EXERCISE

Q1. Select the right answer from the choices given with each question.

1) The molecule of ethane possesses which hybridization.

a) Sp^3 b) Sp^2

c) Sp d) Sp^2d

2) The Sp^3 hybrid orbitals are oriented in space at one angle.

a) 109.5^0 b) 180^0

c) 100^0 d) 120^o

3) The geometry of acetylene is,

a) angular b) bent

c) triangular d) linear

4) Which reaction is used as test for the presence of alkane;

a) reaction of cold diluted alkaline KMn04 b) combustion

c) polymerization d) catalytic hydrogenation

5) The general formula of alkane is

a) CnH2n42 b) CnHn

c) CnH2n d) CnH2n-2

6) Soda lime is:

a) NaOH b) KOH

c) Mixture of Na & Ca hydroxide d) CaO and NaOH

7) The marsh gas is:

a) Ethane b) Methane

c) Propane d) Butane

8) Acidic hydrogen is present:

a) Acetylene b) Ethane

c) Benzene d) Ethene

9) The benzene molecule contains:

a) three double bonds b) two double bonds

c) one double bond d) delocalized

10) The electrophile in aromatic sulphonation is:

a) H_2SO_4 b) HSO_4

c) S03 d) SO-4

11) The conversion of n — hexane into benzene by heating in the presence of pt is called:

a) isomerization b) aromatization

c) dealkylation d) rearrangement

12) Catalyst used for Friedel Craft's reaction is:

a) HNO_3 b) $AlCl_3$

c) $BeCl_3$ d) NaCl

13) Benzene cannot undergo:

a) Elimination b) Substitution

c) Oxidation d) Addition

14) Shape of benzene molecule is:

a) pyramidal b) linear planer

c) trigonal d) hexagonal planer

15) In which one of the following compounds the benzene ring is isolated:

a) Naphthalene b) Anthracene

c) Phenanthrene d) Diphenyl methane

16) Two compounds have the Same composition and also have the same atoms attached to the same atoms, although with different orientations in space. These compounds are:

a) Identical b) position isomer

c) structural d) stereoisomerism

17) The isomers of a substance must have:

a) same chemical properties b) same molecular weight

c) same structural formula d) same functional groups

18) Ethanol and dimethyl ether are best considered.

a) structural isomers b) stereoisomers

c) enantiomers d) Diastregronus

19) Alkanes show geo-metrical isomers due to:

a) Asymmetry b) Rotation around a single bond

c)Resonance d) Restricted rotation around a double bond

20) A molecule is said to be chiral:

a) If is contains plane of symmetry

b) If it contains center of symmetry

c) If it cannot be superimposed to its mirror image

d) If it can be superimposed on its mirror image

21) Geometrical isomerism is shown by:

a) Lactic acid b) maleic acid

c) I – butene d) 1, 1 dichotomy ionic

22) Which of the following statements is false regarding compound?

a) rotate the plane of polarized light b) have cis and trans isomers

c) exist as enantiomers d) can be detected with a polarimeter

23) An optically active compound:

a) must contain at least four carbon

b) when in soluble rotate the plane of polarized light

c) must always contains an asymmetric carbon atom

d) in solution always give a negative reading in polarimeter

24) Plane polarized light is affected by:

a) identical molecules b) all polymers

c) chiral molecule d) all biomolecules

25) It is possible to distinguish between optical isomers.

a) by using chemical tests b) by mass spectrometry

c) by I R spectroscope d) by polarimetry

Answer

1)	a)	2)	a)	3)	d)	4)	a)	5)	a)
6)	d)	7)	b)	8)	a)	9)	a)	10)	c)
11)	b)	12)	b)	13)	a)	14)	d)	15)	d)
16)	d)	17)	b)	18)	a)	19)	b)	20)	c)

21)	b)	22)	b)	23)	d)	24)	c)	25)	d)

Q2. Give short answers of the following questions.

Q1. Why carbon is sp^3 hybridized in the compounds?

Answer

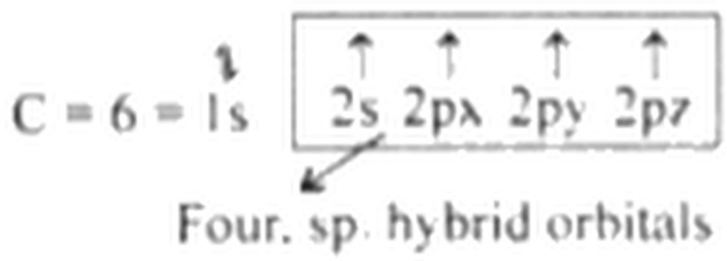
The electronic configuration of c in ground state is

C = 6 - 1s 2s 2px 2py 2pz and in excited state, it is

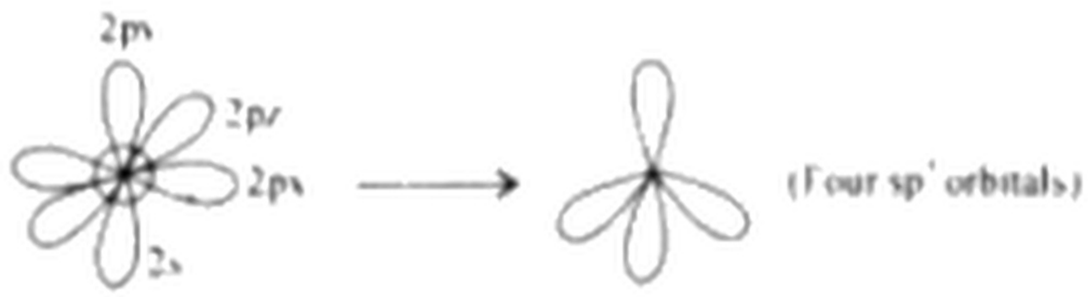
C = 6 = 1s 2s 2px 2py 2pz

In alkanes and in single bonded carbon compounds every carbon atom in its second shell i.e in 2s, 2p. 2py, 2pz contains one unpaired electron in each orbital when hydrogen atoms or other atoms which one more than carbon atoms surrounds the central atom these four orbitals of 2nd shell mix with each other and produce four equal energy sp3 orbitals. These orbitals stay at equal positions and form tetrahedral shaped compounds.

i.e.



or



Q2. How is pi-bond formed in alkenes and alkynes?

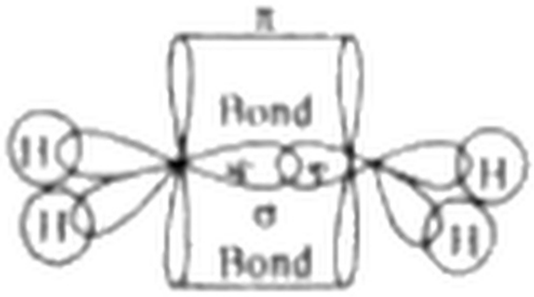
Answer

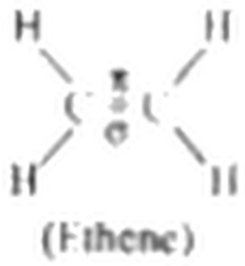
In alkenes one s and two p-orbitals mix and produce there sp2 hybridized orbitals — leaving one p — orbital unhybridized two such atoms having one unhybridized p-orbital when some closer to each other two sp2 orbitals of two carbon atoms overlap each other and form a sigma bond. Then unhybridized two p — orbitals of two carbon atom overlap over each other and form a pi-bond.

