Chemistry · Organic Chemistry

Aromatic Benzene

thanawiya-archive.com

106	3	41
questions	sets	pages

Contents

Multiple choice questions (60 questions) — Questions · p. 2 — Answers · p. 29

Essay questions (16 questions) — Questions · p. 17 — Answers · p. 35

Past exam questions (30 questions) — Questions · p. 20 — Answers · p. 37

Click a question number to jump to its answer, and an answer number to go back to the question.

thanawiya-archive.com

Multiple choice questions — 60 questions

1 All of the following are true for aromatic compounds, except .....

(A) They have distinctive odours.
(B) Some of them have a cyclic shape.
(C) They may be monocyclic or polycyclic.
(D) The simplest of them is benzene.

2 The lengths of the bonds between the carbon atoms are intermediate between single and double bonds in the compound .....

(A) 2-butene.
(B) propyne.
(C) 1-butene.
(D) aromatic benzene.

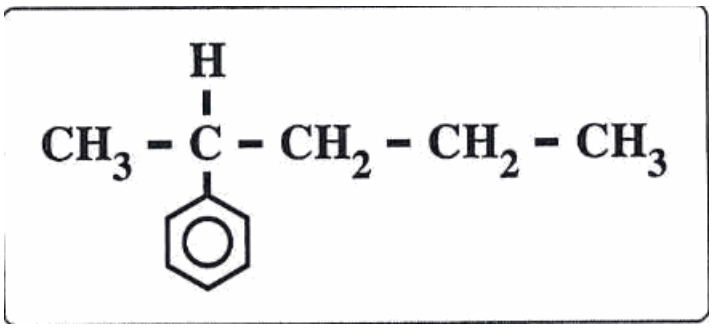
3 The ratio of the number of sigma bonds to the number of pi bonds in aromatic benzene equals .....

(A) 1/4 (B) 1/2 (C) 2/1 (D) 4/1

4 Naphthalene agrees with aromatic benzene in all of the following, except .....

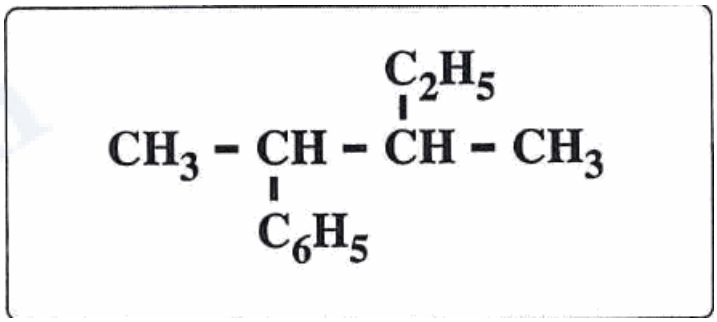
(A) their high percentage of carbon.
(B) both are hydrocarbons.
(C) the physical state.
(D) both are aromatic compounds.

5 What is the IUPAC name of the opposite hydrocarbon?



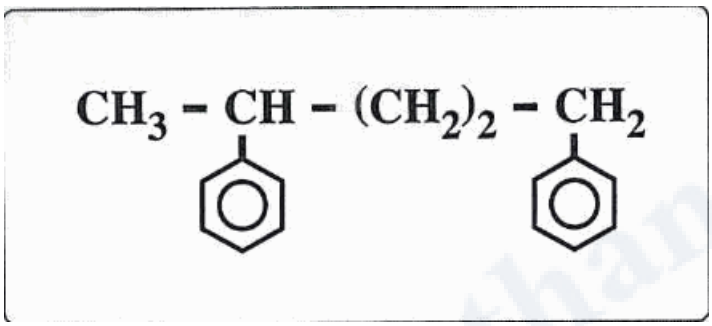
(A) 2-cyclohexylpentane.
(B) 2-phenylpentane.
(C) 3-cyclohexylpentane.
(D) 3-phenylpentane.

6 What is the name of the opposite compound according to the IUPAC system?



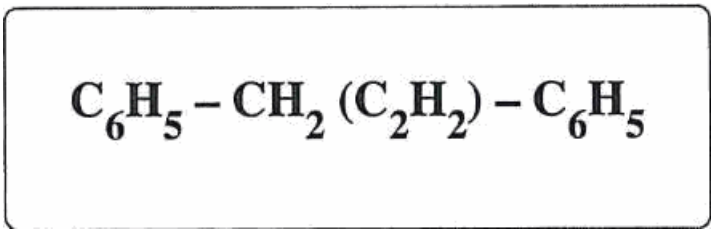
(A) 3,5-dimethyldecane.
(B) 2-ethyl-3-methylnonane.
(C) 2-ethyl-3-phenylbutane.
(D) 3-methyl-2-phenylpentane.

7 What is the name of the opposite compound according to the IUPAC system?



(A) 1,4-diphenylpentane.
(B) diphenylpentane.
(C) 1,3-diphenylbutane.
(D) 2,3-diphenylbutane.

8 What is the name of the opposite compound according to the IUPAC system?



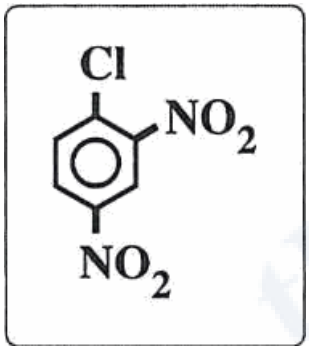
(A) 1,2-diphenylpropene.
(B) 1,3-diphenylpropene.
(C) 1,2-diphenylpropane.
(D) 1,3-diphenylpropane.

9 What is the IUPAC name of the opposite compound?



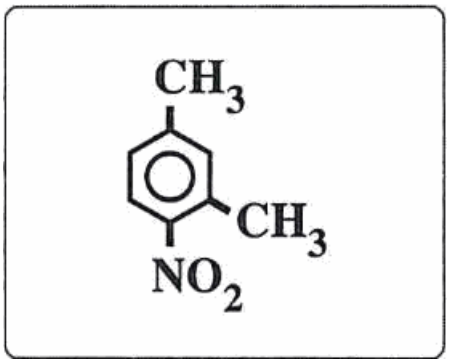
(A) 1-nitro-3-bromo-4-chlorobenzene.
(B) 2-bromo-1-chloro-4-nitrobenzene.
(C) 1-bromo-2-chloro-5-nitrobenzene.
(D) 1-bromo-2-chloro-4-nitrobenzene.

10 What is the IUPAC name of the opposite compound?



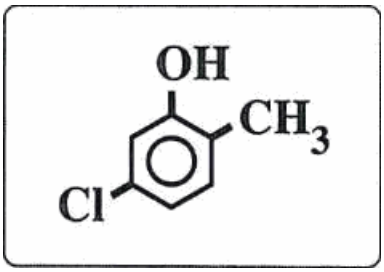
(A) 4-chloro-1,3-dinitrobenzene.
(B) 2,4-dinitro-1-chlorobenzene.
(C) 1,3-dinitro-4-chlorobenzene.
(D) 1-chloro-2,4-dinitrobenzene.

11 What is the IUPAC name of the opposite compound?



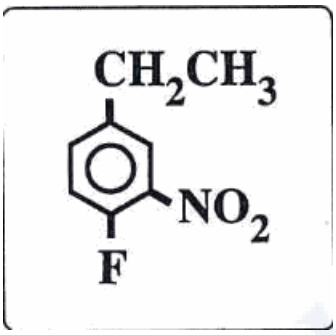
(A) 1,3-dimethyl-4-nitrobenzene.
(B) 1-nitro-3,4-dimethylbenzene.
(C) 2,4-dimethyl-1-nitrobenzene.
(D) 1-nitro-4,6-dimethylbenzene.

12 What is the IUPAC name of the opposite compound?



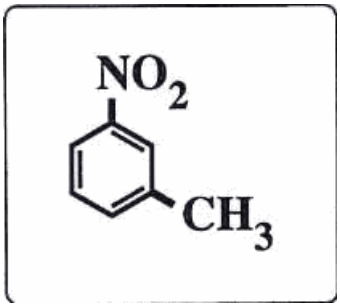
(A) 3-chloro-6-methylphenol.
(B) 1-hydroxy-2-methyl-5-chlorobenzene.
(C) 1-chloro-4-methylphenol.
(D) 4-chloro-2-hydroxy-1-methylbenzene.

13 What is the IUPAC name of the opposite compound?



(A) 1-ethyl-3-nitro-4-fluorobenzene.
(B) 1-fluoro-4-ethyl-2-nitrobenzene.
(C) 4-ethyl-1-fluoro-2-nitrobenzene.
(D) 1-fluoro-2-nitro-4-ethylbenzene.

14 The opposite compound is a disubstituted benzene derivative.
Which of the following expresses the name of this compound?



