



CHEMISTRY

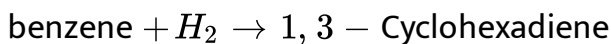
BOOKS - R SHARMA CHEMISTRY (HINGLISH)

AROMATIC HYDROCARBONS

Examples

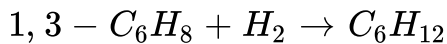
1. Calculate $\Delta_h H^\ominus$ for the addition of 1 mol of H_2 to (i) benzene (C_6H_6) and (ii) 1,3-cyclohexadiene (C_6H_8) from frigure.

Strategy (i): Target is to find $\Delta_h H^\ominus$ of the following reaction



Thus, look for the data involving these two compound.

strategy (ii). We need to find $\Delta_h H^\ominus$ of the following reaction:



Thus, we look for the data involving these two compounds.

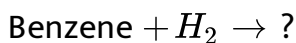
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2. Using the outcome fo previous example, arrange benzene, 1,3-cyclohexadiene, and cyclohexene in the order of decreasing rate of monohydrogenation.

Strategy: Since the change in the number of moles is the same for each hydrogentaion,we assume that the ΔS 's (entropy changes) are about the same, and that the $\Delta_h H$'s are directly related to the ΔH 's.

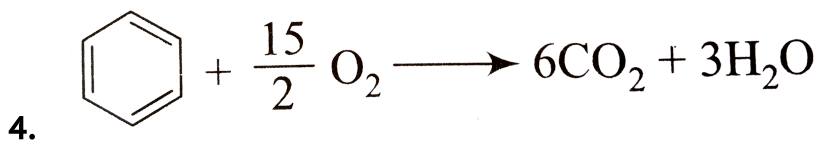
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3. Predict the product of the following reaction:



Strategy: Adding 1 mol H_2 to benzene is endothermic while adding 1 mol H_2 to cyclohexadiene is exothermic. Thus, when benzene is reduced to diene, the cyclohexadiene is reduced all the way to cyclohexane before more benzene reacts.

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Using the following data, calculate the heat of combustion of cyclohexatriene and also find the resonance energy of benzene.

$$\Delta_c H^\ominus (\text{Benzene}) = -789 \text{ kcal mol}^{-1}$$

$$\text{Combustion contribution (C - H)} = -54.0 \text{ kcal}$$

$$\text{Combustion contribution (C - C)} = -49.3 \text{ kcal}$$

$$\text{Combustion contribution (C = C)} = -117.7 \text{ kcal}$$

Strategy: First write a balanced equation for the combustion of one mole of cyclohexatriene:

Now using the structure, calculate the combustion contribution for each bond and do the total for the molecule.

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5. Explain why cyclooctatetraene is not aromatic?

Strategy: Apply Huckel's rule and use the polygon-and-circle method for deriving the relative energies of the πMOs .

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6. Describe the electron distribution in the Mos of the cyclopentadienyl anion.

Strategy: Use the polygon-and-circle method for deriving the relative energies of the πMos

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7. Show that cyclopentadienyl cation is a diradical.

Strategy: Use the polygon-and-circle method for deriving the relative energies of the π MOs

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8. Show the electron distribution in the molecular orbitals of the cycloheptatrienyl cation.

Strategy: Use the polygon-and-circle method for deriving the relative energies of the MOs .

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9. Using MO theory, show that cyclooctatetraene is antiaromatic.

Strategy: Use the polygon-and-circle method for deriving the relative energies of the πMOs .

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10. Using MO theory, explain why cyclobutadiene is antiaromatic.

Strategy: Use the polygon-and-circle method for deriving the relative energies π MOs.

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11. Compare substitution vs addition in aromatic compounds through the thermochemical changes for bromine substitution and addition with benzene as substrate. Treat the bonds in benzene as ethylenic bonds, a reasonable approximation, and use the following data:

$$B. E. (C - H) = 414.2 \text{ kJ mol}^{-1}, B. E. (Br - Br) = 188.3 \text{ kJ mol}^{-1}$$

$$B. E. (C - C) = 347.3 \text{ kJ mol}^{-1}, B. E. (H - Br) = 364.0 \text{ kJ mol}^{-1}$$

$$B. E. (C = C) = 606.7 \text{ kJ mol}^{-1}, B. E. (C = Br) = 284.5 \text{ kJ mol}^{-1}$$

Strategy: Energy is required to break bonds while energy is released during the formation of bonds.

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Follow Up Test 1

1. Which of the following compounds are called arenes?

- A. Cyclic hydrocarbons having conjugated double bonds
- B. Compounds that have aroma (Fragrance)
- C. Compounds that possess benzene ring
- D. Hydrocarbons that possess benzene rings

Answer: 4

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2. Today ___ is the major source of aromatic hydrocarbons.

- A. Distillation of coal tar
- B. Destructive distillation of coal
- C. Petroleum refining
- D. both (2) and (3)

Answer: 3

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3. Aromatic compounds burn with a sooty flame because

- A. they have a relatively high percentage of hydrogen
- B. they have a relatively high percentage of carbon
- C. they have a ring structure

D. they are reluctant to react with atmospheric oxygen.

Answer: 2

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4. Moth repellent balls usually contain

A. benzene

B. naphthalene

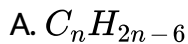
C. anthracene

D. phenanthrene

Answer: 2

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5. the General formula of arenes possessing only one benzene ring and no unsaturated side chain is



Answer: 1



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6. Which of the following is slightly soluble in water?

A. 1,4-Cyclohexadiene

B. 1,3-Cyclohexadiene

C. Benzene

D. All are insoluble in water

Answer: 3

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7. Which of the following has the highest melting point?

A. Benzene

B. 1,4-Cyclohexadiene

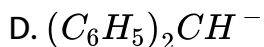
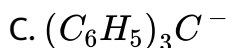
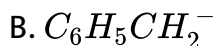
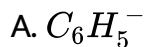
C. 1,3-Cyclohexadiene

D. 1,2-Cyclohexadiene

Answer: 1

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8. Which of the following univalent groups is known as benzenhydriyl?

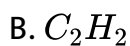
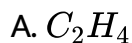


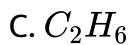
Answer: 4



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9. Which of the hydrocarbons is employed in the Berthelot synthesis of benzene?

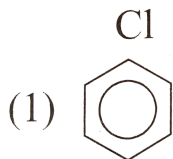




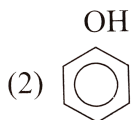
Answer: 2

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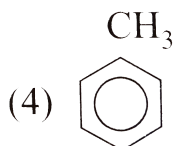
10. Which of the following compounds is usually reduced by hypophosphorous acid to yield benzene?



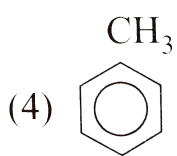
A.



B.



C.



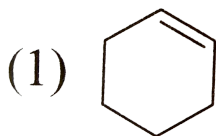
D.

Answer: 4

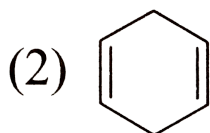
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Follow Up Test 2

1. Which of the following compounds does not decolorize the red-brown color of a solution of bromine in carbon tetrachloride?

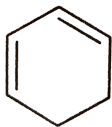


A.



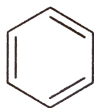
B.

(3)



C.

(4)



D.

Answer: 4



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2. The index of hydrogen deficiency (IHD) of benzene is

A. 4

B. 6

C. 2

D. 3

Answer: 4

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3. The carbon-carbon bond order in benzene is

A. 2

B. 1.5

C. 2

D. 1 and 2 (alternate)

Answer: 2

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4. The planar regular hexagonal structure of benzene was first proposed by

A. Dewar Ladenburg

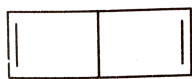
B. August Kekule

C. J.J. Loschmidt

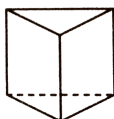
D.

Answer: 3

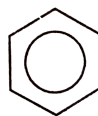
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I



II



III

5.