i.e in ground state C = 6 = ⇅ 1s ⇅ 2s ↑ 2px ↑ 2py ↑ 2pz

In excited state C = 6 = ⇅ 1s | ↑ 2s ↑ 2px ↑ 2py | ↑ 2pz

Three sp^2





In alkynes

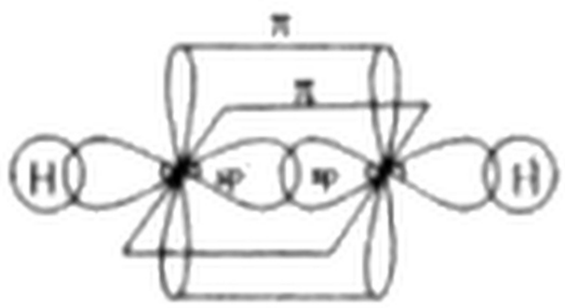
In alkynes in 2nd — shell of carbon (initsexted — state) one exited atom mixes with one — p orbital and produce two sp hybridized orbitals leaving two p — orbitals unhybridized in each carbon. When these two carbon atoms come closer to each other sp of one atom overlaps on sp of other atom and there is formed one — sigma bond than two p- orbitals of one atom overlap on two p-orbitals other carbon atom and form two pi-bonds. As a result an alkyne is formed. For example, ethyne (C2 H2)

i.e in ground state

i.e in ground state $C = 6 = \underset{\uparrow\downarrow}{1s}\ \underset{\uparrow\downarrow}{2s}\ \underset{\uparrow}{2px}\ \underset{\uparrow}{2py}\ \underset{}{2pz}$

and in excited state $C = 6 = \underset{\uparrow}{1s}\ \boxed{\underset{\uparrow}{2s}\ \underset{\uparrow}{2px}}\ \underset{\uparrow}{2py}\ \underset{\uparrow}{2pz}$

Two sp



$H - C \equiv C - H$

(one σ and two π - bonds)

Q3. What is cis-trans isomerism?

Answer

Please see answer of Q42 of chapter notes.

Q4. Why alkanes are relatively chemically inert?

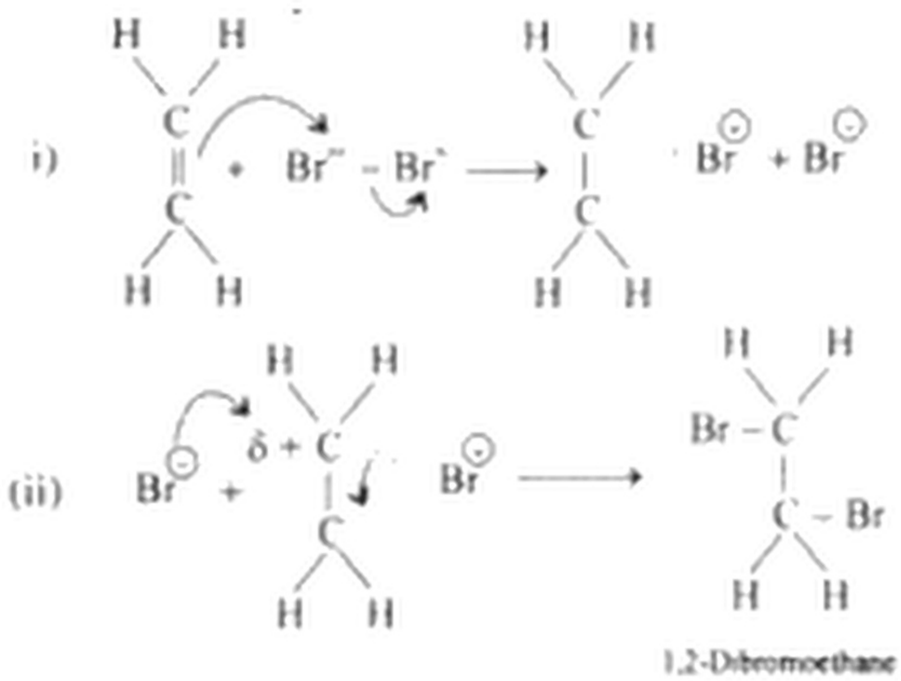
Answer

In alkanes there is sp^3 orbital hybridization in each carbon. One sp3 orbital of when overlaps on sp^3 orbitals of adjacent atom there is formed a very strong sigma bond of very low energy such a sigma bond is very strong and may only be decomposed at very high energy. That is why alkanes one very stable and least reactive at room temperature.

Q5. Alkenes usually undergo addition reactions while alkanes do not why?

Answer

In alkenes there is one exposed pi-bond which is very reactive. Because this exposed pi-bond may attack at positive or partial positive charge of an electrophile



Whereas in alkanes there are strong low energy sigma bonds which are nearly inert and do not take part in any reactions easily.

Q6. What is stereoisomerism?

Answer

Please see answer of short questions of Q44 (b) of chapter notes.

Q7. How optical isomers arise?

Answer

Please see answer of short questions of Q44 (d) of chapter notes.

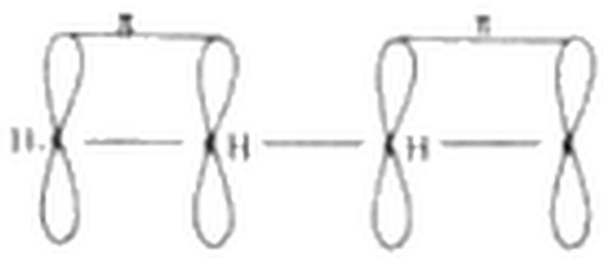
Q8. How are conjugated bonds formed?

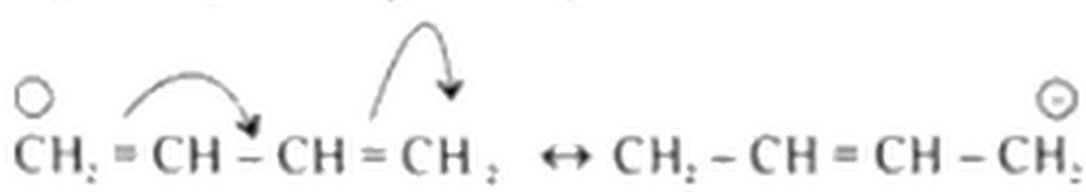
Answer

In a molecule in which there are left unhybridized p — orbitals on adjacent at least three c — atoms the molecule is called a conjugated molecule. These adjacent p — orbitals are responsible for resonance.

For example; 1,3-Butadiene

O = C – atoms





Q9. Why alkenes are more reactive than alkynes?

Answer

In alkenes there is one pi-bond which is exposed and may attack at any positive or partial positive charge therefore very reactive.

Whereas i alkynes there are two pi-bonds which form a new cylindrical shaped orbital which is lesser reactive as compared to alkenes.

Q10. Justify the given order of reactivity?

Answer

Alkenes have exposed pi-bond which may attack at any electrophilic center. Therefore, it is most reactive.

In alkynes there are two pi-bonds around one sigma bond these two pi-bonds form a cylindrical shaped orbital which is stable and lesser reactive.

Whereas in alkanes there are c — c very stable low energy sigma — bonds which are least reactive.

Q11. What is meant by dehydration?

Answer

Dehydration means removal of water dehydration of alcohols is a temperature dependent reaction which gives different products

For Example

$$2CH_3 - CH_2 - OH \xrightarrow[H_2SO_4]{140^0C} CH_3 - CH_1 - O - CH_2 - CH_3 + H_2O$$

(Ethen)

$$2CH_3 - CH_2 \xrightarrow[H_2SO_4]{180^0C} CH_2 = CH_2 + H_2O$$

OH (Alekene)

Q12. What are polymerization reactions?