(A) 3-nitrotoluene , 3-methyl-1-nitrotoluene.
(B) para-nitrotoluene , 3-nitrotoluene.
(C) 3-methylnitrotoluene , meta-methylnitrobenzene.
(D) 3-nitrotoluene , 1-methyl-3-nitrobenzene.

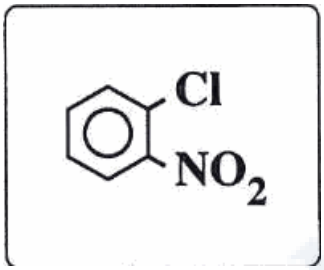
15 What is the IUPAC name of the compound meta-bromotoluene?

(A) 1-bromo-3-methylbenzene.
(B) 1-methyl-3-bromobenzene.
(C) 1-bromo-5-methylbenzene.
(D) 1-methyl-5-bromobenzene.

16 All of the following are correct names, except .....

(A) Toluene is called methylbenzene.
(B) Ethylbenzene is called phenylethane.
(C) Naphthalene is called biphenyl.
(D) ortho-chlorotoluene is called 1-chloro-2-methylbenzene.

17 The opposite compound can be prepared by .....



(A) chlorinating benzene, then nitrating the product.
(B) nitrating benzene, then chlorinating the product.
(C) reacting chlorobenzene with nitrous acid.
(D) reacting benzene with nitrous acid, then chlorinating the product.

18 Benzene is converted into meta-chloronitrobenzene by the two processes .....

(A) halogenation, then nitration.
(B) substitution, then addition.
(C) nitration, then halogenation.
(D) addition, then substitution.

19 When chlorobenzene is chlorinated, ... is formed.

(A) ortho-dichlorobenzene
(B) a mixture of ortho- and para-dichlorobenzene
(C) meta-dichlorobenzene
(D) a mixture of ortho-, para- and meta-trichlorobenzene

20 A cyclic compound (X) has the molecular formula C_7H_8 and a saturated cyclic compound (Y) has the molecular formula C_7H_{14}

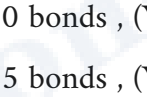
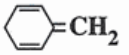
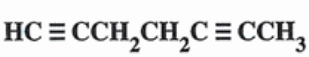
What is the number of sigma bonds in each of the compounds (X) and (Y)?

(A) (X) : 10 bonds , (Y) : 10 bonds.
(B) (X) : 10 bonds , (Y) : 11 bonds.
(C) (X) : 15 bonds , (Y) : 20 bonds.
(D) (X) : 15 bonds , (Y) : 21 bonds.

---

21 From the structural formulas of the following compounds:

Which hydrocarbons are isomers?

			
Compound (4)	Compound (3)	Compound (2)	Compound (1)

(A) Compounds (1) , (2) , (3).
(B) Compounds (2) , (3) , (4).
(C) Compounds (1) , (3) , (4).
(D) Compounds (1) , (2) , (4).

---

22 What is the number of aromatic isomers with the molecular formula C_8H_{10}?

(A) 2 (B) 3 (C) 4 (D) 5

---

23 What is the number of aromatic isomers with the molecular formula $C_6H_4Br_2$?

(A) 1 (B) 2 (C) 3 (D) 4

---

24 Which of the following is true for aromatic benzene?

(A) The positions of the π bonds in it do not change.
(B) It is an unsaturated compound that reacts by addition only.
(C) The electrons of the π bonds are not localized on specific carbon atoms.
(D) When one hydrogen atom in it is replaced by a chlorine atom, it can form 3 isomers.

---

25 Coal tar is a main source of ..... compounds.

(A) aromatic (B) aliphatic (C) saturated cyclic (D) heterocyclic

---

26 The organic solvent whose boiling point is 80°C, which is obtained from coal tar and used to dissolve fats, is .....

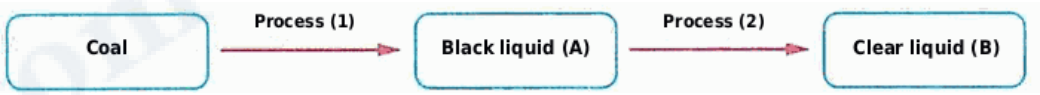
(A) propane.
(B) aromatic benzene.
(C) toluene.
(D) 1,1,1-trichloroethane.

---

27 From the opposite chart:

Coal → process (1) → black liquid (A) → process (2) → clear liquid (B)

Which of the following expresses each of (1) , (2) , (A) , (B)?



(A) (1) destructive distillation , (2) fractional distillation , (A) coal tar , (B) coke

(B) (1) fractional distillation , (2) destructive distillation , (A) the simplest aliphatic hydrocarbon , (B) coke

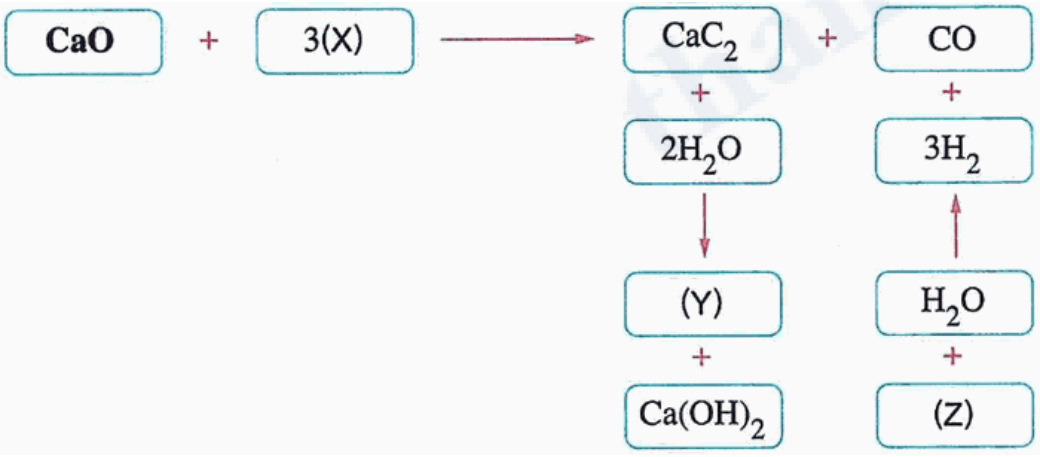
(C) (1) destructive distillation , (2) fractional distillation , (A) coal tar , (B) the simplest aromatic hydrocarbon

(D) (1) fractional distillation , (2) destructive distillation , (A) the simplest aromatic hydrocarbon , (B) coal tar

---

28 The following chart shows some balanced reactions that take place under suitable conditions:

Which of the following is correct?



(A) (X) can be obtained by strongly heating compound (Z) in air.

(B) From (Y) a compound with an aromatic odour can be obtained.

(C) (Z) is heated at 500°C, forming carbon black.

(D) (Y) burns in excess oxygen gas, forming (X).

---

29 What are the suitable conditions for the successive chemical processes that convert a saturated aliphatic hydrocarbon of molar mass 16 g/mol into a saturated hydrocarbon of molar mass 84 g/mol?

[C = 12 , H = 1]

(A) heating then cooling - a nickel tube heated to redness - pressure, heat and catalysts.

(B) pressure, heat and catalysts - heating then cooling - a nickel tube heated to redness.

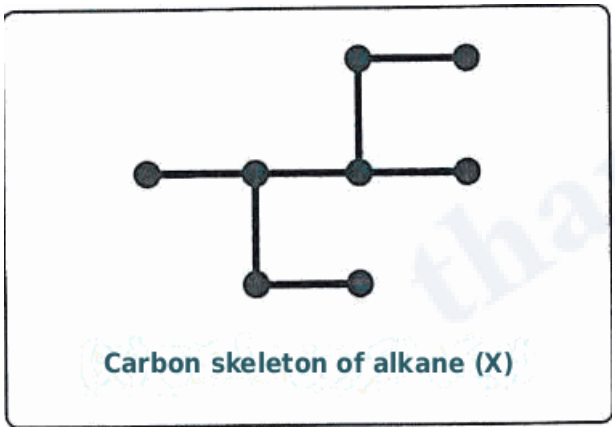
(C) a nickel tube heated to redness - pressure, heat and catalysts - heating then cooling.

(D) pressure, heat and catalysts - a nickel tube heated to redness - heating then cooling.

---

30 The opposite figure shows the carbon skeleton of alkane (X). When the straight-chain isomer of compound (X) undergoes catalytic reforming, compound (Y) is formed.

What is the IUPAC name of each of compounds (X) and (Y), respectively?



Carbon skeleton of alkane (X)

(A) (X) : 3,4-dimethylhexane / (Y) : 1,2-dimethylbenzene.

(B) (X) : 2-ethyl-3-methylpentane / (Y) : 1,2-dimethylbenzene.

(C) (X) : 3,4-dimethylhexane / (Y) : methylbenzene.

(D) (X) : 2-ethyl-3-methylpentane / (Y) : methylbenzene.