The number of monosubstitution products of Dewar (I), prismane (II), and benzene (III) are respectively,

A. 2,1, and 1

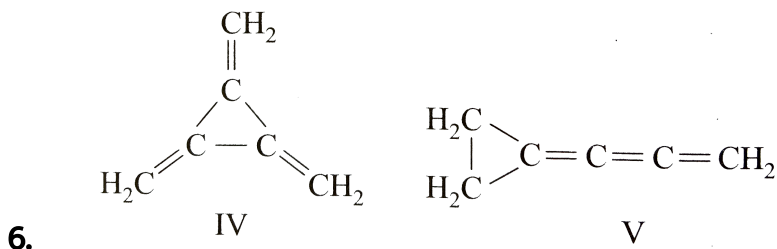
B. 1,2, and 1

C. 1,1, and 2

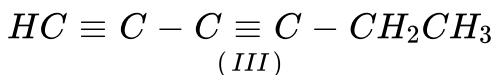
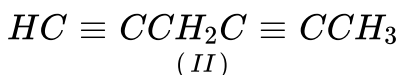
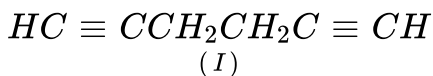
D. 1,1, and 1

Answer: 1

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Consider the following structures of formula C_6H_6



Three isomeric monosubstitution products (neglecting stereoisomers) are theoretically possible from

A. II,III

B. I,II,III

C. III,IV,V

D. II,III,IV

Answer: 1

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7. Benzene adds on ozone to form a

A. Mono-ozonide

B. diozonide

C. triozonide

D. polyozonide

Answer: 3

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8. One mole of toluene on being treated with an excess of ozone and subsequently with zinc and water will produce

- A. two moles of glyoxal and one mole of acetaldehyde
- B. two moles of glyoxal and one mole of methylglyoxal
- C. three moles of glyoxal
- D. two moles of methylglyoxal and one mole of glyoxal

Answer: 2



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9. Benzene does not respond positively to the test of unsaturation because

- A. it exhibits resonance

- B. it has hexagonal structure
- C. its double bonds are present in a ring
- D. all of the bonding molecular orbitals are filled

Answer: 4

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10. How resonating structures are possible for benzene?

- A. two moles of hydroxal and one mole of acetaldehyde
- B. Three
- C. two
- D. Four

Answer: 3

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11. The C-H bond length in benzene is

A. 109 pm

B. 111 pm

C. 113 pm

D. 107 pm

Answer: 1

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12. Find the heat of hydrogenation of cyclohexene if the heat of hydrogenation of benzene is 51 kcal mol^{-1} and its resonance energy is 36 kcal mol^{-1}

A. 15 kcal mol^{-1}

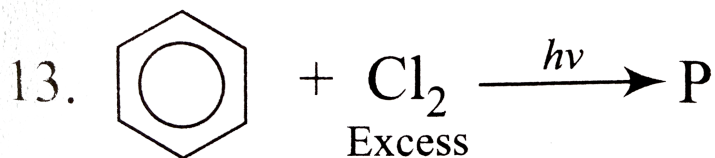
B. 29 kcal mol^{-1}

C. 33 kcal mol^{-1}

D. 36 kcal mol^{-1}

Answer: 2

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13.

The IUPAC name of the product P is

A. Benzene hexachloride

B. Hexachlorobenzene

C. Hexachlorocyclohexana

D. 1,2,3,4,5,6-hexachlorocyclohexane

Answer: 4

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Follow Up Test 3

1. The Huckel rule for aromaticity connects aromatic stability (High delocalization energy or high resonance energy) with the presence of ___ π electrons in a closed shell.

A. $(4n)$

B. $4n + 1$

C. $(4n + 2)$

D. $(4n + 3)$

Answer: 3

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2. Which of the following is not Huckel number?

A. 18

B. 14

C. 10

D. 13

Answer: 4



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3. The smallest aromatic species is a/an

A. cation

B. molecule

C. radical

D. anion

Answer: 1

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4. Which of the following is aromatic like benzene?

A. Cyclopentadiene

B. Cyclopentadienyl anion

C. Cyclopentadienyl cation

D. Cyclopentadienyl free radical

Answer: 2

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5. According to the polygon rule, how many nonbonding molecular orbitals are present in benzen?

- A. Zero
- B. Three
- C. Six
- D. Four

Answer: 1



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6. How many π electrons are present in cyclobutadienyl anion $(C_4H_4)^{2-}$?

- A. 8
- B. 4

C. 6

D. 8

Answer: 3

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7. How may Kekule-type resonance structures can be drawn for cyclooctatetraene, C_8H_8 ?

A. Two

B. Three

C. Zero

D. One

Answer: 1

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8. Which of the following is correct?

- A. Cyclopentadiene is much more acidic than 1,3-cyclohexadiene.
- B. An H of the CH_2 group in cycloheptatriene is much less acidic than a typical allylic H.
- C. Tropylium bromide (7-bromocycloheptatriene) completely dissociates in water and gives a precipitate of AgBr instantaneously with $AgNO_3$, unlike its open chain analog, 3-bromo-1,4-pentadiene.
- D. All of these

Answer: 4

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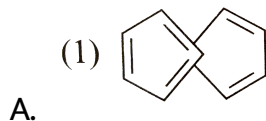
1. Which of the following is aromatic?

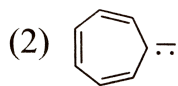
- A. [18]-annulene
- B. [16]-annulene
- C. [14]-annulene
- D. [10]-annulene

Answer: 1

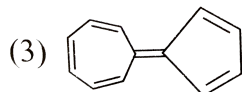
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2. Which of the following species is antiaromatic?

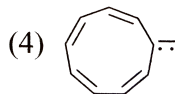




B.



C.



D.

Answer: 2

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3. Cyclooctatetraene is

A. aromatic antiaromatic

B. nonaromatic

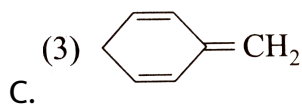
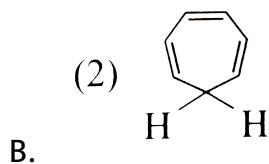
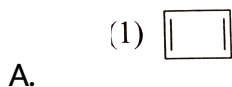
C. non-existent

D.

Answer: 3

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4. Which of the following is not aromatic?

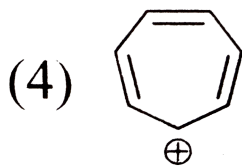
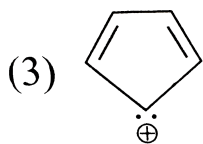
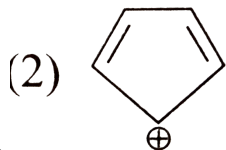
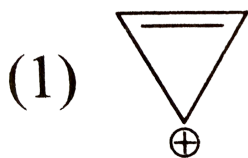


D. All of these

Answer: 4

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5. Which of the following is not aromatic?

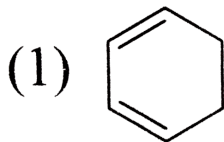


Answer: 2

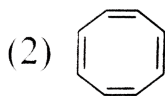


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6. Which of the following is the least reactive towards addition reactions?



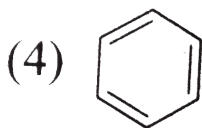
A.



B.



C.

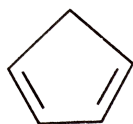


D.

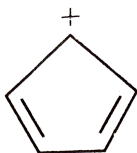
Answer: 4



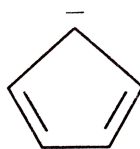
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(i)



(ii)



(iii)

7.

The order of stability of the species (i), (ii) and (iii) is

A. (iii) > (i) > (ii)

B. (iii) > (ii) > (i)

C. (ii) > (iii) > (i)

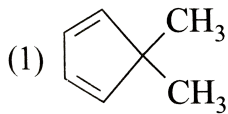
D. (i) > (iii) > (ii)

Answer: 1

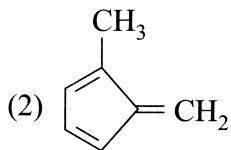


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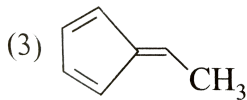
8. In which of the following compounds are the hydrogen atoms of the methyl group the most acidic?



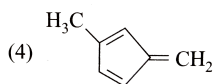
A.



B.



C.

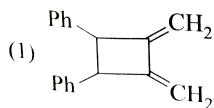


D.

Answer: 3

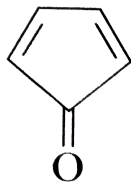
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9. Which of the following is expected to be the least stable?



A.

(2)



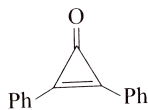
B.

(3)



C.

(4)



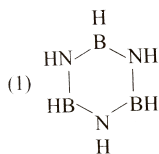
D.

Answer: 2



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10. Which of the following is not aromatic?



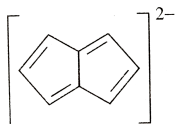
A.

(2)



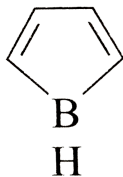
B.

(3)



C.

(4)



D.

Answer: 4



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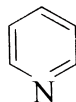
11.



(i)



(ii)



(iii)



(iv)

Which of the following are antiaromatic?