Answer

(Poly = more than one f meros = pieces)

Attachment of large number of small molecules to give a bigger molecule is called polymerization type of product of a polymerization of alkenes and alkynes depend upon the condition of the reaction like temperature, pressure and catalyst.

For Example

$$3H-C\equiv C-H \xrightarrow[300\ ^\circ C]{Cu\text{ - Tube}} \text{Benzene}$$

$$3H-C\equiv C-H \xrightarrow[Cu_2Cl_2]{NH_4Cl} CH_2=CH-C\equiv C-CH=CH_2$$

Divinyl Acetylene

$$4H-C\equiv C-H \xrightarrow[\text{Nickel carbonyl}]{Ni(CO)_4} \text{(Cyclooctatetraene)}$$

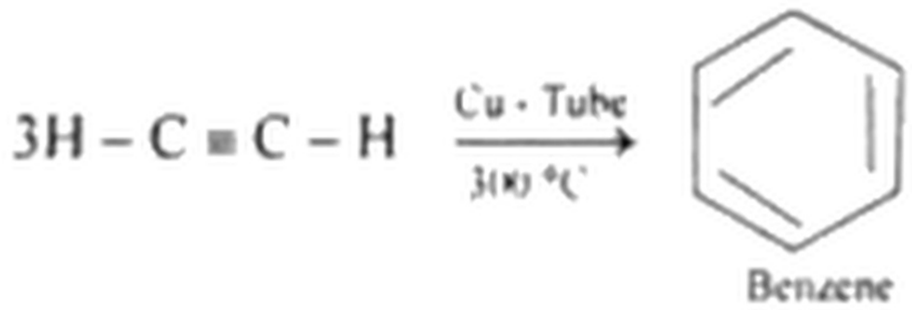
$$n\ CH_2=CH_2 \xrightarrow[0.1-0.2\%O_2]{\substack{250\ ^\circ C\\ 450\ atm}} (CH_2-CH_2)_n$$

(traces $g(O_2)$) Polythene

Q13. How will you convert acetylene into benzene?

Answer

Conversion of acetylene into benzene

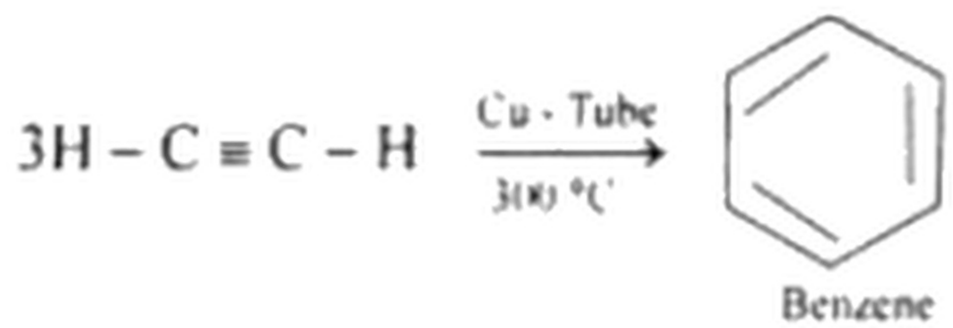


Q14.What is resonance?

Answer

Shifting of pi-electrons from one position to another position is called resonance.

For example: In I, 3 — butadiene



Q15. What is resonance energy?

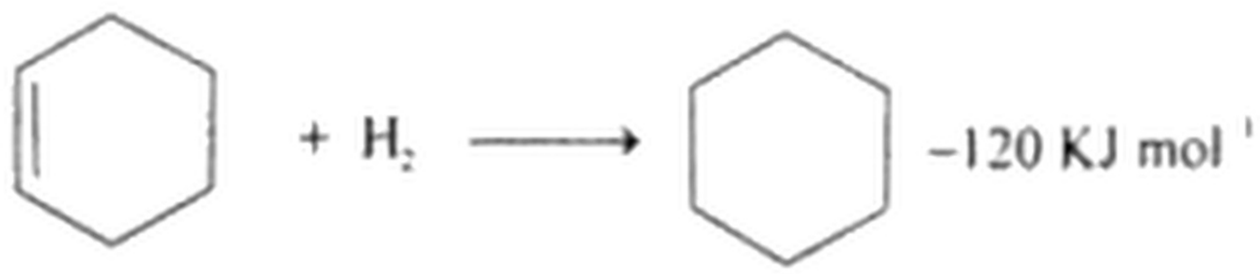
Answer

Resonance Energy

On hydrogenation of a conjugated molecule the difference between obtained actual energy and expected energy is called resonance energy.

For Example: heat of hydrogenation of cyclohexene is — 120 KJ mole-

i.e.



Now, of we consider benzene as cyclohexatriene, and calculate expected energy.

Expected Energy = -360

But actual obtained energy = -208

Difference of Energy (Resonance Energy) = -152

The difference of these two energies i.e. — 152KJ mole-l is called resonance energy.

Q3. Give detail answers of the following questions.

Q1. What is isomerism? Explain different types of isomerism?

Answer

Please see answer of question 38 and 39 of this chapter.

Q2a) How will you prepare 1 — butane from?

i) An alkylhalide **ii) Alcohols**

iii) Electrolysis of salt **iv) Vic - dihalides**

b) What products is formed when n-propane undergo following reactions?

i) Combustion **ii) Nitration**

Answer a)

i) Preparation of l — butane from alkyl halide

$CH_2 - CH_2 - CH_2 - CH_3 + KOH \rightarrow CH_2 = CH - CH - CH_2 - CH_3 + Kbr + H_2O$

|

Br

1 — butene from an alcohol

$$CH_2 - CH_2 - CH_2 - CH_3 \xrightarrow{75\%\ H_2SO_4} CH_2 = CH - CH - CH_2 - CH_3 + H_2O$$

| 175^0C

OH

iii) 1 — butene from Electrolysis of salt

$$CH2 - COONa \qquad CH_2$$

$$| \quad +2HO \xrightarrow{Elec} ||$$

$$CH - COONa \qquad CH + 2NaOH$$

$$| \qquad |$$

$$CH_2 \qquad CH_2 + 2CO_2$$

$$| \qquad |$$

$$CH_3 \qquad CH_3 + H_2$$

iv) 1 — butane from vic — dihalide

$$CH_2 - CH_2 - CH_3 - CH_3$$

$$| \quad | \quad +2KOH \rightarrow CH_2 = CH - CH_2 - CH_3$$

C C (alc)

+2KCL

$+2H_2O$

Answer b)

i — Combustion of n — propane

$$CH_3 - CH_2 - CH_3 + HNO_3 \xrightarrow{H_2SO_4}$$

$CH_3 - CH_2 - CH_2 - NO_2$

$+CH_3 - CH_2 - NO_2$

$+CH_3 - NO_2 + H_2O$

These all are possible products present as mixture

Q3.a) When ethane reacts with C12 in UV light the mixture of products is formed. Give the detail of reaction with mechanism and all types of products.

b) A compound when treated with Zn in methanol, the alkene is formed. When alkene is ozonolysed the acetaldehyde is formed as the major products. Explain reactions, give name and structure of the compound.

