Chemistry · Organic Chemistry

Alkenes (Olefins)

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Multiple choice questions — 100 questions

1 What is the molar mass of the alkene that contains 10 mol of hydrogen atoms?
[C = 12 , H = 1]

(A) 42 g/mol (B) 56 g/mol (C) 70 g/mol (D) 84 g/mol

2 What is the molecular formula of the second member of the olefin series?

(A) C_2H_2 (B) C_2H_4 (C) C_3H_6 (D) C_3H_4

3 Ethylene and propylene both have the same .....

(A) molecular formula. (B) structural formula.
(C) general formula. (D) molar mass.

4 What is the mass of ethene gas that occupies the same volume as 6 g of ethane gas (at STP)?
[C = 12 , H = 1]

(A) 4.67 g (B) 5 g (C) 5.6 g (D) 6 g

5 The following table shows the number of carbon atoms in the molecules of some hydrocarbons and their molar masses:

(W) : 3 carbon atoms , 42 g/mol
(X) : 4 carbon atoms , 56 g/mol
(Y) : 5 carbon atoms , 72 g/mol
(Z) : 6 carbon atoms , 84 g/mol

All these compounds have the same general formula, except .....
[C = 12 , H = 1]

(A) (W). (B) (X). (C) (Y). (D) (Z).

6 What is the number of sigma and pi bonds in one mole of ethene?

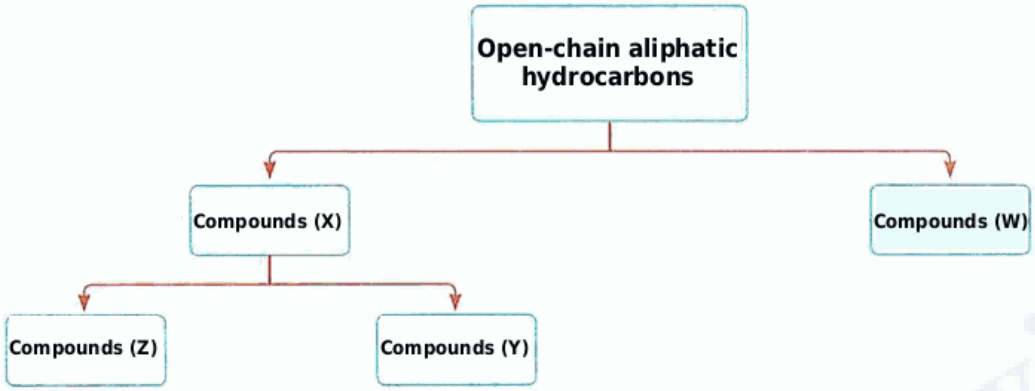
(A) $(\sigma) : 24.08 \times 10^{23}$ / $(\pi) : 12.04 \times 10^{23}$
(B) $(\sigma) : 18.06 \times 10^{23}$ / $(\pi) : 6.02 \times 10^{23}$
(C) $(\sigma) : 30.1 \times 10^{23}$ / $(\pi) : 6.02 \times 10^{23}$
(D) $(\sigma) : 30.1 \times 10^{23}$ / $(\pi) : 12.04 \times 10^{23}$

7 The number of carbon atoms in the molecule of the alkene that contains 10 hydrogen atoms is .....

(A) 3 (B) 4 (C) 5 (D) 6

8 From the following chart:

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



(A) The chemical activity of compounds (W) is less than that of compounds (X).

(B) The number of H atoms in 1 mol of a compound of (Z) is less than in 1 mol of a compound of (W) with the same number of carbon atoms.

(C) Compounds (Y) tend to react by addition.

(D) All the bonds between C atoms in compounds (Z) are sigma bonds.

9 An alkene forms open-chain isomers when the number of its carbon atoms is greater than or equal to .....

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

10 What is the IUPAC name of the opposite compound?

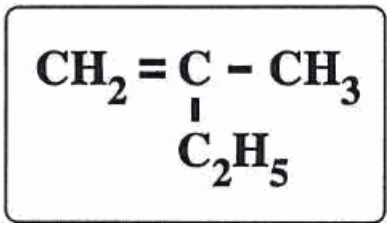
$CH_3–CH=CH–CH_2–CH_3$

(A) Pentane. (B) 3-pentene. (C) 2-pentene. (D) Pentylene.