A. (i) and (ii)

B. (ii) and (iii)

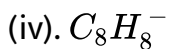
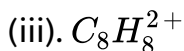
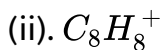
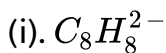
C. (iii) and (iv)

D. (i) and (iv)

Answer: 4

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12. Which of the following ions derived from (1, 3, 5, 7)-cyclooctatetraene (C_8H_8) by adding or removing a suitable number of π electrons are aromatic?



A. (i),(iii)

B. (ii),(iv)

C. (ii),(iii),(iv)

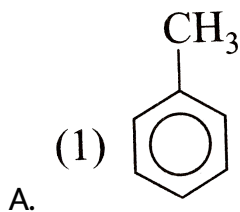
D. (i),(ii),(iii)

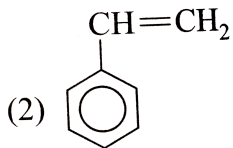
Answer: 1

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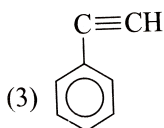
Follow Up Test 5

1. Which of the following is an arene?





B.



C.

D. All of these

Answer: 4

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2. Among the three isometric trimethylbenzenes:

(i). 1,2,3

(ii) 1,2,4

(iii).1,3,5 The least stable and the most stable isomers respectively:

A. (iii) and (i)

B. (ii) and (iii)

C. (i) and (iii)

D. (i) and (ii)

Answer: 3

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3. Which of the following statements is correct?

A. Toluene has higher boiling point than benzene.

B. Benzene has hogher melting point that toluene.

C. Both are insolutble in water.

D. All of these are correct.

Answer: 4

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4. What types of reagents cause characteristic benzene substitution?

(i) Nucleophiles

(ii). Electrophiles

(iii). Lewis acids

(iv). Lewis Bases

A. (i),(iii)

B. (ii),(iv)

C. (ii),(iii)

D. (i),(ii)

Answer: 3



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5. What is the first step in the reaction of an electrophile (E^+) with benzene?

- A. Formation of a cyclic onium ion
- B. Formation of an aromatic carbocation
- C. Formation of a nonaromatic carbocation
- D. Formation of nonclassical carbocation

Answer: 3



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6. The benzenonium ion is a

- A. Stable allylic carbocation
- B. Stable vinylic carbocation

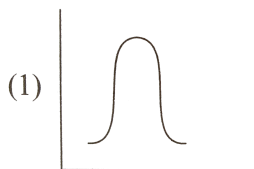
C. Stable phenyl carbocation

D. Stable benzyl carbocation

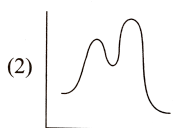
Answer: 1

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7. Which of the following is the correct enthalpy diagram for the electrophilic aromatic substitution?



A.

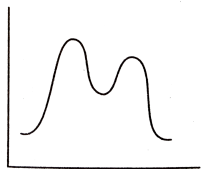


B.



C.

(4)

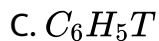
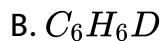


D.

Answer: 4

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8. Which of the following reacts the fastest in electrophilic aromatic substitution?



D. All are equally reactive

Answer: 4

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9. Which of the following statements is correct?

- A. All aromatic substitution reactions are irreversible.
- B. Most aromatic substitution reactions are irreversible.
- C. All aromatic substitution reactions are reversible.
- D. Most aromatic substitution reactions are reversible.

Answer: 2

 [Watch Video Solution](#)

10. Which of the following electrophilic aromatic substitution is reversible?

- A. Halogenation

B. Nitration

C. Sulphonation

D. Alkylation

Answer: 3



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11. Which of the following electrophilic aromatic substitution is expected to show a moderate $\frac{K_H}{K_D}$ isotope effect?

A. Sulphonation

B. Nitration

C. Acylation

D. Alkylation

Answer: 1



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Follow Up Test 6

1. The electrophile in halogenation of arenes is

(i). X_2

(ii). X^+

(iii). $X^{\delta+} \dots X \dots \overset{\delta t-}{A} IX_3$

(iv). X

A. (i) or (iv)

B. (ii) or (iii)

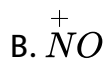
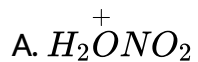
C. (i)

D. (iv)

Answer: 2

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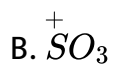
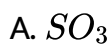
2. The electrophile in the nitration of arenes is

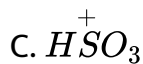


Answer: 3

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3. The electrophile in the sulphonation of arenes is





Answer: 1

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4. Which of the following statements is not correct?

A. In the reaction between $HOCl$ and H^+ the electrophile is



B. In the reaction between Icl and $ZnCl_2$ the electrophile is Cl^+

C. In the reaction between $HONO$ and H^+ the electrophile is



D.

Answer: 2



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5. Dueig the reaction between HNO_3 and H_2SO_4 . There is a _____ depression of freezing point.

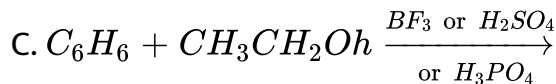
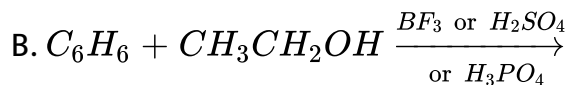
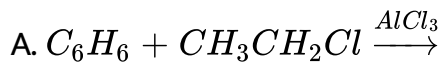
- A. two-fold
- B. three-fold
- C. five-fold
- D. four-fold

Answer: 4



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6. Which of the following reactions will lead to the formation of ethyl benzene?



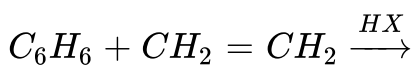
D. All of these

Answer: 4



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7. In the reaction



The best acid to be used is

A. HI

B. HCl

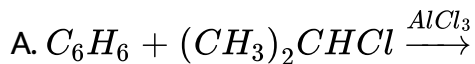
C. HF

D. HBr

Answer: 3

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8. Which of the following reactions gives a mixture of products?



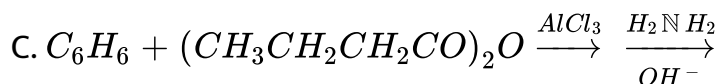
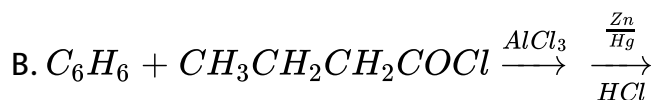
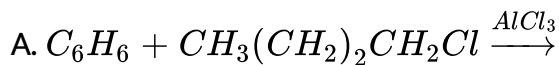
C. Both of these

D. None of these

Answer: 2

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9. Which of the following is the best way to synthesize $C_6H_5(CH_2)_3CH_3$?



D. both (2) and (3)

Answer: 4

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10. Which of the following catalysts is employed in the Friedel-Crafts acylation?

(i) $AlCl_3$

(ii) BF_3

(iii). $FeCl_3$

(iv). $ZnCl_2$

A. (i),(iii)

B. (i),(iii),(iv)

C. (i),(ii),(iii),(iv)

D. (i),(ii),(iii)

Answer: 3



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11. What is the amount of catalyst required in the Friedel-crafts acylation?

A. One equivalent

B. Two equivalents

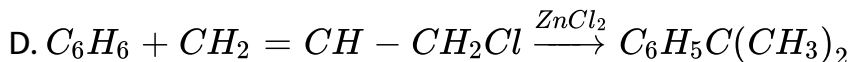
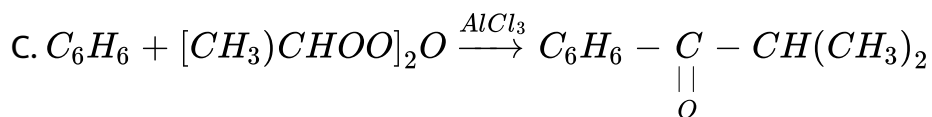
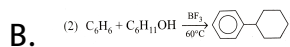
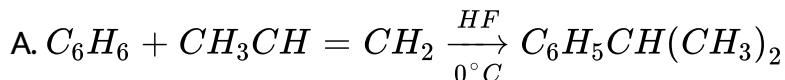
C. Three equivalents

D. More than one equivalent

Answer: 4

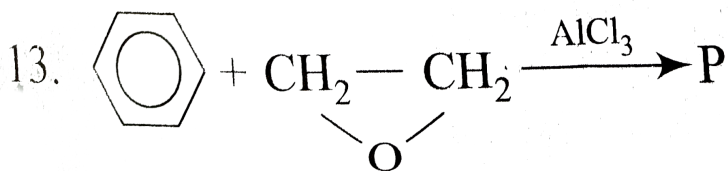
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12. Which of the following products of the reaction of benzene is incorrectly reported?