Answer a)

Reactions of ethane with Cl_2 in presence of UV light

$$CH_3 - CH_2 - Cl \xrightarrow{UV} CH_3 - CH_2$$

|

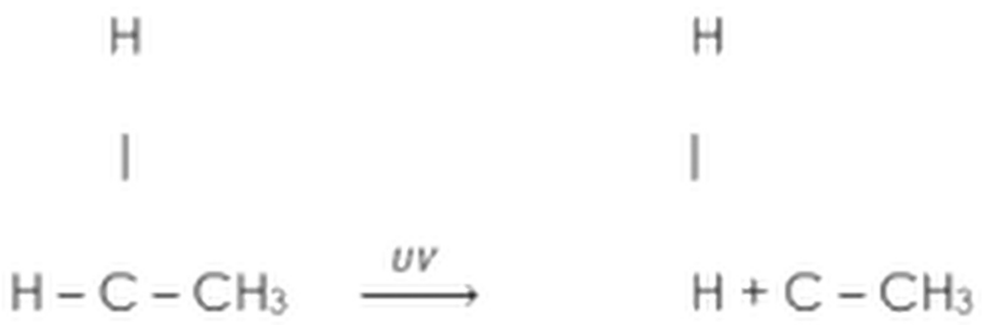
Cl

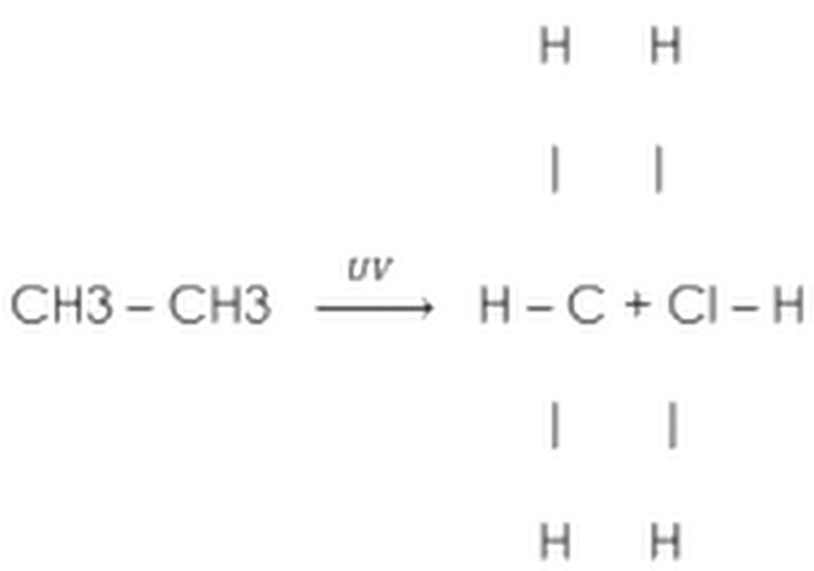
$+CH3 - Cl$

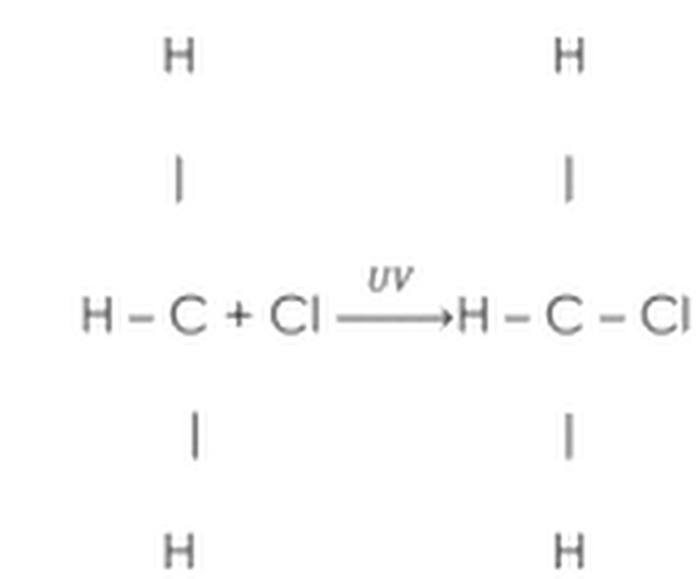
$+ HCl$

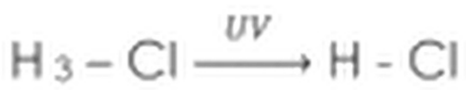
Reaction Mechanism

$$Cl - Cl \xrightarrow{UV} \qquad Cl - Cl$$

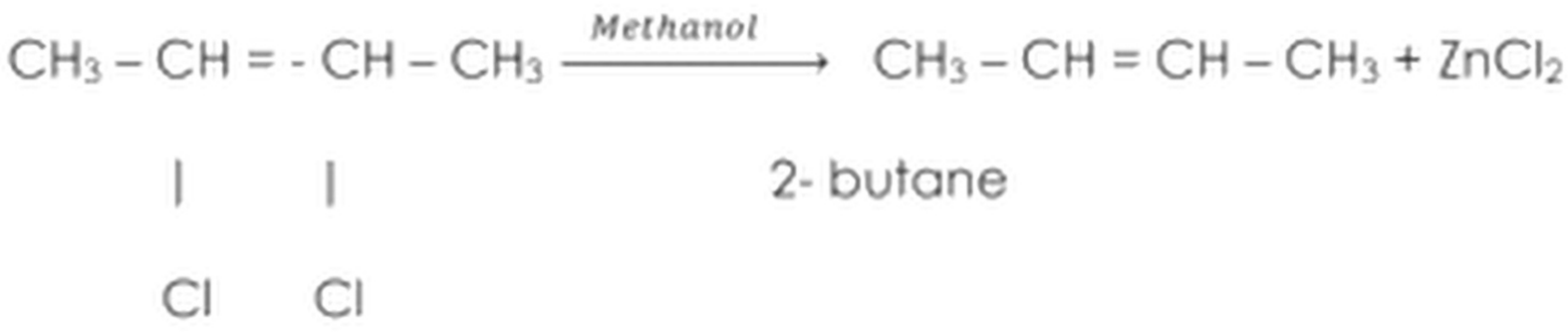




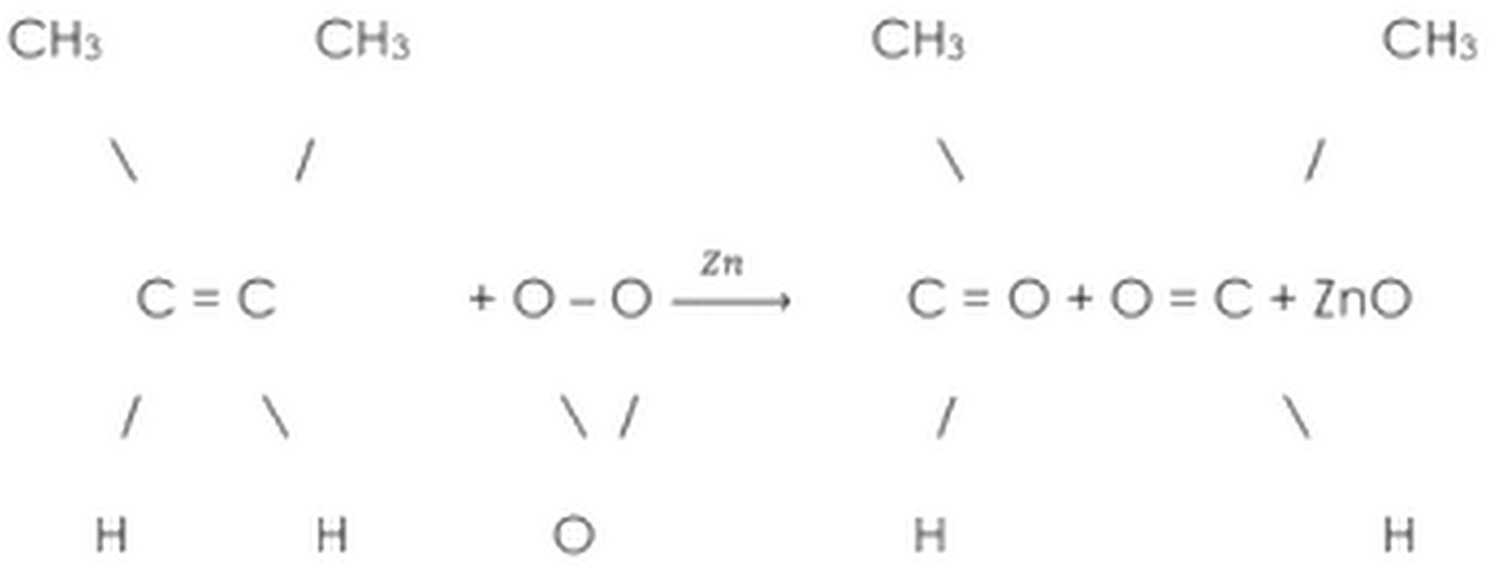




Answer b)



2,3 – dechlorobutane



Q4.a) How will you prove that benzene has cyclic structure?

b) Explain the structure of benzene according to atomic orbital structure.

Answer

a) Please see answer of question 69 and of this chapter.

b) Please see answer of question 79 and of this chapter,

Q5. Explain Friedel Craft acylation and alkylation with complete mechanism.

Answer

For Friedel Craft acylation please see answer of Q80 of this chapter.

For Friedel Craft alkylation please see answer ofQ79 of this chapter.

Q6. Explain the following electrophilic substitution reactions of benzene with mechanism.

i) Halogenation ii) Nitration iii) Sulphonation

Answer

I) Halogenation

Please see answer of question 73 of this chapter.

II) Nitration

Please see answer of question 76 of this chapter.

III) Sulphonation

Please see answer of question 77 of this chapter.

Q7. Write the structural formulas for the following benzene derivatives:

