Carbon Compounds Chemistry Questions with Solutions

Q1: What is the effect of branching on the boiling point of an alkene?

Answer: As the branching increases, the shape of the alkene molecule approaches the shape of a sphere. In general, a sphere has the least surface area among all other shapes. Hence, the strength of van der waals forces acting in between the alkene molecules will decrease. Again, the boiling point of alkene decreases on branching.

Q2. Why does Benzene undergo electrophilic substitution reactions easily rather than nucleophilic substitution reactions?

Answer: Benzene has 6π electrons rich cloud above and below its plane. This is why Benzene attracts electrophilic species and repels nucleophilic species. As a result, Benzene undergoes electrophilic substitution reactions more easily than nucleophilic substitution reactions.

Q3. What effect does a halogen lay on the electrophilic substitution reaction of Benzenes?

Answer: The presence of a halogen on the benzene ring increases the charge density on ortho and para positions rather than on the meta position. The inductive effect of halogens deactivates the benzene ring.

Q4. The correct order of acidities is:

a. RCOOH > ROH > HOH > HC≡CH
b. RCOOH > HC≡CH > HOH > ROH
c. RCOOH > HOH > HC≡CH > ROH
d. RCOOH > HOH > ROH > HC≡CH

Answer: (d.)

Explanation: Carboxylic acids are most acidic among the carbon compounds.
Acidity of water is determined by its reaction with sodium alkoxide that gives alcohols as one of the products. This indicates that H_2O is more acidic than alcohol as only a stronger acid can displace a weaker acid from its salt. The reaction for the same is given below.

$$RONa + H_2O \rightarrow ROH + NaOH$$

Hence, water is a stronger acid and alcohol is a weak acid.
Both water and alcohol form acetylene upon reaction with sodium acetylide. Hence, both water and alcohol are more acidic than acetylene.

$$HC{\equiv}C^-Na^+ + HOH \rightarrow HC{\equiv}CH + NaOH$$
$$HC{\equiv}C^-Na^+ + ROH \rightarrow HC{\equiv}CH + RONa$$

Q5. What is the Peroxide effect? Why is it observed only in HBr?

Answer: According to the Markovnikov rule, the negative part of the adding species adds to that carbon in the double bond which has a lesser number of hydrogens.
In case of peroxides, such as benzoyl peroxide [$(C_6H_5COO)_2$], the addition of HBr occurs contrary to the Markovnikov's rule as:

$$CH_3CH = CH_2 + HBr \xrightarrow[Anti-Mark.Addn.]{(C_6H_5COO)_2,\ \Delta} CH_3CH_2 - CH_2Br$$

This contrary behaviour of HBr in the presence of a peroxide is called the Peroxide effect.
This effect is observed only with HBr because the reaction remains exothermic during all the steps of the free-radical mechanism of HBr's addition to an alkene in the presence of a peroxide.

Q6. Pick the false statement.

a. Single bonds are more easily broken than double bonds.
b. Double bonds are more easily broken than triple bonds.
c. Triple bonds are more easily broken than double bonds.
d. The bonds formed in the endothermic reactions are weaker than the bonds broken.

Answer: (c.)

Explanation: Triple bonds are stronger than double bonds. Hence, triple bonds cannot be more easily broken than double bonds.

Q7. Complete the following reaction and name it.

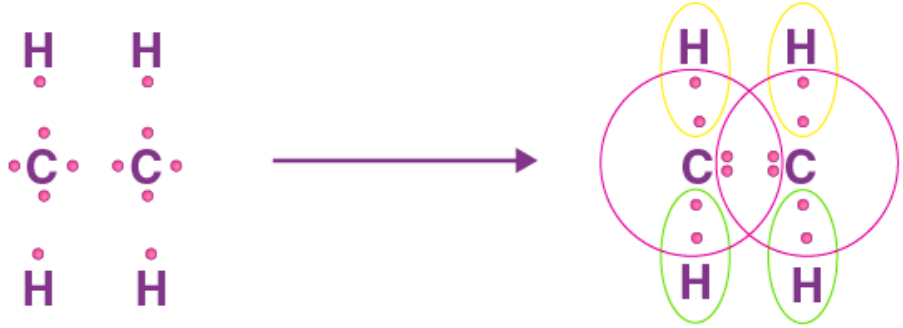
$$CH_3CH_2OH \xrightarrow[\Delta]{conc.\ H_2SO_4}$$

Answer: The reaction is the Dehydration of alcohols by concentrated sulphuric acid at 170-80 °C to form respective alkenes.
The complete reaction is:

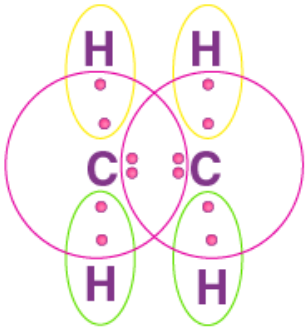
$$CH_3CH_2OH \xrightarrow[\Delta]{conc.\ H_2SO_4} CH_2 = CH_2 + H_2O$$

Q8. Draw the electron dot structure of ethene.

Answer: The molecular formula of ethene is C_2H_4. The total number of valence electrons in ethene is 12. According to the rule, the most electropositive element is kept at the centre and the halogens or hydrogen (with only 1 valency) are placed at terminal positions.
In the above case, both the carbon, the most electropositive elements (other than hydrogen as the hydrogen's position is fixed at the terminals) in the chemical formula of ethene, are placed side-to-side at the centre of the molecule. Hydrogens are placed at the sides of carbon. Now all elements are given their respective valence electrons and hence bonded with a single bond and the lone pairs of electrons are given to the element with an unsatisfied octet.