Answer: 4

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13.

Identify the product:



D. A mixture of (1) and (2)

Answer: 2

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14. Which of the compounds cannot be prepared directly?

(i). Fluoroarenes

(ii). Chloroarenes

(iii). Bromoarenes

(iv). Iodoarenes

A. (i),(ii)

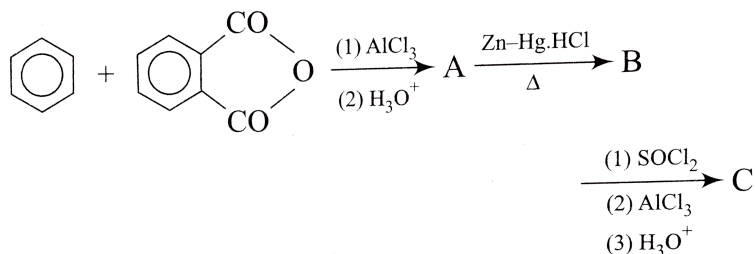
B. (ii),(iii)

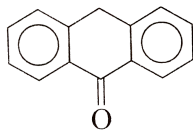
C. (i),(iii)

D. (i),(iv)

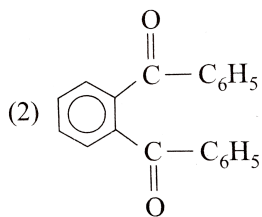
Answer: 4

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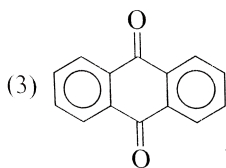




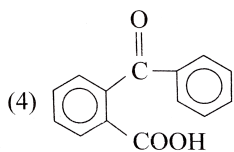
A.



B.



C.



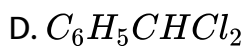
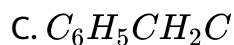
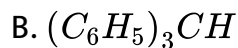
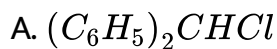
D.

Answer: 1



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16. Benzene reacts with $CHCl_3$ in the presence of anhydrous $AlCl_3$ to form



Answer: 2

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17. Which of the following does not undergo the Friedel-Crafts alkylation reaction?

A. Aniline

B. Nitrobenzene

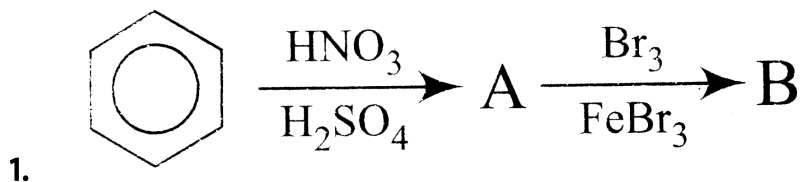
C. Anisole

D. Both (1) and (2)

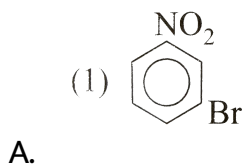
Answer: 4

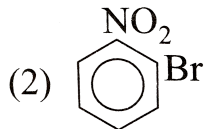
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Follow Up Test 7

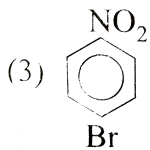


Identify the product B:

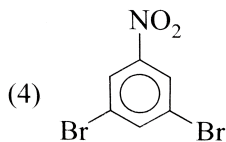




B.



C.

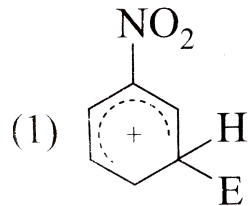


D.

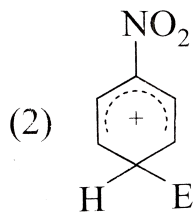
Answer: 1

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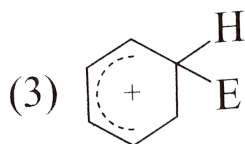
2. The electrophile, $E^{(\oplus)}$ attacks the benzene ring to generate the intermediate σ -complex. Of the following which σ -complex is of lowest energy?



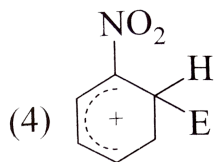
A.



B.



C.

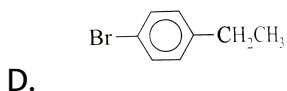
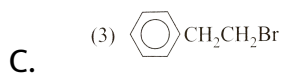
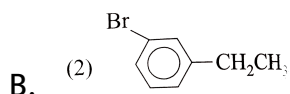
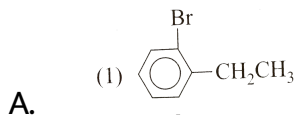


D.

Answer: 3

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3. Ethylbenzene with bromine in the presence of $FeBr_3$ predominantly gives



Answer: 4

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4. Identify the correct order of reactivity in electrophilic substitution reaction of the following compounds.

(1) Benzene

(2) Toluene

(3) Chlorobenzene,

(4) Nitrobenzene.

A. (i) > (ii) > (iii) > (iv)

B. (iv) > (iii) > (ii) > (i)

C. (ii) > (i) > (iii) > (iv)

D. (ii) > (iii) > (i) > (iv)

Answer: 3



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5. The reaction of toluene with Cl_2 in presence of $FeCl_3$ gives predominantly

A. benzoyl chloride

B. m-chlorotoluene

C. benzyl chloride

D. o-and p-chlorotoluene

Answer: 4



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6. Toluene, when treated with $\frac{Br_2}{Fe}$, gives p-bromotoluene as the major product because the $-CH_3$ group of toluene is

A. a meta-directing group

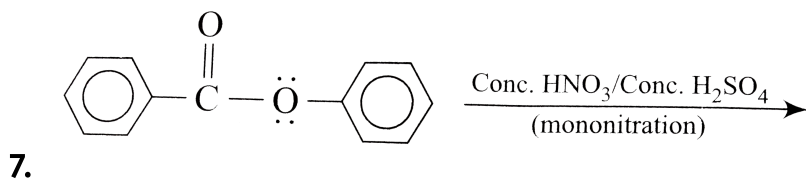
B. an ortho-directing group

C. a para-direction group

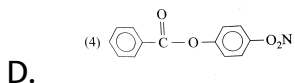
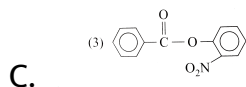
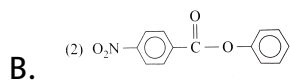
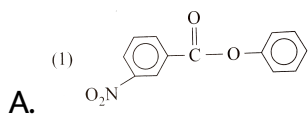
D. an ortho/para direction group but o-bromotoluene suffers steric hindrance to some extent.

Answer: 4

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The major product formed in the reaction is



Answer: 4

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Question Bank

1. The shape of the benzene³ molecule is

- A. tetrahedral
- B. trigonal planar
- C. regular flat hexagon
- D. octahedral

Answer: C

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2. The benzene molecule possesses

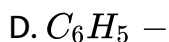
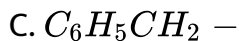
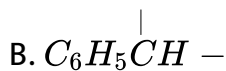
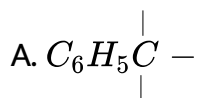
- A. three sp^3 hybridized carbons

- B. six sp^2 hybridized carbons
- C. six sp^3 hybridized carbons
- D. Three sp^2 hybridized carbons.

Answer: B

 [Watch Video Solution](#)

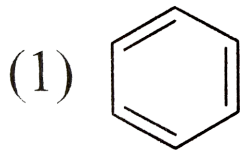
3. Which of the following groups is called benzo?



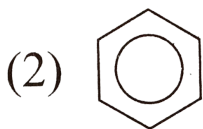
Answer: A

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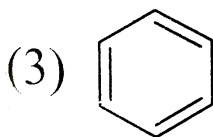
4. Which of the following is the resonance hybrid of benzene?



A.



B.



C.

D. Both (1) and (3)

Answer: B



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5. How many sigma and pi bonds are present in a benzene molecule?

A. 6σ and 3π

B. 9σ and 3π

C. 12σ and 3π

D. 15σ and 3π

Answer: C

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6. One mole of benzene is treated with an excess of ozone and the product formed is then treated with zinc dust and water. The final product formed is.

A. three moles of formaldehyde

- B. three moles of glyoxal
- C. three moles of oxalic acid
- D. three moles of glycol

Answer: B

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7. Benzene's extraordinary stability is related to

- A. the presence of alternate single and double bonds between C atoms
- B. the planar hexagonal structure
- C. an extended π system in which the e^- are symmetrically delocalized over all six carbon atoms
- D. its symmetrical structure

Answer: C

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8. Hyckel's number for benzene is

A. 12

B. 6

C. 1

D. 3

Answer: B

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9. Which of the following shows that benzene differs chemically from an open-chain conjugated triene?