a) 2, 4, 6 — trinitrophenol

b) 1, 4 — dichlorobenzene

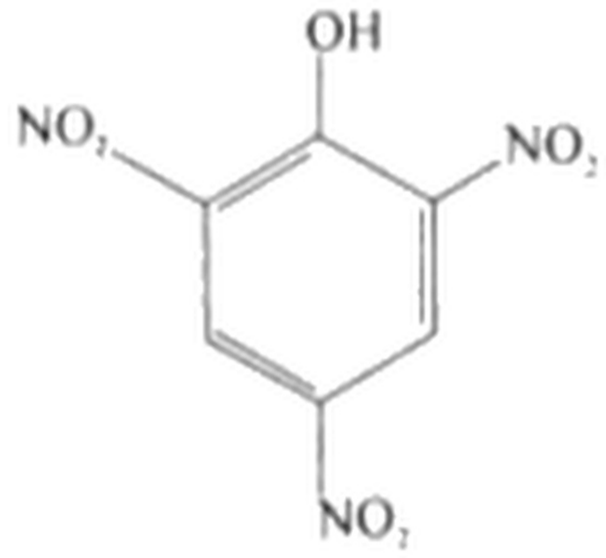
c) 2 — methylbenzene sulphonic acid

d) 2 — hydroxybenzoic acid

f) 2 — chlorophenylamine

Answer

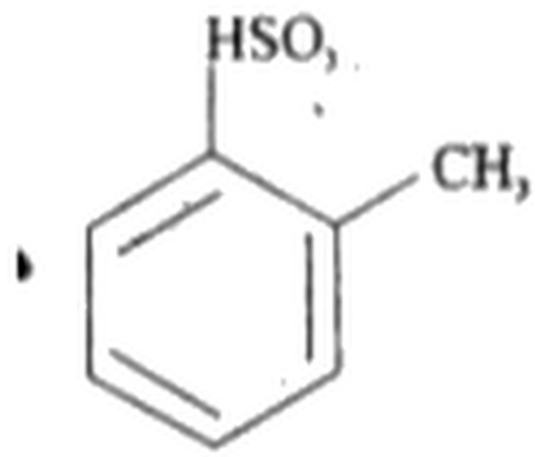
a) 2, 4, 6 – trinitriphenol



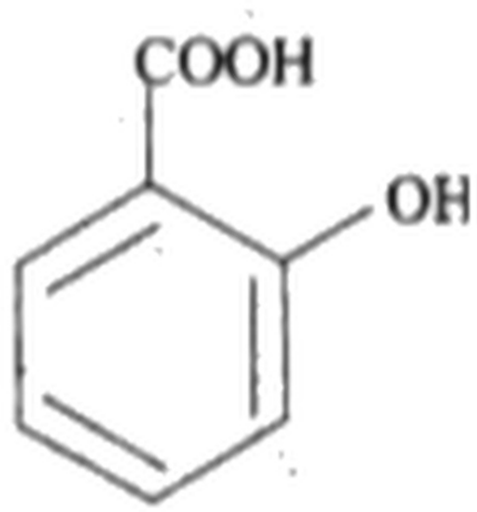
b) 1, 4 – dichlorobenzene

c) 4 – nitrophenylamine

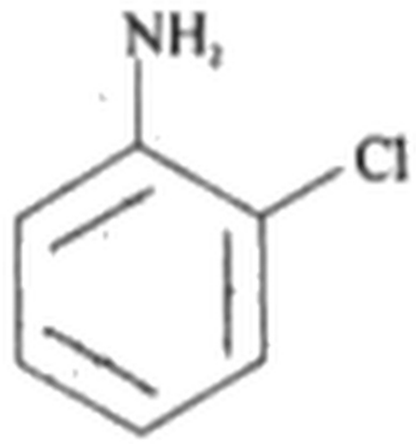
d) 2 — methyl benzene sulphuric acid