---

31 What are the products of the catalytic reforming of normal heptane and normal octane?

(A) normal heptane : toluene , normal octane : ethylbenzene

(B) normal heptane : ethylbenzene , normal octane : toluene

(C) normal heptane : toluene , normal octane : benzene

(D) normal heptane : benzene , normal octane : ethylbenzene

---

32 Benzene can be prepared by the following methods, except .....

(A) phenol : reduction.

(B) benzoic acid : neutralization then dry distillation.

(C) normal hexane : catalytic reforming.

(D) ethene : trimerization.

---

33 When gas (X) is trimerized, compound (Y) is formed, which gives compound (Z) when it is hydrogenated.

Which of the following expresses the type of reactions that convert compound (X) into (Z)?

(A) converting (X) into (Y) : addition , converting (Y) into (Z) : substitution

(B) converting (X) into (Y) : substitution , converting (Y) into (Z) : substitution

(C) converting (X) into (Y) : substitution , converting (Y) into (Z) : addition

(D) converting (X) into (Y) : addition , converting (Y) into (Z) : addition

---

34 Which of the following is a reason why aromatic benzene reacts with difficulty?

(A) Its cyclic structure.

(B) The ring contains 6 carbon atoms.

(C) Its six electrons are not localized on specific carbon atoms.

(D) The ring contains 6 hydrogen atoms.

---

35 From the following chart:

Ethyne → trimerization → compound (X) → catalytic hydrogenation → compound (Y)

What is the similarity between compounds (X) and (Y)?

(A) Reacting by addition.

(B) Being aromatic compounds.

(C) The molar mass.

(D) Being cyclic compounds.

---

36 What is the number of moles of H_2 needed to convert 3-phenylpropene into a saturated compound?

(A) 2 mol (B) 3 mol (C) 4 mol (D) 5 mol

---

37 All of the following are true for naphthalene, except .....

(A) It is an unsaturated hydrocarbon.

(B) Its molar mass is less than the molar mass of biphenyl.

(C) Its molecule contains 10 carbon atoms.

(D) One mole of it reacts with 4 mol of hydrogen to form a saturated compound.

38 All of the following describe vinylbenzene, except that it .....

(A) is a hydrocarbon.

(B) is used in condensation polymerization reactions.

(C) can be converted into a saturated compound.

(D) is used as a monomer in addition polymerization reactions.

39 What is the number of chlorine atoms in one molecule of gammexane?

(A) 2 (B) 3 (C) 5 (D) 6

40 The cyclic haloalkane used as an insecticide is known as .....

(A) 1,1,1-trichloroethane. (B) gammexane.

(C) chlorocyclohexane. (D) halothane.

41 Which of the following expresses the suitable process (X) for converting compound (Y) into the product (Z)?

(A) (X) hydrolysis , (Y) ethyl hydrogen sulphate , (Z) ethene

(B) (X) hydration , (Y) ethanol , (Z) ethene + water

(C) (X) condensation polymerization , (Y) tetrafluoroethene , (Z) Teflon

(D) (X) addition , (Y) aromatic benzene , (Z) gammexane

42 Aromatic benzene and toluene share the general formula .....

(A) C_nH_{2n-6} (B) C_nH_{n-6} (C) C_nH_{2n-2} (D) C_nH_{2n}

43 What is the number of bonds in a toluene molecule?

(A) $(\sigma) : 6 , (\pi) : 3$ (B) $(\sigma) : 9 , (\pi) : 3$

(C) $(\sigma) : 9 , (\pi) : 6$ (D) $(\sigma) : 15 , (\pi) : 3$

44 (1) : Its benzene ring is bonded to a methyl group.

(2) : Its benzene ring is bonded to another benzene ring.

(3) : Its molecule contains only 3 π bonds.

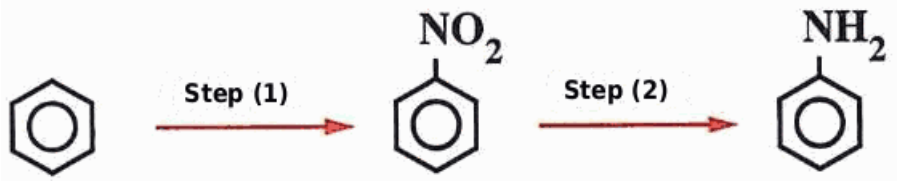
(4) : Its molecule contains 8 hydrogen atoms.

Which statement(s) express(es) the similarity (similarities) between toluene and naphthalene?

(A) (1) only. (B) (4) only. (C) (1) , (2) only. (D) (3) , (4) only.

45 Aminobenzene is prepared from benzene in two steps, as in the opposite chart:

What substances are used in step (1) and what type of reaction is step (2)?



(A) Step (1) : conc HNO_2 , conc H_2SO_4 / Step (2) : oxidation

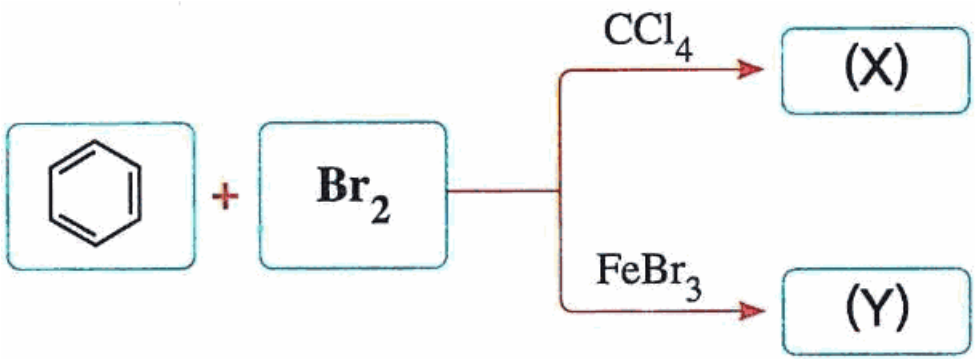
(B) Step (1) : conc HNO_2 , conc H_2SO_4 / Step (2) : reduction

(C) Step (1) : conc HNO_3 , conc H_2SO_4 / Step (2) : oxidation

(D) Step (1) : conc HNO_3 , conc H_2SO_4 / Step (2) : reduction

46 From the opposite chart:

Which of the following expresses the main products (X) and (Y)?



(A) (X) : benzene , (Y) : bromobenzene

(B) (X) : hexabromocyclohexane , (Y) : hydrogen bromide

(C) (X) : hexabromocyclohexane , (Y) : bromobenzene

(D) (X) : benzene , (Y) : hydrogen bromide

47 Which of the following equations is an application of the Friedel-Crafts reaction?

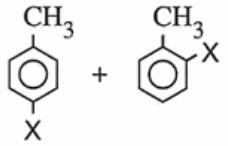
(A) $C_6H_6 + C_2H_5Cl \rightarrow C_6H_5C_2H_5 + HCl$ ($AlCl_3$ anhydrous)

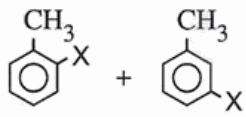
(B) $C_2H_5OH + HCl \rightarrow C_2H_5Cl + H_2O$ ($ZnCl_2$)

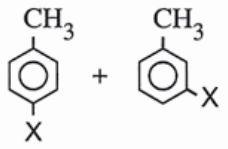
(C) $C_6H_5Cl + CH_3COCl \rightarrow C_6H_5COCH_3 + Cl_2$ ($AlCl_3$ anhydrous)

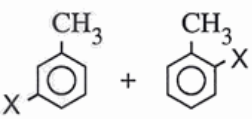
(D) $C_2H_5Br + KOH \rightarrow C_2H_5OH + KBr$

48 When toluene reacts with X_2 in the presence of FeX_3 , ... is formed.

(B) 

(A) 

(D) 

(C) 

49 Benzene reacts with .....

(A) bromine dissolved in CCl_4

(B) nitric acid.

(C) water.

(D) ethanol.

50 What are the steps for preparing para-toluenesulphonic acid from normal hexane?

(A) trimerization → sulphonation → nitration.

(B) reforming → alkylation → sulphonation.

(C) trimerization → sulphonation → alkylation.

(D) reforming → nitration → sulphonation.

51 Toluene reacts with chlorine gas in the presence of (X) as a catalyst to form compound (Y). Which of the following expresses each of (X) and (Y)?

(A) (X) : $FeCl_2$, (Y) : chlorotoluene

(B) (X) : Fe , (Y) : meta-chlorotoluene

(C) (X) : $FeCl_3$, (Y) : gammexane

(D) (X) : Fe , (Y) : a mixture of ortho- and para-chlorotoluene

52 Toluene reacts with concentrated HNO_3 in the presence of concentrated H_2SO_4 , forming .....

(A) para-nitrotoluene.
(B) meta-nitrotoluene.
(C) 2,3-dinitrotoluene.
(D) 4,5-dinitrotoluene.