11 What is the number of sigma and pi bonds in one molecule of 2-methyl-1-butene?

(A) σ : 14 , π : 2 (B) σ : 16 , π : 0 (C) σ : 14 , π : 1 (D) σ : 15 , π : 1

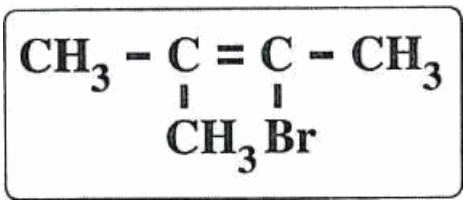
12 What is the IUPAC name of the opposite compound?



(A) 3-methyl-3-butene.
(B) 2-ethyl-1-propene.
(C) 2-methyl-1-butene.
(D) 1-pentene.

---

13 What is the IUPAC name of the opposite compound?



(A) 2-methyl-3-bromo-2-butene.
(B) 3-bromo-2-methyl-2-butene.
(C) 2-bromo-3-methyl-2-butene.
(D) 3-methyl-2-bromo-2-butene.

---

14 All of the following are correct names for isomers of pentene, except .....

(A) 2-methyl-1-butene.
(B) 3-methyl-1-butene.
(C) 2-methyl-2-butene.
(D) 3-methyl-2-butene.

---

15 What is the number of methylene groups in 2-pentene?

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

---

16 Which of the following correctly describes methylbutene?

(A) Number of sigma bonds: 13 , number of the unsaturated carbon atom: 1 , numbers of the carbon atoms that may carry the branch: (2 or 3)
(B) Number of sigma bonds: 14 , number of the unsaturated carbon atom: 2 , numbers of the carbon atoms that may carry the branch: 4
(C) Number of sigma bonds: 14 , number of the unsaturated carbon atom: 1 , numbers of the carbon atoms that may carry the branch: (2 or 3)
(D) Number of sigma bonds: 15 , number of the unsaturated carbon atom: 2 , numbers of the carbon atoms that may carry the branch: 4

---

17 Which of the following chemical formulas gives the largest number of acyclic isomers?

(A) C_4H_9Br (B) C_4H_8 (C) C_3H_6 (D) $C_2H_4Cl_2$

18 1-butene and 2-heptene are alkenes.

Which of the following shows the similarities (✓) and differences (✗) between them?

(A) Chemical activity ✓ , number of methylene groups ✗

(B) Chemical activity ✗ , number of methylene groups ✓

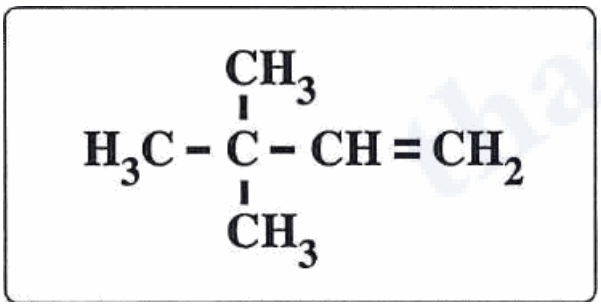
(C) Chemical activity ✗ , number of methylene groups ✗

(D) Chemical activity ✓ , number of methylene groups ✓

19 What is the number of isomers with the molecular formula $C_2BrClFI$?

(A) 3 (B) 4 (C) 5 (D) 6

20 Which of the following is the IUPAC name of the opposite compound?



(A) 3,3,3-trimethyl-1-propene.

(B) 1,1,1-trimethyl-2-propene.

(C) 3,3-dimethyl-1-butene.

(D) 2-methyl-3-butene.