- A. it possesses high resonance energy.
- B. It resists oxidation by mild oxidants such as aq. $KMnO_4$ and dil. HNO_3
- C. It reacts by substitution rather than addition with electrophilic reagents.
- D. All of these.

Answer: D



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10. Benzene forms a single C_6H_5Br product when it is monobrominated because

- A. bromine is able to replace only one of the H atoms
- B. only one H on the ring is easily replaceable

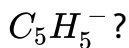
C. all the H's in benzene are equivalent

D. None of these

Answer: C

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11. How many π electrons are present in the cyclopentadienyl anion



A. 4

B. 3

C. 6

D. 2

Answer: C

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12. What is the correct decreasing order of resonance energies stabilities?

A. Aromatic > Antiaromatic > Nonaromatic

B. Nonaromatic > Aromatic > Antiaromatic

C. Aromatic > Nonaromatic > Antiaromatic

D. Nonaromatic > Antiaromatic > Aromatic

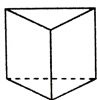
Answer: C

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13. Which of the following isomers of benzene has six equivalent H atoms?

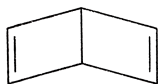
A.

(1)



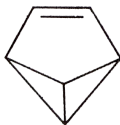
B.

(2)



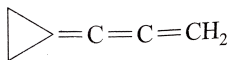
C.

(3)



D.

(4)



Answer: A



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14. The resonance energy of benzene is approximately

A. 18 kcal mol^{-1}

B. 37 kcal mol^{-1}

C. 54 kcal mol^{-1}

D. 48 kcal mol^{-1}

Answer: B

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15. How many trichloro derivatives of benzene are possible?

A. Six

B. Four

C. Five

D. Three

Answer: C

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16. How many trinitrotoluenes are possible?

- A. Six
- B. Seven
- C. Eight
- D. Five

Answer: A



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17. Which of the following is incorrect?

- A. An aromatic species must be cyclic.
- B. An aromatic ring must be planar.

C. An aromatic ring must involve the cyclic delocalization of $(4n + 2)\pi$ electrons.

D. An aromatic ring must involve the cyclic delocalization of $4n\pi$ electrons.

Answer: D

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18. Which of the following molecules shows aromatic character?

A. Fullerene 60

B. Azulene

C. Ferrocene

D. All of these

Answer: D



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19. Benzene reacts with methyl chloride in the presence of anhydrous aluminium chloride to give toluene. The reaction is an example of

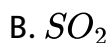
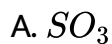
- A. alkylation of benzene
- B. Friedel-Crafts reaction
- C. methylation
- D. all of these

Answer: D



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20. In the sulphonation of benzene, the active electrophilic species is



Answer: A



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21. Benzene can be obtained by heating either benzoic acid with X or phenol with Y. X and Y, respectively are

A. Zinc dust and sodalime

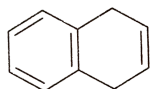
B. sodalime and zinc dust

C. zinc dust and sodium hydroxide

D. sodalime and copper

Answer: B

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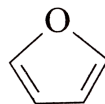
I



II



III



IV

22.

Which of the following compounds will show aromatic character?

A. I, II and III

B. II and III

C. II, IV

D. I, II, III and IV

Answer: C

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23. Benzene reacts with sulphuric acid to form benzenesulphonic acid, only when the sulphuric acid is

- A. cold and dilute
- B. hot and dilute
- C. hot and concentrated
- D. mixed with HNO_3

Answer: C

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24. 3-chloro-4-methylbenzenesulphonic acid reacts with superheated steam to give

- A. m-chlorobenzenesulphonic acid
- B. toluene
- C. p-methylbenzenesulphonic acid
- D. o-chlorotoluene

Answer: D



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25. Which of the following fraction obtained from coal tar yields anthracene and phenanthrene?

- A. Light oil
- B. Middle oil

C. Heavy oil

D. Green oil

Answer: D

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26. Which of the following names is correct?

A. 2,4,6-Trinitrobenzene

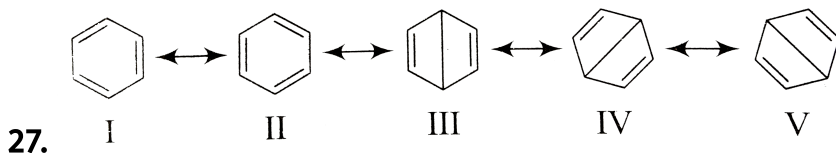
B. 4-Chloro-meta-xylene

C. 2-Aminonitrobenzene

D. 1-butyl-4-ethylbenzene

Answer: D

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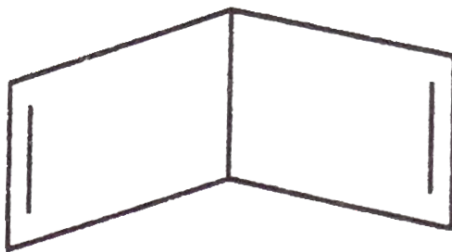
Benzene is resonance hybrid of the following resonance contributors:

Which of the following statements is correct?

- A. All the above structures represent discrete real molecules.
- B. All the above structures contribute equally.
- C. Structures I and II contribute equally and to the highest extent.
- D. Structures III, IV and V are not planar.

Answer: C

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28.

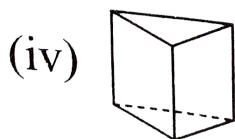
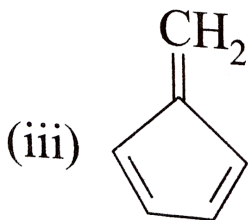
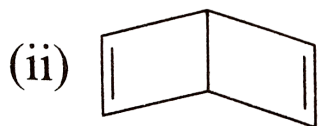
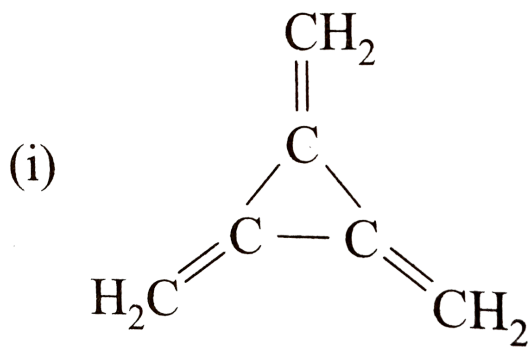
Dewar benzene has the following structure: It has been prepared it is not planar its IUPAC name is

- A. Bicyclo[0,2,2]hexadiene
- B. Bicyclo[2,0,2]hexadiene
- C. Bicyclo[2,2,2]hexadiene
- D. Bicyclo[2,2,0]hexadiene

Answer: D



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29.

Which of the following C_6H_6 structures give only one C_6H_5Br isomer?

A. (i),(iv)

B. (i),(ii),(iii),(iv)

C. (ii),(iii)

D. (i),(ii),(iv)

Answer: A



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30. How many dibrominated derivatives of benzene are possible?

A. Just one

B. Three

C. Four

D. Five

Answer: B



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31. Completely conjugated monocyclic hydrocarbons are called

A. annulenes

B. cumulenes

C. allenes

D. arenes

Answer: A

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32. Which of the following hydrocarbons has an acceptable huckel number but is not aromatic?

A. [10]-annulene

B. [12]-annulene

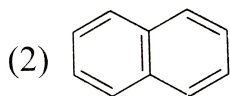
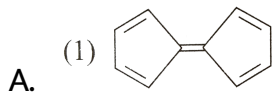
C. [14]-annulene

D. [18]-annulene

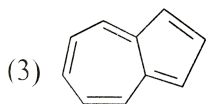
Answer: A

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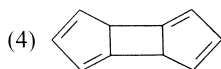
33. Which one of the following isomeric compounds has the greatest dipole moment?



B.



C.

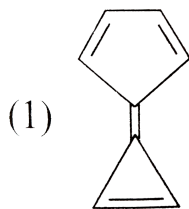


D.

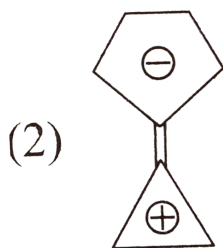
Answer: C

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34. Celicene C_7H_6 , is expected to be a fairly polar aromatic molecule. Which of the following resonance forms contributes to the greatest extent towards the real structure (resonance hybrid) of the molecule?

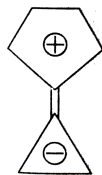


A.



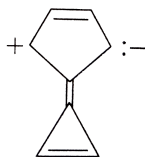
B.

(3)



C.

(4)



D.

Answer: B



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35. Ozonolysis of o-xylene (1,2-dimethylbenzene) gives ____ different products.