53 Benzene can be converted into TNT through two reactions, which are .....

(A) alkylation, then nitration.
(B) nitration, then alkylation.
(C) alkylation, then addition.
(D) addition, then nitration.

54 The compound 1-chloro-2-methylbenzene is produced from .....

(A) reducing phenol, then halogenating the product.
(B) alkylating benzene, then halogenating the product in the presence of iron.
(C) reducing phenol, then alkylating the product.
(D) alkylating toluene, then halogenating the product in the presence of iron.

55 An aromatic derivative (A) contains more than one (N – O) bond.
Which of the following is incorrect for (A)?

(A) It can be prepared from toluene.
(B) It contains its own fuel.
(C) Nitrogen gas is produced when it burns.
(D) It exists in the gaseous state.

56 Which of the following expresses a compound, a mixture and a polymer?

(A) compound : bronze , mixture : marsh gas , polymer : Fehling's solution
(B) compound : TNT , mixture : water gas , polymer : PP
(C) compound : Fehling's solution , mixture : marsh gas , polymer : bronze
(D) compound : PP , mixture : water gas , polymer : TNT

57 The following chart shows the steps for converting benzene into 2-bromo-1-methyl-4-nitrobenzene:

benzene → (1) → (2) → (3) → (4) → (5) → (6)

Which of the following is correct?

(A) (1) : CH_3Cl / $AlCl_3$, (3) : HNO_3 / H_2SO_4 , (6) : $C_7H_6BrNO_2$

(B) (2) : $C_6H_5CH_3$, (4) : $C_7H_8NO_2$, (5) : HBr / Fe

(C) (1) : CH_3Cl / $AlCl_3$, (3) : Br_2 / Fe , (6) : $C_7H_8BrNO_3$

(D) (2) : $C_6H_5NO_2$, (4) : CH_3Cl / $AlCl_3$, (5) : $C_6H_4BrNO_2$

---

58 The following chart shows some reactions that take place under suitable conditions:

Which of the following expresses the IUPAC name of each of compounds (X) and (Y)?



(A) (X) : 1-chloro-2-nitrobenzene , (Y) : 1-chloro-4-nitrobenzene.

(B) (X) : meta-chloronitrobenzene , (Y) : 1-chloro-5-nitrobenzene.

(C) (X) : 1-chloro-4-nitrobenzene , (Y) : 1-chloro-3-nitrobenzene.

(D) (X) : 4-nitro-1-chlorobenzene , (Y) : para-chloronitrobenzene.

---

59 Sulphuric acid is used in the following industries, except .....

(A) making one type of car battery.

(B) making food preservatives.

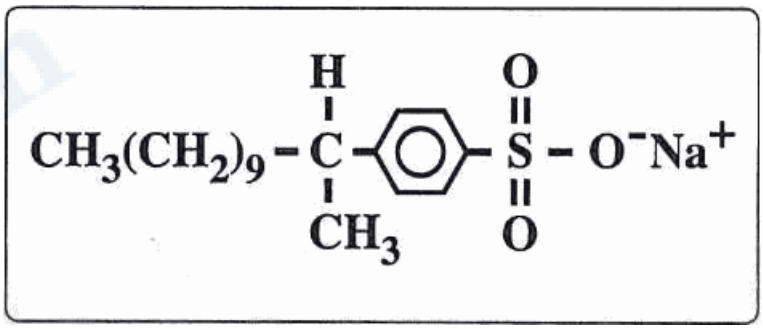
(C) making synthetic detergents.

(D) detecting the barium cation.

---

60 The opposite figure shows the structural formula of a compound.

All of the following describe this compound, except .....



(A) It dissolves in water.

(B) It is a sodium salt.

(C) It has an ionized group.

(D) It is formed by neutralization, then sulphonation.

Essay questions — 16 questions

1 Explain the mistake in the name of each of the following two compounds, and write the correct name of each according to the IUPAC system:

(1) 1,1-dimethyl-2-phenylethene.

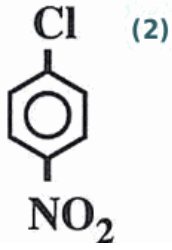
(2) 1,5-dihydroxybenzene.

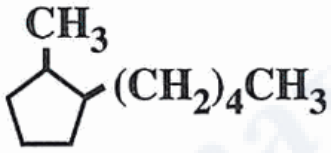
2 Draw the structural formula and write the molecular formula of each of:

(1) 1,3-dibromobenzene.

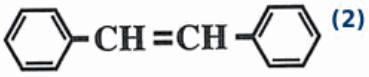
(2) 1-ethyl-3-methylcyclohexane.

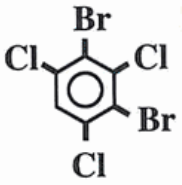
3 Write the IUPAC name of each of the following:

(2) 

(1) 

4 Write the IUPAC name of each of the following:

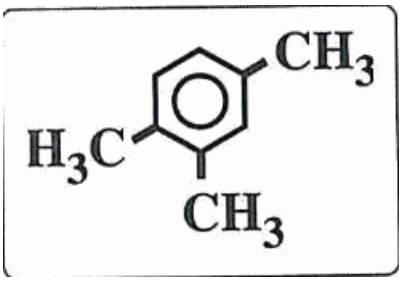
(2) 

(1) 

5 The opposite figure shows the structural formula of an aromatic compound:

(1) Write the IUPAC name of this compound.

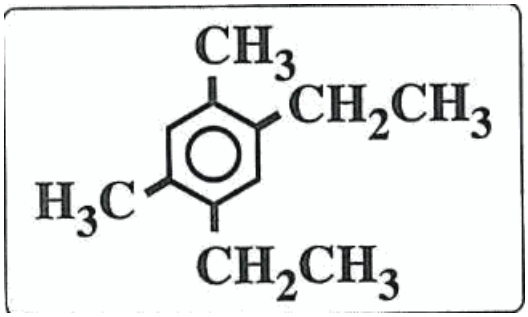
(2) How many moles of H_2 are needed to convert this compound into a cycloalkane?



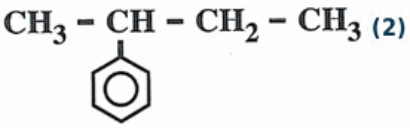
6 The opposite figure shows the structural formula of an aromatic compound:

(1) Write the IUPAC name of this compound.

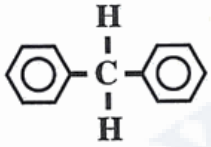
(2) Write the molecular formula of this compound.



7 Write the IUPAC name of each of the following:



(2)



(1)

8 Iron reacts with chlorine gas forming compound (X), while its reaction with the concentrated acid (Y) does not continue because of passivity. Write the balanced symbolic equation for preparing each of:

(1) a blood-red solution from compound (X).

(2) a compound with the chemical formula $C_7H_5N_3O_6$ using compound (Y).

9 Compound (X) can be obtained by hydrogenating aromatic benzene:

(1) Why is compound (X) stable?

(2) Compare compound (X) and aromatic benzene in terms of the general formula.

10 Halothane is prepared from ethane, while gammexane is prepared from aromatic benzene:

(1) State the type of reaction in each case.

(2) Compare halothane and gammexane in terms of the number of chlorine atoms in one molecule.

11 Halogenating aromatic benzene by substitution forms compound (X), while halogenating it by addition forms compound (Y).

(1) How many moles of halogen are used to form one mole of: (a) compound (X). (b) compound (Y).

(2) Classify each of compounds (X) and (Y) as halogenated hydrocarbon derivatives.

12 Show by symbolic equations how aromatic benzene is used to prepare ortho- and para-nitrochlorobenzene.

13 Show by symbolic equations how gammexane is obtained from phenol.

14 Show by symbolic equations how a straight-chain alkane is converted into a cycloalkane.

15 TNT and PVC are well-known chemical substances:
(1) Which of these two compounds has a giant molecule? Explain.
(2) Draw the structural formula of each of: (a) TNT (b) PVC

16 Rearrange the following steps to obtain meta-chloronitrobenzene from calcium carbide: polymerization. , nitration. , halogenation. , hydrolysis.

Past exam questions — 30 questions

1 If you know that compounds (A) and (B) are hydrocarbons with the following formulas: (Sample exam 2026)

(A) : $(CH)_6$, (B) : $(CH_2)_6$

Which of the following applies to compounds (A) and (B)?

(A) (A) : produced by the catalytic reforming of heptane , (B) : produced by the hydration of hexene.

(B) (A) : its molecular formula is C_nH_{2n} , (B) : its molecular formula is C_nH_n

(C) (A) : produced by the reduction of carbolic acid , (B) : produced by the hydrogenation of compound (A).

(D) (A) : an open-chain alkane , (B) : produced by cyclic polymerization.