21 Which of the following is the IUPAC name of the opposite compound?

$C_2H_3CH(CH_3)_2$

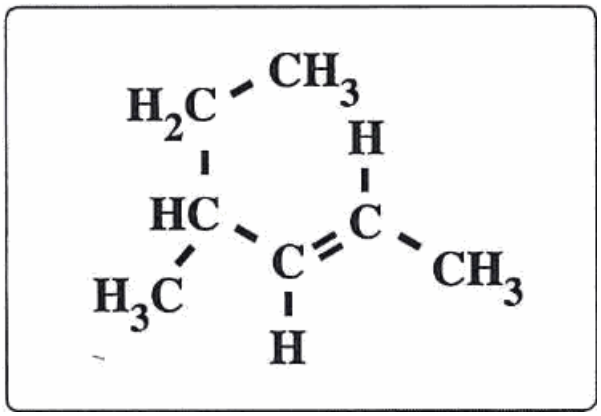
(A) 1,1-dimethyl-2-propene.

(B) 2-vinylpropane.

(C) 3-methyl-1-butene.

(D) 2-methyl-3-butene.

22 Which of the following is the IUPAC name of the opposite compound?



(A) 4-methyl-2-hexene.
(B) 4-ethyl-2-hexene.
(C) 2-ethyl-3-pentene.
(D) 3-methyl-4-hexene.

---

23 What is the IUPAC name of the alkene whose molecule contains 6 carbon atoms and includes 4 methyl groups?

(A) 1,1,2,2-tetramethylethene.
(B) 2,3-dimethyl-2-butene.
(C) 2,2-dimethyl-2-butene.
(D) 1,2-dimethyl-2-butene.

---

24 What is the IUPAC name of the compound $(CH_3)_2CC(CH_3)_2$?

(A) 1,1,2,2-tetramethylethene.
(B) 2,3-dimethyl-2-butane.
(C) 2,3-dimethyl-2-butene.
(D) 1,2-dimethyl-2-butene.

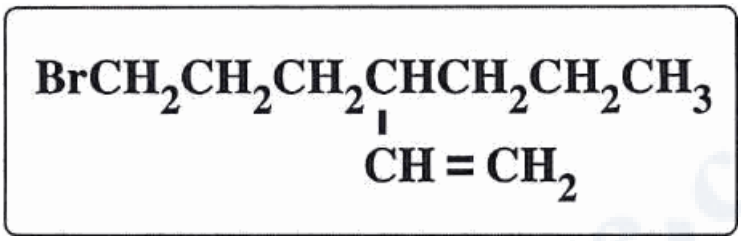
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25 What is the number of atoms in one molecule of one of the olefins and also the number of its unsaturated isomers?

(A) 12 atoms / 4 isomers.
(B) 12 atoms / 5 isomers.
(C) 15 atoms / 5 isomers.
(D) 15 atoms / 6 isomers.

---

26 What is the IUPAC name of the opposite compound?



(A) 1-bromo-4-propyl-5-hexene.
(B) 1-bromo-3-vinylheptane.
(C) 1-bromo-4-vinylheptane.
(D) 6-bromo-3-propyl-1-hexene.

27 The molecular formula C_9H_{18} has more than one structural formula. All of the following are IUPAC names of these compounds, except .....

(A) 4-ethyl-4-methyl-1-hexene.
(B) 4-ethyl-3-methyl-1-hexene.
(C) 3-ethyl-3-heptene.
(D) 3-ethyl-4-methyl-1-pentene.

28 A compound was named wrongly: 2-ethyl-5-bromo-5-heptene
What is the correct name of this compound?

(A) 3-bromo-6-ethyl-2-heptene.
(B) 6-bromo-3-methyl-6-octene.
(C) 3-bromo-6-methyl-2-octene.
(D) 4-bromo-1-ethyl-1-methyl-2-hexene.

29 What is the number of isomers of the dibromo-alkene whose molar mass is 185.8 g/mol? [C = 12 , H = 1 , Br = 79.9]

(A) 2 (B) 3 (C) 4 (D) 6

30 The process used to prepare ethene from ethanol is .....

(A) oxidation. (B) dehydration. (C) reduction. (D) addition.

31 When ethylene gas is prepared, it is passed through sodium hydroxide solution in order to .....

(A) neutralize the acid and lower the activation energy of the reaction.
(B) absorb water and remove impurities.
(C) neutralize the acid and absorb water.
(D) dry the gas and remove impurities.