A. two

B. four

C. three

D. just one

Answer: C

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36. The number of possible dechloronitrobenzene isomers is

A. 8

B. 6

C. 4

D. 3

Answer: B

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37. When the three dibromobenzenes are mononitrated, the one melting at $87^{\circ}C$ gives only one mononitro product, while those

with melting points of 6°C and -7°C give two and three mononitro derivatives, respectively. Which of the following statements is correct?

- A. The isomer melting at 87°C is para-dibromobenzene.
- B. The isomer melting at 6°C is ortho-dibromobenzene.
- C. The isomer melting at -7°C
- D. None of these

Answer: D

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38. Which of the following statements is correct?

- A. Both phenyl cation and anion are more stable than cyclohexyl cation and anion.

- B. Both phenyl cation and anion are less stable than cyclohexyl cation and anion.
- C. phenyl cation is less stable than cyclohexyl cation while phenyl anion is more stable than cyclohexyl anion.
- D. Phenyl cation is more stable than cyclohexyl cation while phenyl anion is less stable than cyclohexyl anion.

Answer: C

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39. The number of five-membered and six-membered carbocyclic rings present in the fullerene C_{60} molecule are, respectively.

- A. 12 and 18
- B. 14 and 18

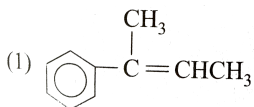
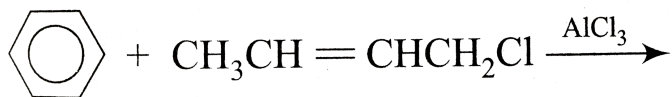
C. 10 and 20

D. 12 and 20

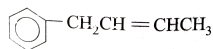
Answer: D

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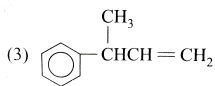
40. The major product of the following reaction is



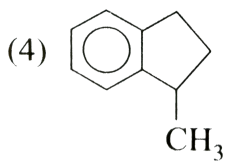
A.



B.



C.

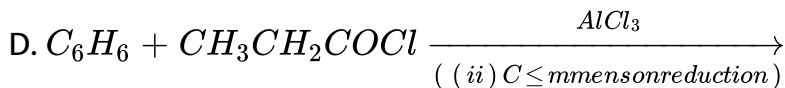
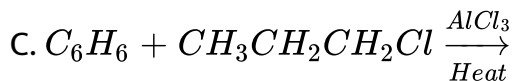
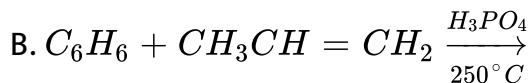
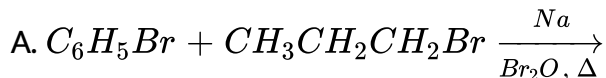


D.

Answer: C

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41. Which of the following methods would you consider to be the best for preparing n-propylbenzene?



Answer: D

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42. The concept of aromatic sextet was first proposed by

A. Robinson

B. Kekule

C. Dewar V.Meyer

D.

Answer: A

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I



II



III

43.

The number of disubstitution products of benzene (I), Dewar benzene (II), and prismane (III) are, respectively.

A. 5,2 and 2

B. 3,2 and 2

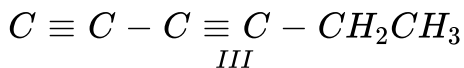
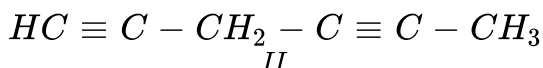
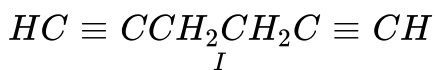
C. 3,6 and 3

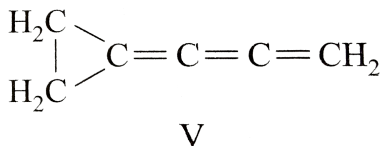
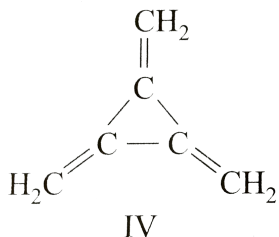
D. 3,6 and 6

Answer: C

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44. Consider the following structure of formula C_6H_6





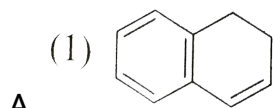
Five isomeric disubstitution products are theoretically possible from

- A. III,IV,V
- B. I,II,III
- C. II,III,IV
- D. I,III,V

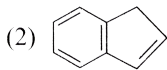
Answer: A

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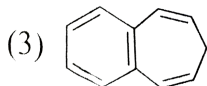
45. Which one of the following is the strongest acid?



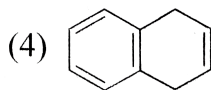
A.



B.



C.

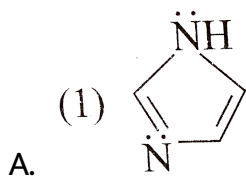


D.

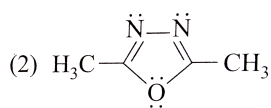
Answer: C

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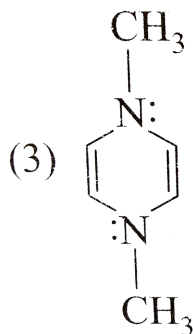
46. Which one of the following compounds is not aromatic?



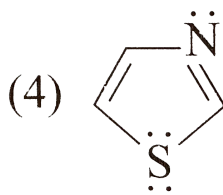
A.



B.



C.



D.

Answer: C

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47. How many bromochlorotoluenes are possible?

A. 8

B. 10

C. 9

D. 7

Answer: B

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48. $C_6H_6 + Hg(OCOCH_3)_2 \xrightarrow{HClO_4} P$ Identify the product:

A. $C_6H_5HgOCOCH_3$

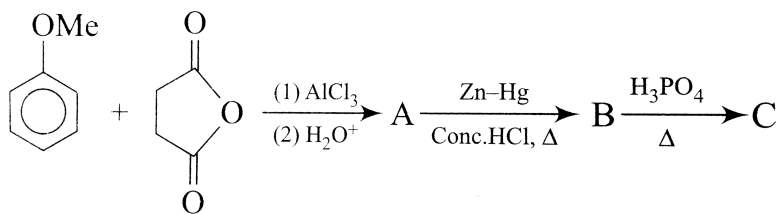
B. $C_6H_5COCH_3$

C. $C_6H_5CH_2CH_3$

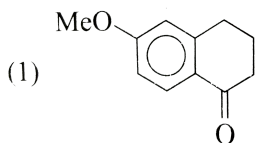
D. A mixture of (2) and (3)

Answer: A

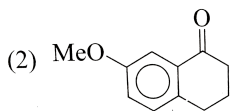
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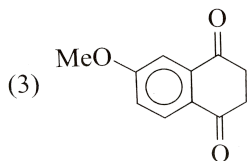
Identify the end product (C):



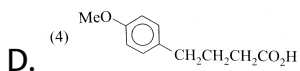
A.



B.



C.



D.

Answer: A

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50. Benzene reacts with formaldehyde and dry HCl gas in the presence of anhydrous $ZnCl_2$ to form

- A. benzotrichloride
- B. benzal chloride
- C. benzyl chloride
- D. benzoyl chloride

Answer: C

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51. Which one of the following statements on the nitration of aromatic compounds is false?

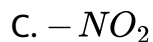
- A. The rate of nitration of benzene is almost the same as that of hexadeuteriobenzene.
- B. The rate of nitration of toluene is greater than that of benzene.
- C. The rate of nitration of benzene is greater than that of hexadeuteriobenzene.
- D. Nitration is an electrophilic substitution reaction.

Answer: C

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Archives

1. Some meta-directing substituents in aromatic substitution are given which one is the most deactivating?



Answer: C

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2. Which of the following compounds will not undergo Friedel – Crafts reaction easily ?

A. Xylene

B. Nitrobenzene

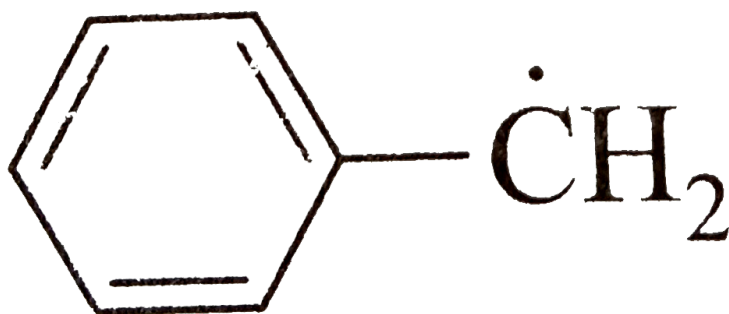
C. Toluene

D. Cumene

Answer: B

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3. The radical



is aromatic

because it has

- A. 7 p-orbitals and 6 unpaired electrons
- B. 7 p-orbitals and 7 unpaired electrons
- C. 6 p-orbitals and 7 unpaired electrons
- D. 6 p-orbitals and 6 unpaired electrons

Answer: B

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4. Chlorobenzene is _____ reactive than benzene towards electrophilic substitution and directs the incoming electrophile to the _____ position.