---

2 Two organic compounds (X) and (Y): (Sample exam 2026)

(X) : a hydrocarbon that reacts vigorously with chlorine, and the reaction is accompanied by light and a flame.

(Y) : a halogen derivative of a hydrocarbon used as an insecticide.

Which of the following expresses compound (X) or (Y)?

(A) (X) : an aromatic hydrocarbon that follows the formula C_nH_{2n-6}

(B) (Y) : an aromatic derivative that follows the formula $C_nH_{n-1}Cl$

(C) (X) : an aliphatic hydrocarbon that follows the formula C_nH_{2n}

(D) (Y) : an aliphatic derivative that follows the formula $C_nH_nCl_n$

---

3 The following equation shows one of the catalytic thermal cracking processes: (Sample exam 2026)

$C_{20}H_{42}(s) \rightarrow X(l) + Y(g) + Z(l)$ (catalyst / pressure / Δ)

(X) : an alkene, one mole of which contains 30 moles of atoms.

(Y) : the heaviest gaseous alkene.

Which of the following does not express compound (Z)?

(A) It is produced by the hydrogenation of hexyne.

(B) It reacts with hydrogen halides (HBr) according to Markovnikov's rule.

(C) Its catalytic reforming gives a compound used as an organic solvent.

(D) It follows the general formula C_nH_{2n+2}

4 An aromatic liquid (X) whose boiling point is 80°C underwent the opposite reactions: (Sample exam 2026)

X + chlorine (UV) → Y

X + chlorine ($UV/FeCl_3$) → Z

Which of the following is correct?

(A) (Y) is an aliphatic derivative.
(B) (Y) is an aromatic hydrocarbon.
(C) (Z) is an aromatic hydrocarbon.
(D) (Z) is an aliphatic derivative.

---

5 A saturated aliphatic hydrocarbon (X) has the general formula C_nH_{2n} and contains 6 methylene groups. (Sample exam 2026)

Which of the following expresses the correct order of the processes needed to obtain compound (X) from calcium carbide?

(A) dropping water → trimerization → halogenation.
(B) dropping water → catalytic hydration → oxidation.
(C) dropping water → trimerization → hydrogenation.
(D) thermal decomposition → polymerization → hydrogenation.

---

6 Which of the following choices expresses the correct order of the processes needed to obtain an aliphatic insecticide with the formula $C_nH_nCl_n$ from an aliphatic compound with the formula C_nH_{2n+2}? (Sample exam 2026)

(A) catalytic reforming – halogenation in the presence of a catalyst.
(B) trimerization – halogenation in the presence of UV
(C) catalytic reforming – halogenation in the presence of UV
(D) trimerization – halogenation in the presence of a catalyst.

---

7 Which of the following choices expresses a compound that does not decolourize bromine dissolved in carbon tetrachloride? (Sample exam 2026)

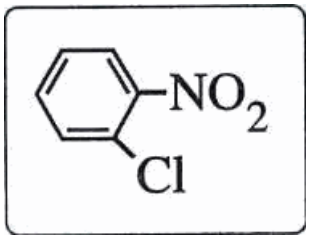
(A) The product of dropping water on calcium carbide.
(B) The product of the catalytic reforming of hexane.
(C) The product of adding concentrated sulphuric acid to propanol at 180°C
(D) The product of strongly heating then rapidly cooling the product of the dry distillation of sodium acetate.

---

8 Which of the following is the compound produced by the catalytic reforming of 3-ethylhexane, then the hydrogenation of the product? (1st session 2025)

(A) Ethylbenzene.
(B) Dimethylbenzene.
(C) Methylcyclohexane.
(D) Ethylcyclohexane.

9 Which of the following is the last process to obtain the following compound from benzene? (1st session 2025)



(A) Nitration.
(B) Polymerization.
(C) Alkylation.
(D) Halogenation.

10 The opposite table shows the molecular formulas of three organic compounds X , Y , Z , so ..... (Trial exam / June 2021)

(X) : C_3H_6 , (Y) : C_7H_8 , (Z) : C_3H_8

(A) (X) : cycloalkane , (Z) : normal alkane , (Y) : aromatic.
(B) (X) : normal alkane , (Z) : cycloalkane , (Y) : aromatic.
(C) (X) : alkyne , (Z) : normal alkane , (Y) : aromatic.
(D) (X) : aromatic , (Z) : alkene , (Y) : alkyne.

11 You have the following four compounds: (1st session 2022)

(A) : C_3H_8 , (B) : C_6H_6 , (C) : C_8H_{10} , (D) : C_2H_2

Which of the following is correct?

(A) Compound (A) is unsaturated aliphatic, compound (C) is aromatic.
(B) Compound (A) is saturated aliphatic, compound (D) is unsaturated aliphatic.
(C) Compound (B) is aromatic, compound (D) is saturated aliphatic.
(D) Compound (C) is aromatic, compound (B) is saturated aliphatic.

12 Using the following table: (2nd session 2022)

(A) : C_3H_4 , (B) : $C_{10}H_8$, (C) : C_4H_8 , (D) : $C_{10}H_{22}$

The correct choice that expresses substances (A) , (B) , (C) , (D) is .....

(A) (A) : aromatic , (B) : alkyne , (C) : alkene , (D) : alkane.

(B) (A) : alkyne , (B) : aromatic , (C) : alkane , (D) : alkene.

(C) (A) : alkyne , (B) : aromatic , (C) : alkene , (D) : alkane.

(D) (A) : cycloalkane , (B) : aromatic , (C) : alkane , (D) : alkane.

---

13 From the following organic compounds: (1st session 2024)

(X) : C_7H_8 , (Y) : C_3H_6 , (Z) : C_6H_{14}

Which of the following choices is correct?

(A) (X) is an alkyne used in the oxyacetylene flame, (Y) is an alkane used to prepare benzene, (Z) is an alkene used to prepare acetaldehyde.

(B) (X) is aromatic and used as an organic solvent, (Y) is an alkene used to make plastic bags, (Z) is an alkane used as a fuel.

(C) (X) is an alkane used as an anaesthetic, (Y) is an alkane used as a fuel, (Z) is aromatic and used as an organic solvent.

(D) (X) is aromatic and used to make explosives, (Y) is an alkene used to make carpets, (Z) is an alkane used to prepare benzene.

---

14 Each of the following steps is carried out to convert a compound with the general formula C_nH_{2n+2} into a compound with the general formula C_nH_{2n} , except ..... (1st session 2023)

(A) strong heating and rapid cooling – polymerization – hydrogenation.

(B) reforming – alkylation – hydrogenation.

(C) halogenation – alkaline hydrolysis – dehydration.

(D) strong heating and rapid cooling – catalytic hydration – reduction.

---

15 The number of moles of hydrogen that must be added to 1 mol of diphenylacetylene to convert it into a saturated compound equals ..... (1st session 2022)

(A) 4 mol (B) 5 mol (C) 6 mol (D) 8 mol

---

16 To obtain a cycloalkane from calcium carbide we follow the steps ..... (Trial exam / June 2021)

(A) reaction with water / polymerization / hydrogenation.

(B) hydrogenation / polymerization / reaction with water.

(C) reaction with water / hydrogenation / polymerization.

(D) hydrogenation / reaction with water / polymerization.

---

17 Hydrogenating the compound produced by the reduction of phenol under suitable conditions leads to the formation of ..... (1st session 2021)

(A) picric acid.

(B) an aliphatic compound.

(C) vinyl chloride.

(D) an aromatic compound.

---

18 The number of moles of hydrogen gas that must be added to 2 mol of phenylacetylene to saturate it equals ..... (Trial exam / March 2023)

(A) 5 mol (B) 10 mol (C) 4 mol (D) 6 mol

---

19 From the following chart: (Trial exam / March 2023)

$C_nH_nO \rightarrow$ (reduction) $C_nH_n \rightarrow (1)$ (A) C_nH_{2n}

Process (1) and compound (A) are .....

(A) (1) : polymerization , (A) : cyclohexane.

(B) (1) : hydrogenation , (A) : cyclohexane.

(C) (1) : hydrogenation , (A) : hexene.

(D) (1) : polymerization , (A) : hexene.

---

20 To obtain an aliphatic compound used as an insecticide from calcium carbide, the steps in order are ..... (2nd session 2022)

(A) dropping water – polymerization – halogenation by addition.

(B) dropping water – hydrogenation – oxidation.

(C) dropping water – hydrogenation – reduction.

(D) dropping water – polymerization – halogenation by substitution.

---

21 The correct order of the chemical processes used to convert an alkane made of (5) atoms into an insecticide made of (18) atoms is ..... (Trial exam / March 2023)

(A) strong heating with rapid cooling, then halogenation, then polymerization.

(B) polymerization, then halogenation, then strong heating with rapid cooling.

(C) strong heating with rapid cooling, then polymerization, then halogenation.