32 When the isomer of dimethyl ether reacts with the main test reagent for the iodide ion at 180°C, ... is formed.

(A) $CH_3CH_2OH_2^+HSO_4^-$
(B) $CH_3CH_2OSO_2OH$
(C) $CH_3CH_2OCH_2CH_3$
(D) $H_2C{=}CH_2$

33 When drops of the hot substance (X) are added to ethanol, it changes into ethene, and to purify the ethene produced it is passed over substance (Y).

Which of the following represents substances (X) and (Y)?

(A) (X) : acidified potassium permanganate solution , (Y) : sodium hydroxide solution

(B) (X) : concentrated sulphuric acid , (Y) : dilute sulphuric acid

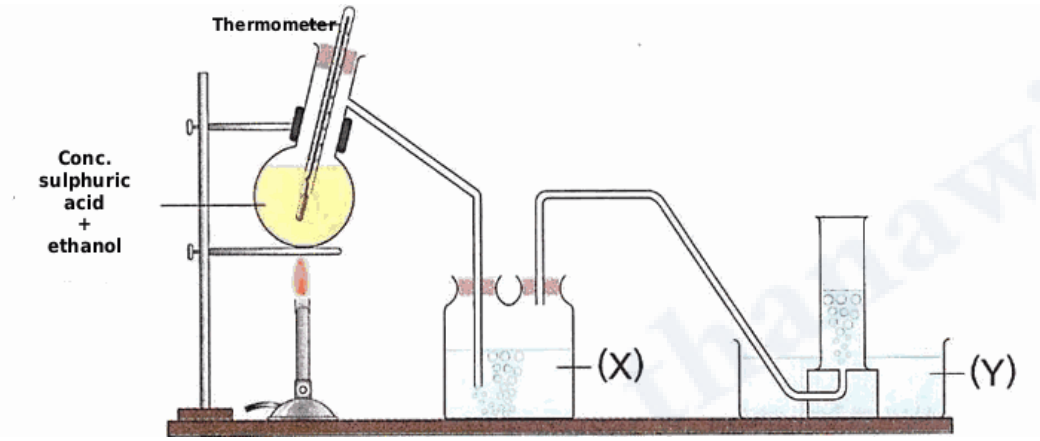
(C) (X) : concentrated sulphuric acid , (Y) : sodium hydroxide solution

(D) (X) : sodium hydroxide solution , (Y) : concentrated sulphuric acid

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34 The following figure shows the apparatus for preparing ethene gas in the laboratory:

What are the likely pH values of substances (X) and (Y), respectively, after the reaction ends?



(A) (X) : 3 , (Y) : 7

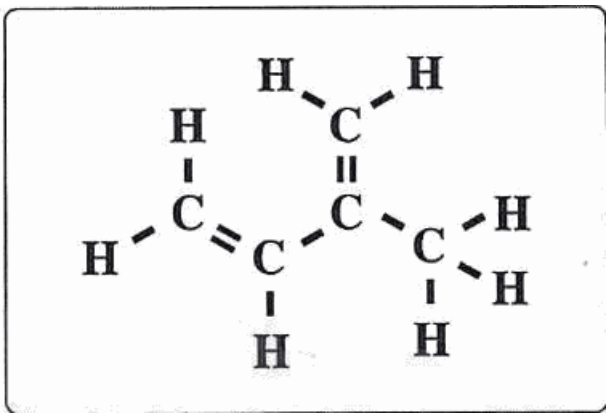
(B) (X) : 12 , (Y) : 7

(C) (X) : 7 , (Y) : 5

(D) (X) : 9 , (Y) : 9

---

35 What happens when the opposite compound is added to water with shaking?



(A) It dissolves in it.

(B) It does not dissolve in it.

(C) The corresponding alcohol is formed.

(D) The pi bonds break.

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36 All of the following are physical properties of ethene gas, except that it .....

(A) is colourless.
(B) decolourizes $KMnO_4$
(C) is sparingly soluble in water.
(D) has a boiling point below 0°C

37 The complete combustion of which of the following substances forms 1 mol of CO_2 gas?

(A) 0.25 mol of ethanol.
(B) 0.5 mol of ethene.
(C) 1 mol of propane.
(D) 1.5 mol of graphite.

