpropan-2-ol and from R is 2-Butanol. *[Give 0.5 marks for each correct answer]* (c) Primary alcohol  Tertiary alcohol  *[Give 1 mark for each correct equation]* (d) The first step of the reaction is the nucleophilic addition of Grignard reagent to the carbonyl group to form an adduct. Secondary alcohol formation	5



[Give 0.5 mark for naming the mechanism and 1 mark for the correct equation.]

Q.154

	Benzyl alcohol	Phenol
Hybridisation of the C-atom to which oxygen is attached to	sp^3	sp^2
C-O-H bond angle is 109^0 because	the compounds with sp3 hybridisation have a bond angle of 109°	of the partial double bond character on account of the unshared electron pair of oxygen with the benzene ring

[Give 0.5 marks for each correctly mentioned points]

2

Q.155

(a) D: ethanol

E: phenol

F: diethyl ether

[0.5 marks for each correct answer]

(b) The decreasing order of the C-O bond length is :

Diethyl ether ~ ethanol > phenol. *[1]*

(c)

Compound	D	E	F
percentage of s-character	25%	33%	25%

[0.5 marks for each correct answer]

4

Q.156

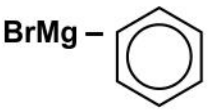
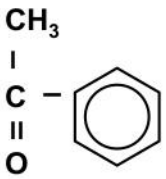
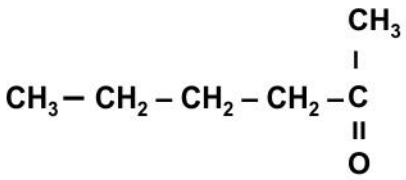
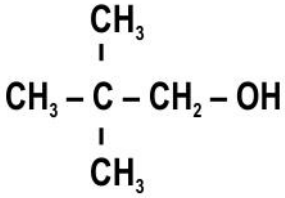
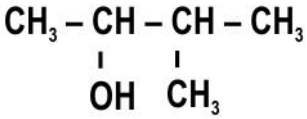
(a) The molecular formulae will be the same, C_3H_8O.

(b) Both the products contain the -OH or alcohol group.

(c) 1 mark each for the following:

- Reaction with water will produce propan-2-ol.

4

	- Reaction with diborane will produce propan-1-ol	
Q.157	This is not a good method for the preparation of n-propyl ethyl ether. The reaction will produce a mixture of three different ethers which would be difficult to separate.	2
Q.158	CH_3- CH_2 - O - CH_2 - CH_3 CH_3- CH_2 - O - CH_2 - CH_2 - CH_3 CH_3- CH_2 - CH_2 - O - CH_2 - CH_2 - CH_3	3
Q.159	(i) 1 mark each for the following: $CH_3-CH_2-CH_2-CH_2-MgBr$  Grignard reagent 1 Grignard reagent 2 (ii) 1 mark each for the following:   Ketone 1 Ketone 2	4
Q.160	 (i)  (ii)	3

	(iii)