(D) halogenation, then strong heating with rapid cooling, then polymerization.

---

22 An aromatic compound with the molecular formula C_8H_{10} can be prepared from ..... (Trial exam / June 2021)

(A) the reaction of ethyl chloride with benzene in the presence of anhydrous aluminium chloride.

(B) the reaction of methyl chloride with benzene in the presence of anhydrous aluminium chloride.

(C) heating heptane in the presence of platinum.

(D) heating hexane in the presence of platinum.

---

23 From the following chart: (1st session 2023)

$C_3H_6 \rightarrow (HX)\ (A) \rightarrow (C_6H_6 + \text{anhydrous } AlCl_3)\ (B)$

(A) and (B) are .....

(A) (A) : secondary propyl chloride , (B) : 1-phenylpropane.

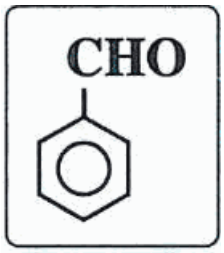
(B) (A) : primary propyl bromide , (B) : 1-phenylpropane.

(C) (A) : secondary propyl chloride , (B) : 2-phenylpropane.

(D) (A) : primary propyl bromide , (B) : 2-phenylpropane.

---

24 When the opposite compound (benzaldehyde) is nitrated, the product is ..... (1st session 2022)



Benzaldehyde

(A) ortho-nitrobenzaldehyde.

(B) para-nitrobenzaldehyde.

(C) meta-nitrobenzaldehyde.

(D) a mixture of ortho- and para-nitrobenzaldehyde.

---

25 When the compound produced by the catalytic reforming of normal heptane is nitrated, ... is formed. (1st session 2021)

(A) an insecticide

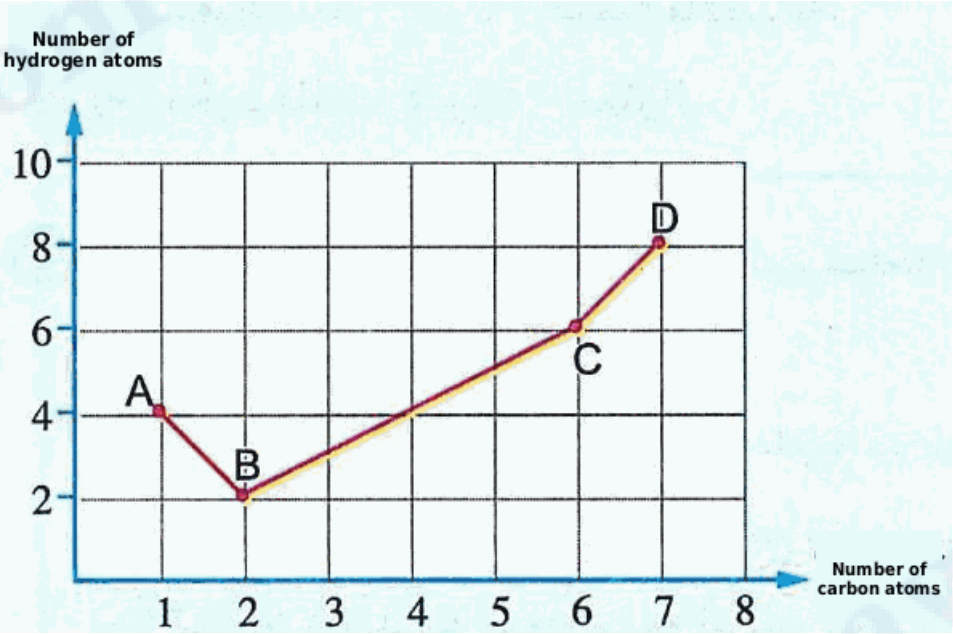
(B) a synthetic detergent

(C) an explosive with the molecular formula $C_6H_3N_3O_7$

(D) an explosive with the molecular formula $C_7H_5N_3O_6$

---

26 After studying the opposite graph, which shows the relation between the number of carbon atoms and the number of hydrogen atoms for some hydrocarbons, (2nd session 2023)
the processes used to obtain compound (D) from compound (A) are .....



(A) strong heating then rapid cooling – alkylation – polymerization.
(B) strong heating then rapid cooling – polymerization – alkylation.
(C) polymerization – alkylation – strong heating then rapid cooling.
(D) polymerization – strong heating then rapid cooling – alkylation.

---

27 From the following chart: (2nd session 2023)
heptane → (reforming) (X) → (hydrogenation) (Y)
Which of the following choices is correct for each of (X) and (Y)?

(A) (X) and (Y) react by addition.
(B) (X) and (Y) react by substitution.
(C) (Y) reacts by addition only.
(D) (X) reacts by substitution only.

---

28 From the following reaction: (Sample exam 2026)
$C_6H_5CH_2Cl + C_6H_6 \rightarrow A + B$ (in the presence of $AlCl_3$)
Which of the following represents each of compounds (A) and (B)?

(A) (A) : $C_6H_5CHClC_6H_5$, (B) : H_2
(B) (A) : $C_6H_5CH_2C_6H_4Cl$, (B) : H_2
(C) (A) : $C_6H_5CH_2C_6H_5$, (B) : HCl
(D) (A) : $C_6H_5CH_2C_6H_5$, (B) : Cl_2

---

29 When the chemical processes (halogenation - reaction with benzene - nitration) are carried out in order on (a gas found in coal mines), the compound produced is ..... (Sample exam 2026)

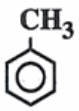
(A) the insecticide trinitrobenzene.
(B) the explosive TNT
(C) the explosive picric acid.
(D) the insecticide gammexane.

30 The following table shows the chemical formulas of organic compounds: (Sample exam 2026)
Write the IUPAC name of each of the following:

(1) The compound produced by the reaction of one mole of one of the above compounds with 2 mol of bromine to give a saturated compound.

(2) The compound produced by the reaction of HBr with one of the above compounds according to Markovnikov's rule in the first step.

(3) The two compounds produced by the reaction of 2 mol of one of the above compounds with 2 mol of chlorine under suitable conditions, giving two isomers, each monochlorinated.

(C) $CH_3 - CH = CH_2$	(B) $CH_2 = CH_2$	(A) 
(F) 	(E) 	(D) $CH \equiv CH$

Answer key and solutions

Multiple choice questions

1 B	2 D	3 D	4 C	5 B	6 D	7 A	8 B	9 B	10 D
11 C	12 D	13 C	14 D	15 A	16 C	17 A	18 C	19 B	20 D
21 C	22 C	23 C	24 C	25 A	26 B	27 C	28 B	29 A	30 A
31 A	32 D	33 D	34 C	35 D	36 C	37 D	38 B	39 D	40 B
41 D	42 A	43 D	44 B	45 D	46 A	47 A	48 B	49 B	50 B
51 D	52 A	53 A	54 B	55 D	56 B	57 A	58 C	59 B	60 D

1 **Answer (B)**

All aromatic compounds contain a benzene ring, so all of them are cyclic, not only some.

2 **Answer (D)**

The six bonds between the carbon atoms in benzene are identical, and their length is intermediate between single and double bonds.

Butene and propyne have separate single and double (or triple) bonds.

3 **Answer (D)**

In C_6H_6 : σ bonds = 6 (C–C) + 6 (C–H) = 12 , π bonds = 3

The ratio = 12 : 3 = 4 : 1

4 **Answer (C)**

Naphthalene is a solid and benzene is a liquid, so they differ in physical state.

5 **Answer (B)**

The longest chain has 5 carbon atoms (pentane) and the phenyl group is on carbon atom number 2

The name: 2-phenylpentane.

6 **Answer (D)**

The longest chain passing through the ethyl group: 5 carbon atoms (pentane).

Numbering from the phenyl side: phenyl on carbon 2 and methyl on carbon 3

The name: 3-methyl-2-phenylpentane.

7 **Answer (A)**

The continuous chain of 5 carbon atoms carries two phenyl groups on carbon 1 and carbon 4

The name: 1,4-diphenylpentane.

8 **Answer (B)**

The chain of 3 carbon atoms has a double bond (propene) and carries two phenyl groups at the two ends.

The name: 1,3-diphenylpropene.

9 **Answer (B)**

The lowest set of numbers for the substituents is (1, 2, 4): chlorine 1, bromine 2, nitro 4

The name: 2-bromo-1-chloro-4-nitrobenzene.

10 **Answer (D)**

Chlorine is on carbon 1 and the two nitro groups are on 2 and 4

The name: 1-chloro-2,4-dinitrobenzene.

11 **Answer (C)**

The lowest numbers (1, 2, 4) are obtained by numbering the nitro 1 and the methyls 2 and 4

The name: 2,4-dimethyl-1-nitrobenzene.

12 **Answer (D)**

The lowest numbers for the substituents (1, 2, 4): methyl 1, hydroxy 2, chlorine 4

The name: 4-chloro-2-hydroxy-1-methylbenzene.