A. more, ortho/para

B. less, ortho/para

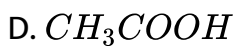
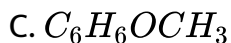
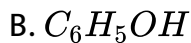
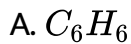
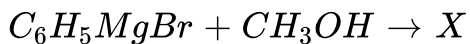
C. more, meta

D. less meta

Answer: B

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5. In the reaction given below, X is



Answer: A



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6. Benzene reacts with CH_3Cl in the presence of anhydrous $AlCl_3$

to form

A. chlorobenzene

B. benzyl chloride

C. xlene

D. toluene

Answer: C

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7. Nitrobenzenen can be prepared from benzene by using a mixture of conc HNO_3 and conc. H_2SO_4 in the nitrating mixture. Nitric acid acts as a

A. base

B. acid

C. reducing agent

D. catalyst

Answer: A

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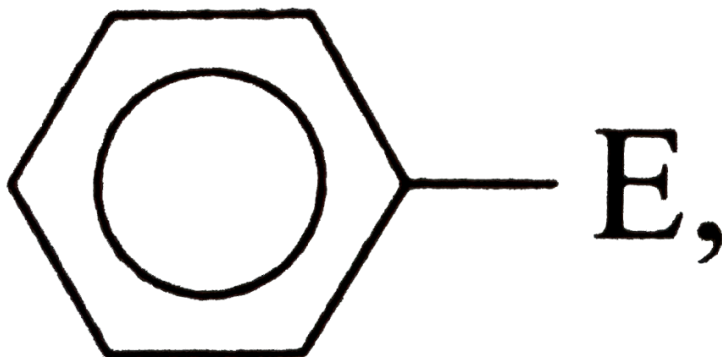
8. Which of the following is not aromatic?

- A. cyclopentadienyl cation
- B. cyclopropenyl cation
- C. Tropylium cation
- D. Cyclopentadienyl anion

Answer: A

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9. In a compound



electrophilic substitution has occurred the substituents E are methyl $-CH_3$, $-CH_2Cl$, $-CHCl_2$, $-CCl_3$ and $-Cl$ the correct increasing order towards electrophilic substitution is

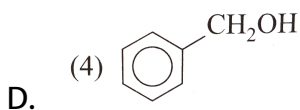
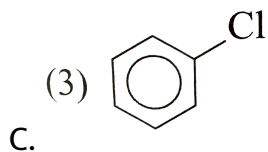
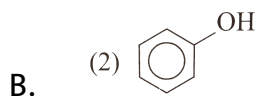
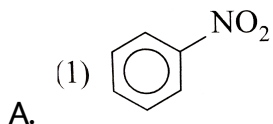
- A. $-CH_3 < -CH_2Cl < -CHCl_2 < -CCl_3$
- B. $-CH_3 < -CHCl_2 < -CH_2Cl < -CCl_3$
- C. $-CCl_3 < -CH_2Cl < -CHCl_2 < -CH_3$
- D. $-CCl_3 < -CHCl_2 < -CH_2Cl < -CH_3$

Answer: D



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10. Which one of the following is the most reactive towards electrophilic attack?



Answer: B



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11. The order of decreasing reactivity towards an electrophilic reagent for the following,

(i). Benzene

(ii). Toluene.

(iii). Chlorobenzoic acid.

(iv). Phenol. Would.

A. $(iv) > (ii) > (i) > (iii)$

B. $(i) > (ii) > (iii) > (iv)$

C. $(ii) > (iv) > (i) > (iii)$

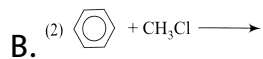
D. $(iv) > (iii) > (ii) > (i)$

Answer: A



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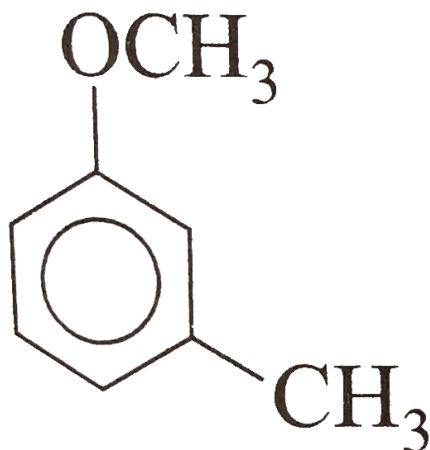
12. In which reaction , polysubstitution takes place :



Answer: B

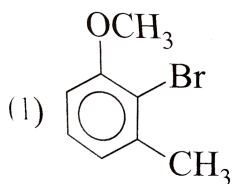


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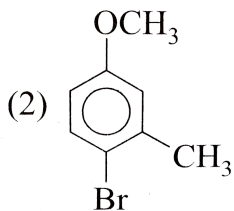


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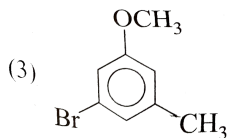
The major product formed on monobromination $\left(\frac{Br_2}{FeBr_3}\right)$ of the following compound. Is



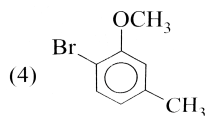
A.



B.



C.



D.

Answer: B

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14. The strongest ortho/para and the strongest meta directing groups, respectively, are

A. $-NO_2$ and NH_2

B. $-CONH_2$ and NH_2

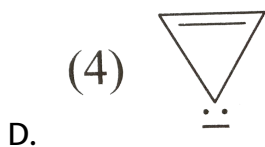
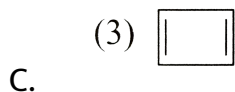
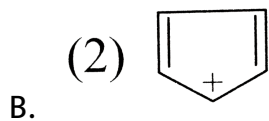
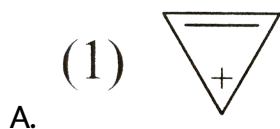
C. $-NH_2$ and $CONH_2$

D. $-NH_2$ and $-NO_2$

Answer: D

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15. Among the following, the aromatic compound is



Answer: A

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16. The treatment of benzene with isobutene in the presence of sulphuric acid gives

- A. isobutylbenzene
- B. tert-butylbenzene
- C. n-butylbenzene
- D. no reaction

Answer: B

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17. $C - C$ bond length in benzene is

- A. 1.54\AA
- B. 1.39\AA

C. 1.33\AA

D. 1.20\AA

Answer: B

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18. The $C - C - C$ bond angle in benzene is

A. $60^\circ C$

B. $109^\circ C$

C. $120^\circ C$

D. $90^\circ C$

Answer: C

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19. The centric formula of benzene was proposed by

- A. Dewar
- B. Ladenburg
- C. Armstrong and Baeyer
- D. Kekule

Answer: C



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20. The ratio of σ and π bond in benzene is

- A. 2
- B. 4
- C. 6

D. 8

Answer: B

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21. According to the huckel rule, planar and completely conjugated monocyclic polyene is aromatic if it possesses

A. $(4n + 1)\pi$ electrons

B. $(4n + 2)\pi$ electrons

C. $(2n + 2)\pi$ electrons

D. $4n\pi$ electrons

Answer: B

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22. Select the correct statement about benzene:

- A. Benzene possesses two types of carbon-carbon bonds.
- B. Benzene usually undergoes addition reaction.
- C. Benzene produced three monosubstituted products.
- D. Benzene involves cyclic delocalization of six π electrons.

Answer: D

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23. Which of the following statements is not compatible with arenes?

- A. Arenes usually have good thermodynamic stability.
- B. Arenes involve cyclic delocalization of $(4n + 2)\pi$ electrons.
- C. Arenes show resonance

D. Arenes usually undergo electrophilic addition at ring double bonds.

Answer: D

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24. Aromatic character of benzene can be explained by

- A. resonance theory
- B. aromatic sextet theory
- C. molecular orbital theory
- D. all of these

Answer: D

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25. The total number of possible isomeric trimethylbenzenes is

A. 2

B. 3

C. 4

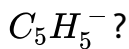
D. 6

Answer: B



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26. How many π electrons are present in the cyclopentadienyl anion



A. 2

B. 4

C. 6

D. 8

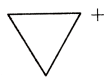
Answer: C

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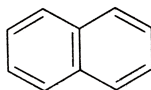
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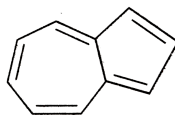
I



II



III



IV

Which of the following chemical systems is/are nonaromatic?