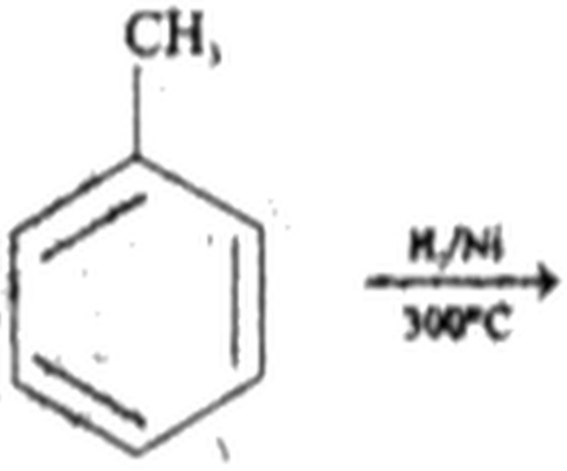
e) 2 – hydroxybenzoic acid

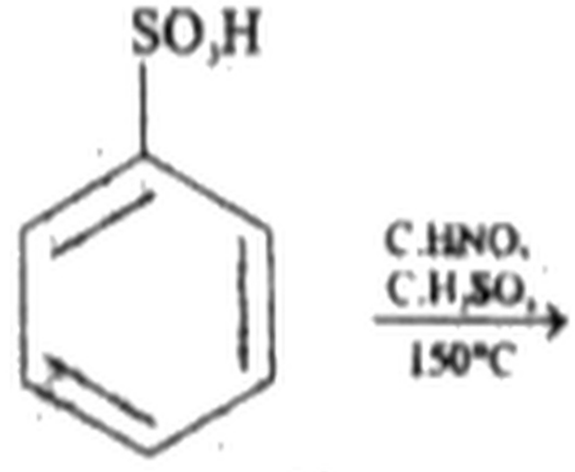


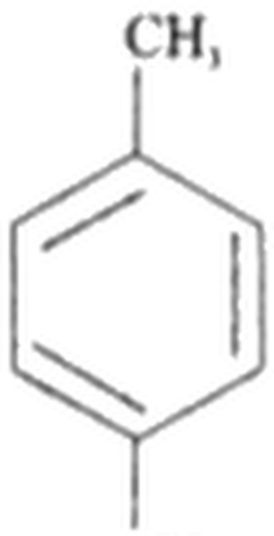
f) 2 – chlorophenylamine

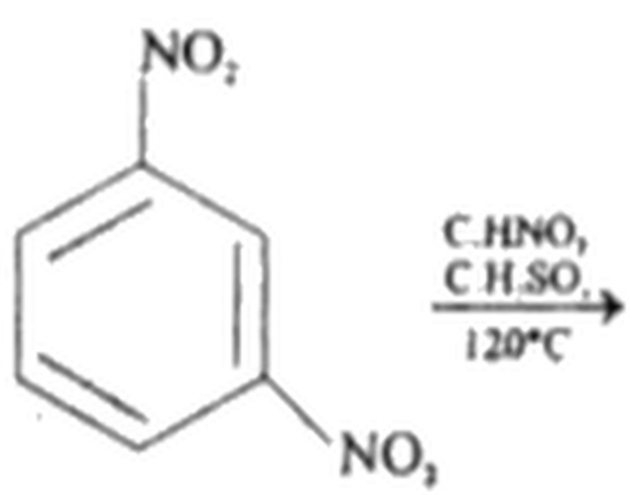


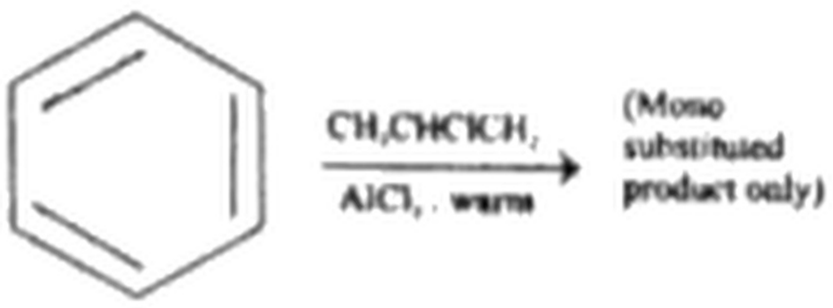
Q8. Predict the major products of the following reactions.

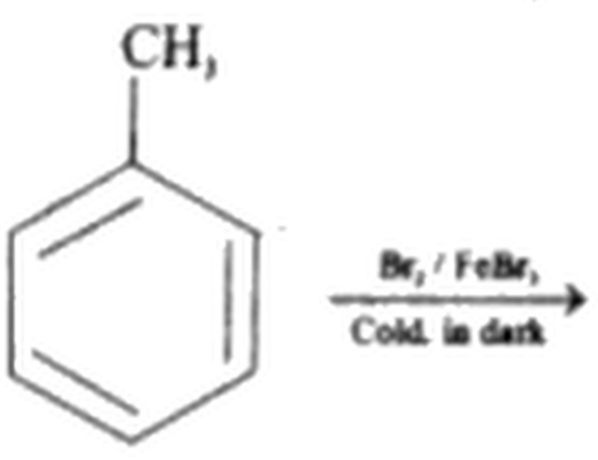
a) 

b) 

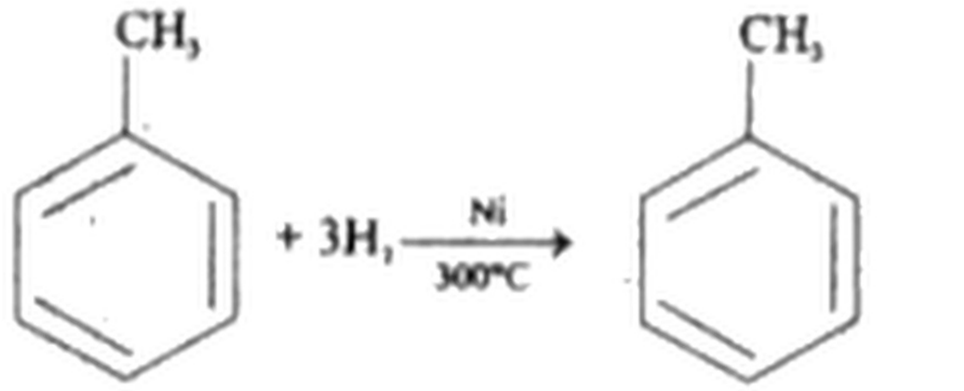
c) 

d) 

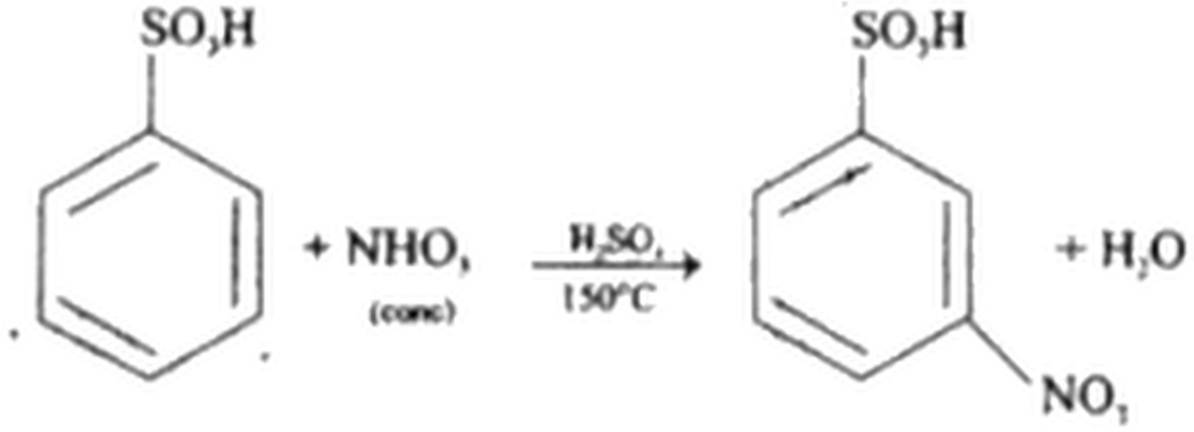
e) 

f) 