13 **Answer (C)**

Lowest numbers (1, 2, 4): fluoro 1, nitro 2, ethyl 4, and they are arranged alphabetically.

The name: 4-ethyl-1-fluoro-2-nitrobenzene.

14 **Answer (D)**

The methyl and nitro groups are in the meta position (1, 3).

The name: 3-nitrotoluene or 1-methyl-3-nitrobenzene.

15 **Answer (A)**

Meta means the positions $(1, 3)$, and bromo comes before methyl alphabetically, so it takes number 1

The name: 1-bromo-3-methylbenzene.

16 **Answer (C)**

Biphenyl is two benzene rings joined by a single bond, while naphthalene is two fused rings.

17 **Answer (A)**

The compound is ortho-chloronitrobenzene.

Chlorine directs to ortho and para, so we chlorinate benzene first, then nitrate the product.

18 **Answer (C)**

The nitro group directs to meta, so we nitrate benzene first, then halogenate the product.

19 **Answer (B)**

Chlorine directs to ortho and para, so a mixture of ortho- and para-dichlorobenzene is formed.

20 **Answer (D)**

(X) toluene : $\sigma = 7\ (C–C) + 8\ (C–H) = 15$

(Y) methylcyclohexane : $\sigma = 7\ (C–C) + 14\ (C–H) = 21$

21 **Answer (C)**

$(1)\ C_7H_8$, $(2)\ C_6H_6$, $(3)\ C_7H_8$, $(4)\ C_7H_8$

Compounds (1) , (3) , (4) have the same molecular formula, so they are isomers.

22 **Answer (C)**

The aromatic isomers of C_8H_{10}: ethylbenzene and ortho-, meta- and para-dimethylbenzene, i.e. 4

23 **Answer (C)**

The isomers of $C_6H_4Br_2$: ortho, meta and para, i.e. 3

24 **Answer (C)**

The circle inside the hexagon shows that the electrons of the π bonds are not localized on specific carbon atoms.

Benzene reacts by addition and substitution, and replacing one H atom with chlorine gives only one compound.

25 **Answer (A)**

Aromatic compounds are produced by the fractional distillation of coal tar.

26 **Answer (B)**

Aromatic benzene is a solvent whose boiling point is 80°C, and it is extracted from coal tar.

27 **Answer (C)**

The destructive distillation of coal gives coal tar (a black liquid).

The fractional distillation of coal tar gives benzene (the simplest aromatic hydrocarbon).

28 **Answer (B)**

$CaO + 3C \rightarrow CaC_2 + CO$, so compound (X) is carbon.

$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$, so compound (Y) is ethyne.

$CH_4 + H_2O \rightarrow CO + 3H_2$, so compound (Z) is methane.

The trimerization of ethyne gives benzene, which has an aromatic odour.

29 **Answer (A)**

16 g/mol is methane CH_4 , and 84 g/mol is cyclohexane C_6H_{12}

$CH_4 \rightarrow$ heating then cooling $\rightarrow C_2H_2 \rightarrow$ heated nickel tube $\rightarrow C_6H_6 \rightarrow$ pressure, heat and catalysts (hydrogenation) $\rightarrow C_6H_{12}$

30 **Answer (A)**

The longest chain in the skeleton has 6 carbon atoms with two methyl groups on carbons 3 and 4 : (X) 3,4-dimethylhexane (C_8H_{18}).

Its straight-chain isomer is normal octane, and its reforming gives 1,2-dimethylbenzene.

31 **Answer (A)**

$C_7H_{16} \rightarrow C_6H_5CH_3 + 4H_2$ (toluene)

$C_8H_{18} \rightarrow C_6H_5C_2H_5 + 4H_2$ (ethylbenzene)

32 **Answer (D)**

It is the trimerization of ethyne (not ethene) that gives benzene.

33 **Answer (D)**

(X) is ethyne, (Y) is benzene, (Z) is cyclohexane.

Trimerization is an addition reaction, and hydrogenation is an addition reaction.

34 **Answer (C)**

The six electrons of the π bonds in benzene are not localized on specific carbon atoms, which makes it stable and hard to react.

35 **Answer (D)**

(X) is benzene and (Y) is cyclohexane, and both are cyclic compounds.

36 **Answer (C)**

$C_6H_5–CH_2–CH=CH_2$: the ring needs 3 mol H_2 and the double bond 1 mol

The total is 4 mol

37 **Answer (D)**

Naphthalene $C_{10}H_8$ has 5 π bonds, so it needs 5 mol H_2 to become saturated, not 4 mol

38 **Answer (B)**

Vinylbenzene (styrene) is used as a monomer in addition polymerization, not condensation.

39 **Answer (D)**

Gammexane $C_6H_6Cl_6$ has 6 chlorine atoms.

40 **Answer (B)**

Gammexane (hexachlorocyclohexane) is a cyclic haloalkane used as an insecticide.

41 **Answer (D)**

Adding chlorine to benzene in the presence of ultraviolet rays gives gammexane.

Teflon is produced by addition polymerization, and ethene is produced by removing water from ethanol.

42 **Answer (A)**

Benzene C_6H_6 and toluene C_7H_8 both follow C_nH_{2n-6}

43 **Answer (D)**

Toluene $C_6H_5CH_3$: $\sigma = 7\ (C–C) + 8\ (C–H) = 15$, $\pi = 3$

44 **Answer (B)**

Toluene C_7H_8 and naphthalene $C_{10}H_8$ both have 8 hydrogen atoms.

Naphthalene is two fused rings and has 5 π bonds.

45 **Answer (D)**

Step (1) is nitration with a mixture of concentrated nitric and sulphuric acids.

Step (2) converts $-NO_2$ into $-NH_2$, which is reduction.

46 **Answer (A)**

Benzene does not react with bromine dissolved in CCl_4, so it stays benzene (X).

In the presence of $FeBr_3$ substitution takes place and bromobenzene (Y) is formed.

47 **Answer (A)**

The Friedel-Crafts reaction: replacing an H atom in the benzene ring with an alkyl group in the presence of anhydrous $AlCl_3$.

48 **Answer (B)**

The methyl group directs to the ortho and para positions.

49 **Answer (B)**

Benzene reacts with nitric acid (nitration) and does not react with bromine dissolved in CCl_4

50 **Answer (B)**

Normal hexane → reforming → benzene → alkylation → toluene → sulphonation → para-toluenesulphonic acid.

51 **Answer (D)**

Iron reacts with chlorine, forming the catalyst $FeCl_3$.

Methyl directs to ortho and para, so a mixture of ortho- and para-chlorotoluene is formed.

52 **Answer (A)**

Methyl directs to ortho and para, so para-nitrotoluene is formed.

53 **Answer (A)**

The alkylation of benzene gives toluene, then its nitration gives TNT

54 **Answer (B)**

The alkylation of benzene gives toluene, then its halogenation in the presence of iron gives ortho-chlorotoluene (1-chloro-2-methylbenzene).

55 **Answer (D)**

(A) is TNT, and it is a solid, not a gas.

56 **Answer (B)**

TNT is a compound, water gas ($CO + H_2$) is a mixture, and PP is a polymer.

57 **Answer (A)**

(1) alkylation with CH_3Cl / $AlCl_3$ → (2) toluene → (3) nitration with HNO_3 / H_2SO_4 → (4) para-nitrotoluene → (5) halogenation with Br_2 / Fe → (6) $C_7H_6BrNO_2$

58 **Answer (C)**

(X) : chlorine directs to ortho and para, so 1-chloro-4-nitrobenzene is formed.

(Y) : nitro directs to meta, so 1-chloro-3-nitrobenzene is formed.

59 **Answer (B)**

Sulphuric acid is not used in making food preservatives.

60 **Answer (D)**

The detergent is prepared by sulphonating the alkylbenzene, then neutralizing with NaOH , not by neutralization then sulphonation.

Essay questions

1 **Model answer**

(1) The mistake: the compound is named after ethene although the longest continuous carbon chain in it has 3 carbon atoms.

The correct name: 2-methyl-1-phenyl-1-propene.

(2) The mistake: the numbering of the branching points does not give the lowest possible sum of the substituent numbers.

The correct name: 1,3-dihydroxybenzene.

2 **Model answer**

(1) A benzene ring with two bromine atoms in positions 1 and 3 , molecular formula: $C_6H_4Br_2$

(2) A saturated hexane ring carrying an ethyl group on carbon 1 and a methyl group on carbon 3 , molecular formula: C_9H_{18}

3 **Model answer**

(1) 1-methyl-2-pentylcyclopentane.

(2) 1-chloro-4-nitrobenzene.

4 **Model answer**

(1) 2,4-dibromo-1,3,5-trichlorobenzene.

(2) 1,2-diphenylethene.

5 **Model answer**

(1) 1,2,4-trimethylbenzene.