A. II

B. IV

C. II and IV

D. None of these

Answer: A



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28. Number of π electrons present in naphthalene is

A. 4

B. 6

C. 10

D. 14

Answer: C



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29. When sodium benzoate is heated with sodalime, the product formed is

A. toluene

B. phenol

C. benzene

D. benzaldehyde

Answer: C

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30. The nitration of benzene is an example of

A. nucleophilic substitution

B. nucleophilic addition

C. electrophilic addition

D. electrophilic substitution

Answer: D

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31. In the nitration of benzene with a mixture of concentrated HNO_3 and concentrated H_2SO_4 the active species involved is



Answer: D



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32. When phenol is heated with zinc dust the major product formed is



B. phenolphthalein

C. benzene

D. biphenyl

Answer: C



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33. Which of the following compounds is the most reactive towards nitration with a mixture of conc. HNO_3 and conc. H_2SO_4 under identical conditions?

A. C_6H_6

B. $C_6H_5NO_2$

C. $C_6H_5CH_3$

D. $C_6H_5Cl_3$

Answer: C

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34. The strongest ortho-and para-directing group among the following is

A. $-OH$

B. $-Cl$

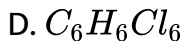
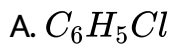
C. $-C_6H_5$

D. $-Br$

Answer: A

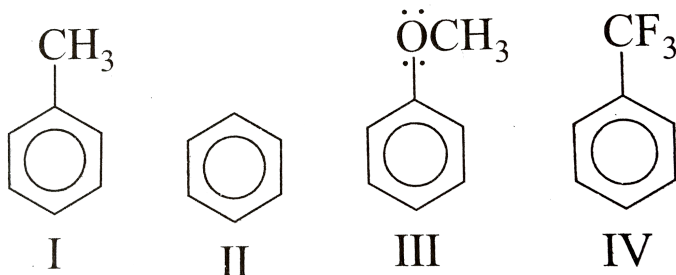
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35. $C_6H_6 + Cl_2 \xrightarrow{UV\text{Light}}$ Product In above reaction product is .

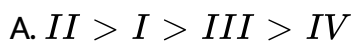


Answer: D

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Among the compounds the order of decreasing reactivity towards electrophilic substitution is



B. $III > I > II > IV$

C. $IV > I > II > III$

D. $I > II > III > IV$

Answer: B

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37. The function of anhydrous $AlCl_3$ in friedel-Crafts' reaction is to

A. absorb water

B. absorb HCl

C. produce a nucleophile

D. produce and electrophile

Answer: D

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38. Benzene reacts with n-propyl chloride in the presence of anhydrous $AlCl_3$ to give predominantly

- A. isopropylbenzene
- B. n-propylbenzene
- C. propiophenone
- D. 1-chloro-3-propylbenzene

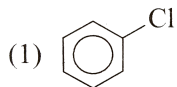
Answer: A



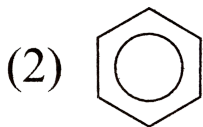
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39. Which one of the following will be the most easily attacked by an electrophile?

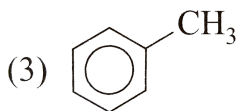
A.



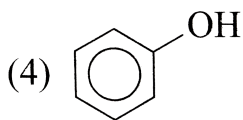
B.



C.



D.



Answer: D



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40. The most common reaction of benzene is

A. nucleophilic substitution

B. nucleophilic addition

C. electrophilic addition

D. electrophilic substitution

Answer: D

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41. In the chlorination of benzene with Cl_2 , in the presence of anhydrous $FeCl_3$ the electrophilic species that attacks the benzene ring

A. Cl^+

B. $Cl - \overset{+}{Cl} - \overset{-}{FeCl_3} - -$

C. Cl^-

D. Cl

Answer: B

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42. The correct order of decreasing reactivity of anisole (I), benzene (II) and nitrobenzene (III) towards aromatic substitution with a given electrophile is

- A. $(II) < (III) < (I)$
- B. $(III) > (II) > (I)$
- C. $(II) > (I) > (III)$
- D. $(I) > (III) > (II)$

Answer: D

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43. Anhydrous $AlCl_3$ is used as a catalyst in the Friedel-Crafts reaction because it is

- A. an electron-rich molecule
- B. solution in ether
- C. ionizable to Al^{3+} and Cl^-
- D. an electr-deficient molecule

Answer: D



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44. The rate of nitration of phenol

- A. slower than that of benzene
- B. much faster than that of benzene

C. equal to that of benzene

D. almost zero

Answer: B

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45. Benzene reacts with acetyl chloride in the presence of anhydrous $AlCl_3$ to give

A. phenyl acetate

B. benzoyl chloride

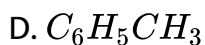
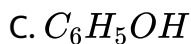
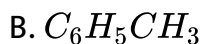
C. chlorobenzene

D. acetophenone

Answer: D

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46. Which of the following compounds reacts slower than benzene in electrophilic bromination in the benzene ring?



Answer: A

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47. When benzene is heated with air at $500^\circ C$ in the presence of V_2O_5 as catalyst, the major product formed is

A. oxalic acid

B. glyoxal

C. maleic anhydride

D. fumaric acid

Answer: C

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48. Which of the following can be employed as a reagent for a freidel-crafts acylation reaction?

A. $(CH_3CO)_2O$

B. CH_3Cl

C. CH_3CH_2Cl

D. CH_3COOCH_3

Answer: A



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49. Benzene is heated with mixture of concentrated HNO_3 and concentrated H_2SO_4 at $60^\circ C$ the product of this reaction is then treated with Cl_2 in the presence of anhydrous $FeCl_3$ the major product obtained in the final step is

- A. 2-chloro-1-nitrobenzene
- B. 3-chloro-1nitrobenzene
- C. 4-chloro-1-notrobenzene
- D. equal amount of (1) and (3)

Answer: B



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50. Which one of the following compounds will undergo meta substitution (mainly) on monochlorination?

A. chlorobenzene

B. phenol

C. ethyl benzoate

D. ethoxybenzene

Answer: C

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51. When nitrobenzene is heated with fuming nitric acid in the presence of fuming sulphuric acid for many hours the end product formed is

A. 1,4-dinitrotoluene

B. 1,3-dinitrobenzene

C. TNB

D. picric acid

Answer: C

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52. Fridel-crafts' reaction of bromobenzene with methyl iodide gives

A. o-bromotoluene

B. p-bromotoluene

C. o-and p-bromotoluene

D. m-bromotoluene

Answer: C

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53. p-Nitrotoluene on further nitration gives

- A. 3,4-dinitrotoluene
- B. 2,4-dinitrotoluene
- C. 2,4-dinitrobenzyl alcohol
- D. 2,5-dinitrotoluene

Answer: B

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54. Which of the following substituents deactivates the benzene ring towards electrophilic substitution?

- A. $-NHCH_3$

B. $-OH$

C. $-OCH_3$

D. $-COOCH_3$

Answer: D



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55. The electrophilic aromatic substitution of a compound C_6H_5Y produces mainly a meta-disubstituted product. Among the following which one could be the substituent Y?

A. $-NH_3$

B. $-COOH$

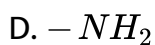
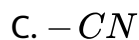
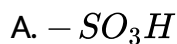
C. $-CH_3$

D. $-Cl$

Answer: B

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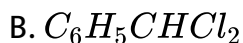
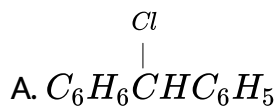
56. Which of the following is not a meta-directing group in electrophilic aromatic substitution?



Answer: D

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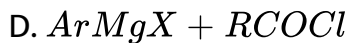
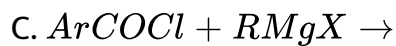
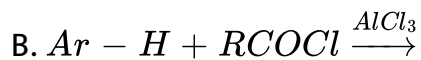
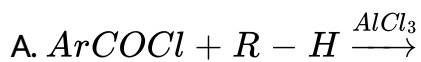
57. Which of the following structures corresponds to the product expected from the reaction of benzene (excess) with CH_2Cl_2 in the presence of anhydrous $AlCl_3$?



Answer: D

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58. Which of the following reactions will produce $RCOAr$ in good yield?

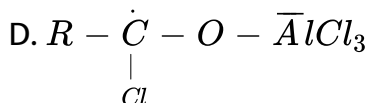
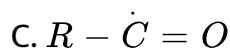
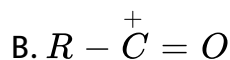


Answer: B



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59. In the Friedel-Crafts acylation reaction, the electrophile is



Answer: B



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