The lone pairs are converted into double bonds between the 2 C-atoms to complete their octet. Hence, the Lewis-dot structure of ethene is:



Q9. Explain why the air holes of a gas burner need to be cleaned when the heated vessels on the stove get blackened by the flame.

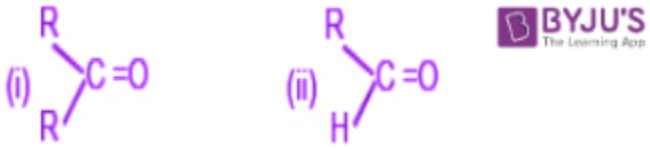
Answer: The vessel's blackening occurs due to the generation of soot which sticks to the bottom of the vessel as it is heated. The soot majorly consists of tiny black carbon particles. Whenever the burner's holes get blocked, the fuel undergoes incomplete combustion resulting in the formation of soot. Hence, the air holes of a gas burner need to be cleaned when the heated vessels on the stove get blackened by the flame.

Q10. Write a balanced chemical reaction between vinegar and baking soda.

Answer: The reaction between vinegar (acetic acid) and baking soda (sodium bicarbonate) is given below:

$$CH_3COOH + NaHCO_3 \rightarrow CO_2 + H_2O + CH_3COONa$$

Q11. Write the names of the following functional groups.



Answer: The given functional groups are:
(i) Two alkyl groups connected on either side of a carbonyl (C=O) carbon indicate that the functional group is a ketone.
(ii) An alkyl group and a hydrogen atom are connected on each side of the carbonyl carbon. This is an alcohol functional group.

Q12. How can you distinguish between ethanol and ethanoic acid?

Answer: By adding either sodium carbonate or sodium bicarbonate separately in the two solutions, we can distinguish between an alcoholic and an acidic solution like ethanol and ethanoic acid.
One of the solutions will show brisk effervescence of the CO_2 gas produced as a result of the reaction; while the other will not. The solution that gives brisk effervescence of the CO_2 gas is the ethanoic acid solution and the solution which does not give brisk effervescence of the CO_2 gas is ethanol. This happens because ethanol does not react with either sodium carbonate or sodium bicarbonate.

Q13. Why does carbon majorly form covalent bonds?

Answer: This is because carbon has 4 valence electrons. To complete its octet, carbon has to either gain 4 more electrons or lose the 4 valence electrons. Both of these cases are not possible with carbon, since losing 4 electrons will require very high energy and to gain and hold 4 more electrons, carbon does not have enough nuclear charge. Hence, as a result, carbon forms a bond by sharing its valence electrons in order to complete its octet by sharing. Thus, carbon majorly forms covalent bonds.

Q14. What happens when a tiny piece of Na-metal is dropped into alcohol?

Answer: Na starts reacting vigorously with alcohol forming bubbles of H_2 gas. The reaction for the same is:
$2CH_3CH_2OH + Na \rightarrow CH_3CH_2ONa + H_2$

Q15. A student accidentally spills dilute sulphuric acid solution on his lab coat and the lab coat gets tattered. What does this indicate about the property of sulphuric acid?

Answer: This indicates that sulphuric acid is very acidic and burns substances that may come in contact with it. In such a case, if the acid comes in contact directly with the skin, it should be washed properly and some basic sodium bicarbonate solution must be applied on the affected area.

Practise Questions on Carbon Compounds

Q1. Suggest a Lewis acid except for anhydrous aluminium chloride that can be used for ethylation of Benzene.

Answer: During ethylation, an ethyl group is introduced on the surface of the benzene ring. This can be done by Friedel Crafts reaction of benzene. And the Lewis acid that can be used (except anhyd. $AlCl_3$) are $FeCl_3$, BF_3, $SnCl_4$, and so on.

Q2. Why is the Wurtz reaction not considered for preparation of alkanes containing an odd number of carbon atoms?

Answer: The Wurtz reaction produces an alkane with double the number of carbon atoms initially present in the alkyl halide participating in the reaction. In case of mixed alkyl halides, a mixture of alkanes is obtained which cannot be isolated from one another even by using distillation as a process. Hence, Wurts reaction is not considered for preparation of alkanes containing an odd number of carbon atoms.

$$CH_3Br + CH_3CH_2Br + 2Na \rightarrow CH_3CH_3 + CH_3CH_2CH_2CH_3 + CH_3CH_2CH_3$$

Q3. What are the main constituents of LPG?

Answer: Butane and isobutane.

Q4. How can a mixture of ethane, ethylene and acetylene be separated from each other?

Answer: These can be separated by the following reactions:

1. The mixture of these gases is passed through Tollen's reagent. Tollen's reagent reacts only with the acetylene and the other two gases remain unaffected and pass as it is.
   $$HC\equiv CH + 2[Ag(NH_3)_2]^+OH^- \rightarrow AgC\equiv CAg \text{ (white solid)} + 4NH_3 + 2H_2O$$
   The white precipitate thus formed can be treated with dilute nitric acid to re-obtain acetylene.
2. The remaining mixture of ethane and ethylene is passed through cold concentrated sulphuric acid. H_2SO_4 absorbs ethylene forming ethyl hydrogen sulphate.
   $$CH_2=CH_2 + H_2SO_4 \text{ (conc.)} \rightarrow CH_3CH_2OSO_2OH$$
   The ethyl hydrogen sulphate can be heated with H_2SO_4 to obtain ethylene.
   Ethane passes out from the solution as it is and can be collected in a separate container.

Q5. What is the product of the reaction between Benzene and chlorine in the presence of UV light?

Answer: Upon reaction with chlorine in the presence of UV light, Benzene forms benzene hexachloride.

$$C_6H_6 + Cl_2 \xrightarrow[light]{UV} C_6H_6Cl_6$$

The IUPAC name for this product is 1,2,3,4,5,6-hexachlorocyclohexane.