(2) 3 mol

6 **Model answer**

(1) 1,5-diethyl-2,4-dimethylbenzene.

(2) $C_{12}H_{18}$

7 **Model answer**

(1) diphenylmethane.

(2) 2-phenylbutane.

8 **Model answer**

(1) Compound (X) is $FeCl_3$:

$FeCl_3(aq) + 3NH_4SCN(aq) \rightleftharpoons Fe(SCN)_3(aq) + 3NH_4Cl(aq)$

(2) Compound (Y) is HNO_3 :

$C_6H_5CH_3 + 3HNO_3 \rightarrow C_6H_2(CH_3)(NO_2)_3 + 3H_2O$ (conc H_2SO_4 , Δ)

9 **Model answer**

(1) Compound (X), cyclohexane, is stable because the angles between its bonds are close to 109.5°, so the overlap between the atomic orbitals is strong, forming strong sigma (σ) bonds that are hard to break.

(2) General formula: compound (X) : C_nH_{2n} , aromatic benzene : C_nH_n

10 **Model answer**

(1) The type of reaction for preparing halothane from ethane: substitution.

The type of reaction for preparing gammexane from benzene: addition.

(2) Number of chlorine atoms: halothane one atom , gammexane 6 atoms.

11 **Model answer**

(1) (a) 1 mol (b) 3 mol

(2) Compound (X) : aromatic , compound (Y) : aliphatic.

12 **Model answer**

$C_6H_6 + Cl_2 \rightarrow C_6H_5Cl + HCl$ ($FeCl_3$)

$2C_6H_5Cl + 2HNO_3 \rightarrow$ ortho-nitrochlorobenzene + para-nitrochlorobenzene + $2H_2O$ (conc H_2SO_4 , Δ)

13 **Model answer**

(1) $C_6H_5OH + Zn \rightarrow C_6H_6 + ZnO$ (Δ , reduction)

(2) $C_6H_6 + 3Cl_2 \rightarrow C_6H_6Cl_6$ (UV) (gammexane)

14 **Model answer**

$C_6H_{14} \rightarrow C_6H_6 + 4H_2$ (Pt , Δ)

$C_6H_6 + 3H_2 \rightarrow C_6H_{12}$ (Δ / P , cat.)

15 **Model answer**

(1) PVC, because it is made of a very large number of monomers.

(2) (a) TNT : a benzene ring with a methyl group and three nitro groups in positions 2 , 4 , 6

(b) PVC : $-[CH_2-CHCl]_n-$

16 **Model answer**

hydrolysis → polymerization → nitration → halogenation.

Past exam questions

1	2	3	4	5	6	7	8	9	10
C	D	B	A	C	C	B	D	A	A
11	12	13	14	15	16	17	18	19	20
B	C	D	D	D	A	B	B	B	A
21	22	23	24	25	26	27	28	29	30
C	A	C	C	D	B	B	C	B	—

1 **Answer (C)**

(A) is benzene C_6H_6 , and (B) is cyclohexane C_6H_{12}

Benzene is produced by reducing phenol (carbolic acid) with zinc, and its hydrogenation gives cyclohexane.

2 **Answer (D)**

(Y) is gammexane $C_6H_6Cl_6$, an insecticide, and it is an aliphatic derivative (cyclic, non-aromatic) with the formula $C_nH_nCl_n$

3 **Answer (B)**

(X) : an alkene C_nH_{2n} with 3n atoms = 30 , n = 10 , $C_{10}H_{20}$

(Y) the heaviest gaseous alkene C_4H_8

(Z) = $C_{20}H_{42} - C_{10}H_{20} - C_4H_8 = C_6H_{14}$ (hexane)

Hexane is a saturated alkane that does not react by addition with HBr

4 **Answer (A)**

(X) is benzene (it boils at 80°C).

With chlorine in UV light it reacts by addition, forming (Y), gammexane $C_6H_6Cl_6$, which is an aliphatic derivative.

With $FeCl_3$ it reacts by substitution, forming (Z), chlorobenzene, which is an aromatic derivative.

5 **Answer (C)**

(X) is cyclohexane C_6H_{12}

$CaC_2 + H_2O \rightarrow$ ethyne , trimerization → benzene , hydrogenation → cyclohexane.

6 **Answer (C)**

Hexane (C_nH_{2n+2}) gives benzene by catalytic reforming.

The halogenation of benzene in the presence of UV gives gammexane $C_6H_6Cl_6$

7 **Answer (B)**

The catalytic reforming of hexane gives benzene, which does not decolourize bromine without a catalyst.

The other choices give ethyne or propene, which remove the colour.

8 **Answer (D)**

The catalytic reforming of 3-ethylhexane gives ethylbenzene.

Its hydrogenation gives ethylcyclohexane.

9 **Answer (A)**

Chlorine directs to ortho and para, and the nitro group directs to meta.

So halogenation is done first, then nitration, and the last process is nitration.

10 **Answer (A)**

(X) C_3H_6 follows C_nH_{2n} , so it can be a cycloalkane (cyclopropane).

(Z) C_3H_8 is a normal alkane, and (Y) C_7H_8 , toluene, is aromatic.

11 **Answer (B)**

(A), propane, is saturated aliphatic, and (D), ethyne, is unsaturated aliphatic.

12 **Answer (C)**

(A) C_3H_4 alkyne , (B) $C_{10}H_8$ naphthalene, aromatic , (C) C_4H_8 alkene , (D) $C_{10}H_{22}$ alkane.

13 **Answer (D)**

(X) C_7H_8 , toluene, is aromatic and used to make explosives (TNT).

(Y) C_3H_6 , propene, is an alkene, and polypropylene for carpets is made from it.

(Z) C_6H_{14} , hexane, is an alkane, and benzene is made from it by reforming.

14 **Answer (D)**

Strongly heating and rapidly cooling methane gives ethyne, its hydration gives acetaldehyde, and its reduction gives ethanol.

And the formula of ethanol is not C_nH_{2n}

15 **Answer (D)**

Diphenylacetylene $C_6H_5–C{\equiv}C–C_6H_5$

The triple bond needs 2 mol and each benzene ring 3 mol

2 + 3 + 3 = 8 mol

16 **Answer (A)**

CaC_2 + water → ethyne , polymerization → benzene , hydrogenation → cyclohexane.

17 **Answer (B)**

The reduction of phenol gives benzene, and its hydrogenation gives cyclohexane, which is an aliphatic (cyclic) compound.

18 **Answer (B)**

Phenylacetylene $C_6H_5–C{\equiv}CH$ needs 2 + 3 = 5 mol per mole.

2 mol of it need 10 mol

19 **Answer (B)**

The reduction of phenol C_6H_6O gives benzene C_6H_6

The hydrogenation of benzene (process 1) gives cyclohexane C_6H_{12}

20 **Answer (A)**

CaC_2 + water → ethyne , polymerization → benzene , halogenation by addition → gammexane (an insecticide).

21 **Answer (C)**

The alkane made of 5 atoms is methane, and the insecticide made of 18 atoms is gammexane $C_6H_6Cl_6$

strong heating and rapid cooling → ethyne , polymerization → benzene , halogenation → gammexane.

22 **Answer (A)**

$C_6H_6 + C_2H_5Cl \rightarrow C_6H_5C_2H_5 + HCl$ ($AlCl_3$)

Ethylbenzene has the formula C_8H_{10}

23 **Answer (C)**

C_3H_6 + HCl according to Markovnikov gives secondary propyl chloride (A).

Alkylating benzene with it gives 2-phenylpropane (B).

24 **Answer (C)**

The CHO group directs to the meta position, so the product is meta-nitrobenzaldehyde.

25 **Answer (D)**

The reforming of heptane gives toluene, and its nitration gives TNT with the formula $C_7H_5N_3O_6$

26 **Answer (B)**

(A) CH_4 , (B) C_2H_2 , (C) C_6H_6 , (D) C_7H_8

strong heating then rapid cooling → ethyne , polymerization → benzene , alkylation → toluene.

27 **Answer (B)**

(X) is toluene, and (Y) is methylcyclohexane.

Both react by substitution (toluene also reacts by addition with difficulty).

28 **Answer (C)**

Friedel-Crafts reaction: $C_6H_5CH_2Cl + C_6H_6 \rightarrow C_6H_5CH_2C_6H_5 + HCl$

29 **Answer (B)**

Methane → (halogenation) chloromethane → (+ benzene) toluene → (nitration) TNT

30 **Model answer**

(1) 1,1,2,2-tetrabromoethane (from ethyne (D) with 2 mol of bromine).

(2) 2-bromopropane (from propene (C) with HBr).

(3) From toluene (F) with chlorine in the presence of a catalyst:

2-chlorotoluene (1-chloro-2-methylbenzene), and 4-chlorotoluene (1-chloro-4-methylbenzene).