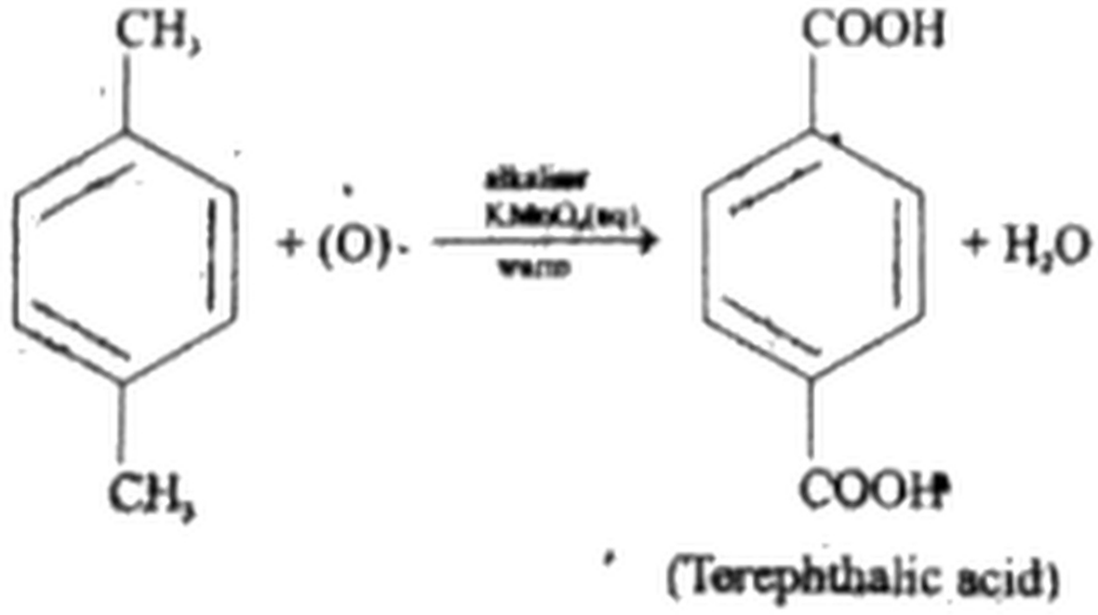
Answers

a) 

Toluene Methylcyclohexane

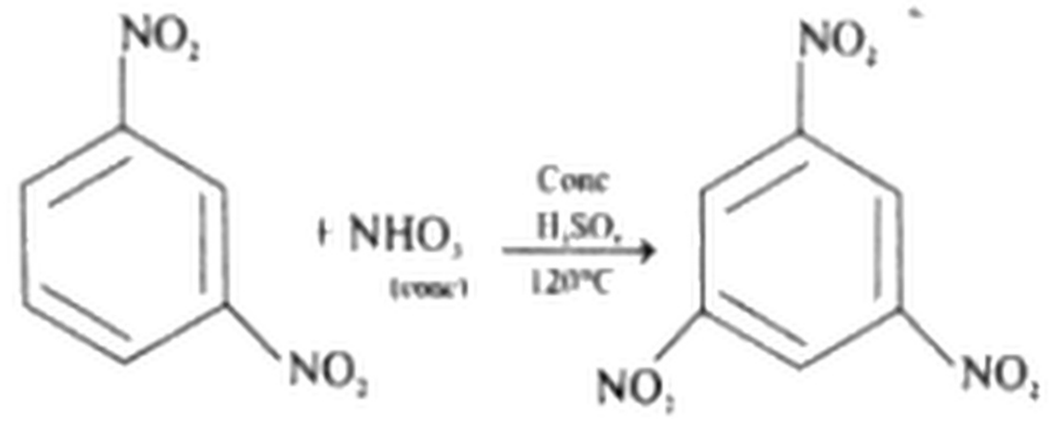
b) 

(m - nitro sulphonic benzene)

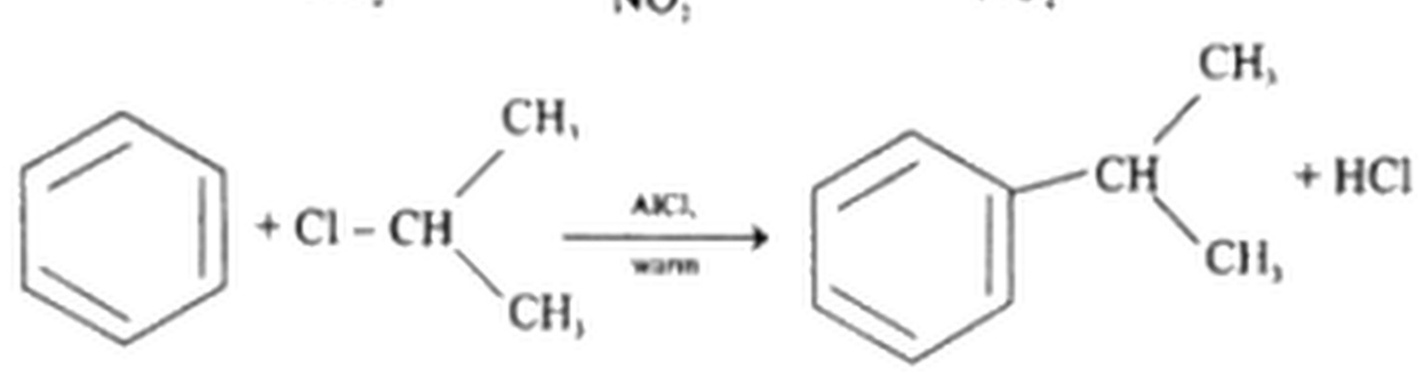
c) 

(Terephthalic acid)

d)

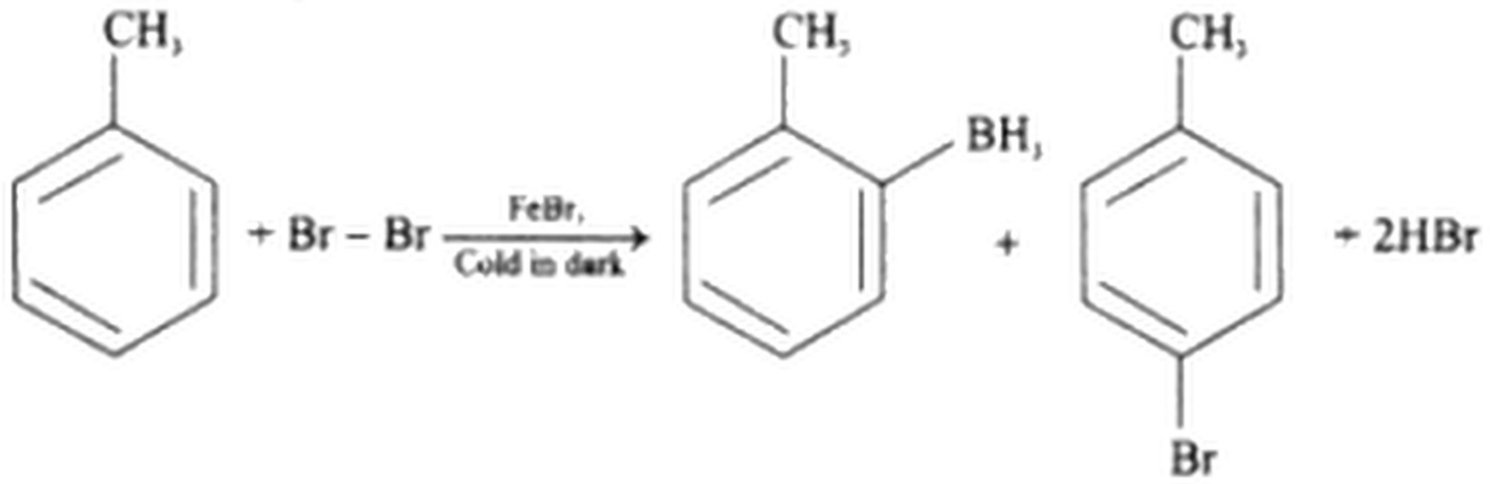


e)



Propane Isoprophyl benzene

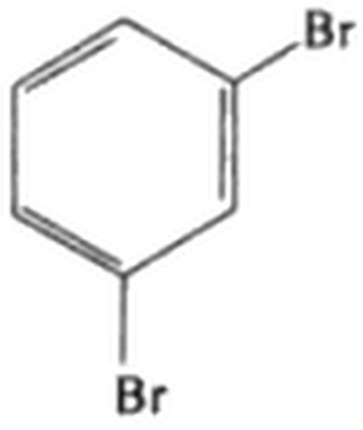
f)



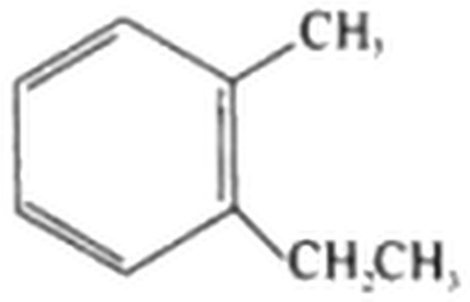
0 - bromo toluene P - bromo toluene

Q9. Name the following benzene derivatives.

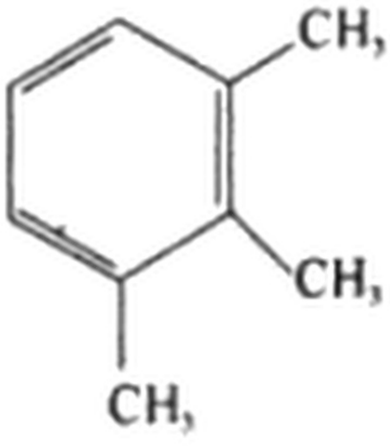
a)



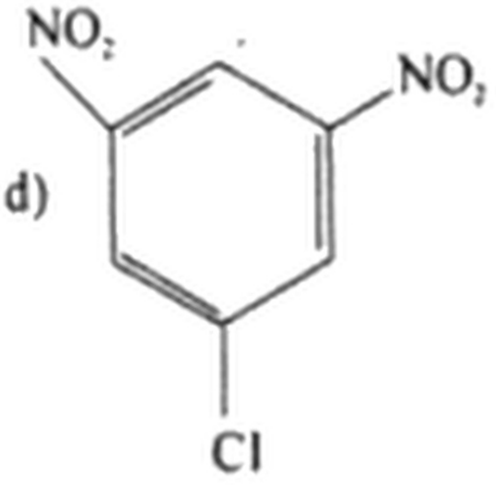
b)

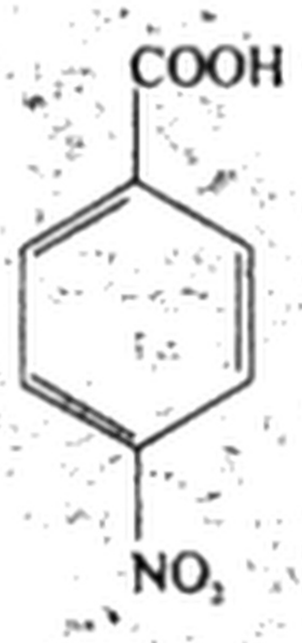


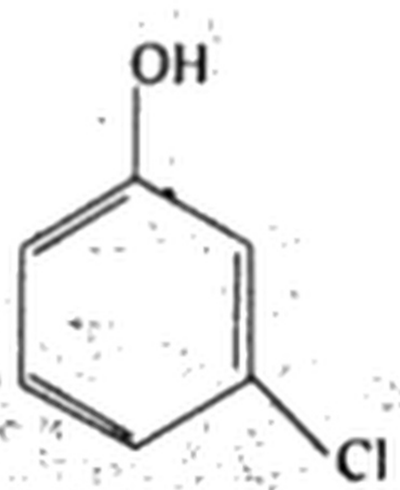
c)



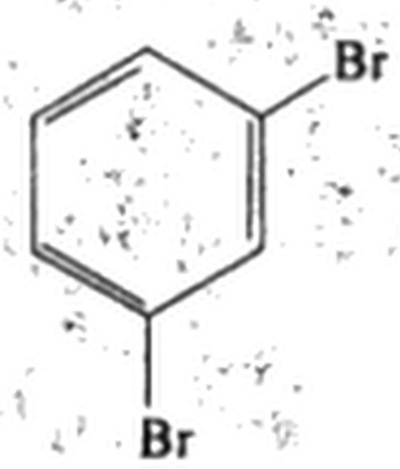
d)



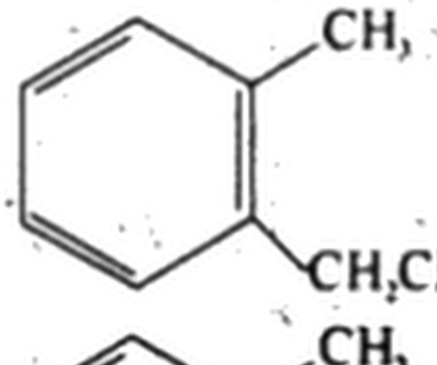
e) 

f) 

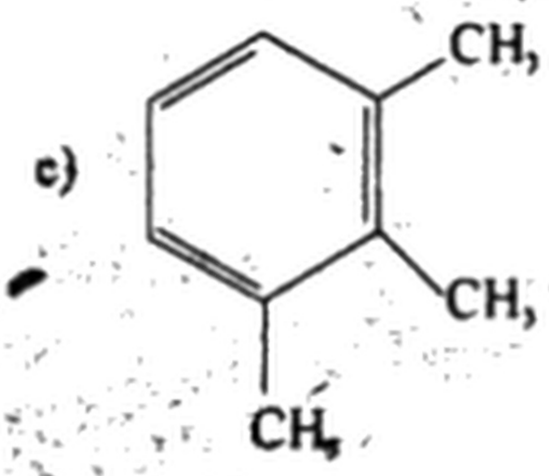
Answer

a) 

1, 3 – dibromobenzene

b) 

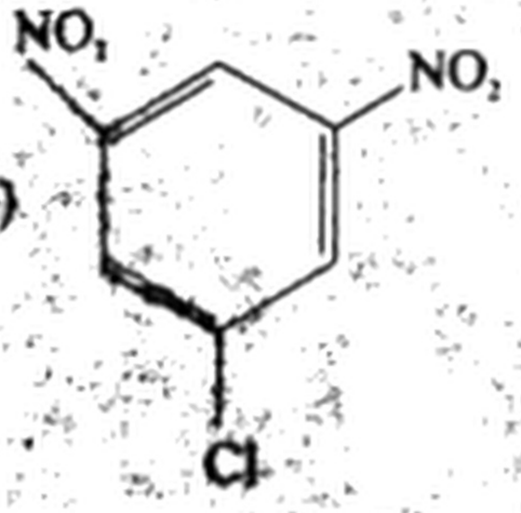
2 – ethyltoluene

c) 

1, 2, 3 – trimethyl benzene

Or

2, 3 – dimethyl toluene

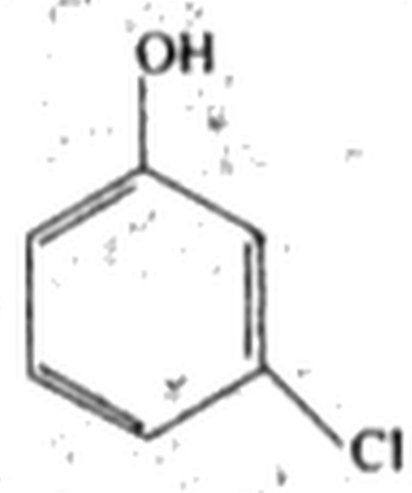
d) 

5 – bromo – 3 – chloronitrobenzene

e)

3 – nitrobenzoic acid

f)



Meta – chlorophenol