38 1 mol of hydrocarbon (X) burns in (Y) moles of oxygen gas, forming a number of moles of H_2O greater than the number of moles of CO_2

Which of the following represents (X) and (Y), respectively?

(A) Butane / 6 mol O_2
(B) Butene / 6.5 mol O_2
(C) Butane / 6.5 mol O_2
(D) Butene / 6 mol O_2

39 When 1 mol of the largest gaseous alkene is burnt in excess oxygen and the combustion products are passed for a short time through excess calcium hydroxide solution, a solid substance of mass ..... is formed.

[Ca = 40 , C = 12 , O = 16]

(A) 100 g
(B) 200 g
(C) 300 g
(D) 400 g

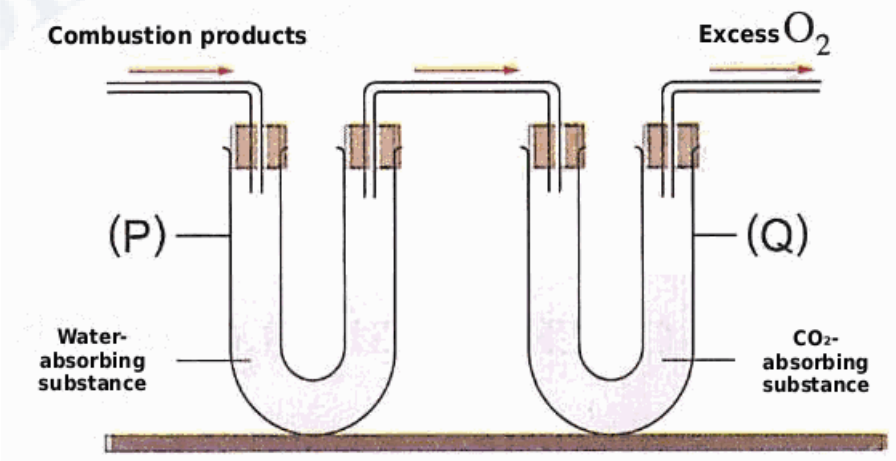
40 Hydrocarbon (X) burns in oxygen according to the following equation:

$?X(g) + ?O_2(g) \rightarrow ?CO_2(g) + nH_2O(l)$

If the combustion is carried out in a closed vessel containing 60 mL of oxygen gas and 10 mL of hydrocarbon (X), and after complete combustion and condensation of the water vapour produced, the volume of the gases remaining in the vessel is 50 mL (at STP), and after passing these gases through NaOH solution 30 mL of oxygen gas remain. What is the chemical formula of hydrocarbon (X)?

(A) CH_4
(B) C_2H_6
(C) C_2H_4
(D) C_3H_6

41 A sample of the compound C_6H_{12} was burnt completely in excess dry oxygen gas, and the products were passed through the apparatus shown in the opposite figure.
What is the ratio of the increase in mass of tube (P) to that of tube (Q)?
[H = 1 , O = 16 , C = 12]

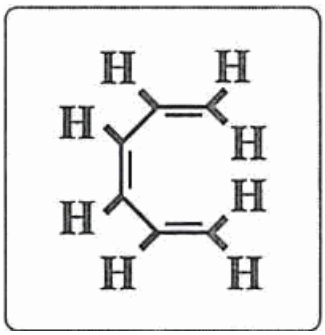


(A) 9/22 (B) 9/11 (C) 11/9 (D) 22/9

42 What is the product of the hydrogenation of butene?

(A) Butylene. (B) Butane. (C) Methylpropane. (D) Butyne.

43 What is the product of the reaction of 1 mol of the opposite compound with 3 mol of hydrogen gas under suitable conditions?



(A) Aromatic benzene. (B) Cyclohexane.
(C) Normal hexane. (D) Hexene.

44 What is the product of the hydrogenation of ethylbutene?

(A) 2-ethylbutane. (B) 3-ethylbutane. (C) 2-methylpentane. (D) 3-methylpentane.

45 What is the correct order of the chemical processes needed to change ethanol into ethane?

(A) Substitution – thermal decomposition – addition.

(B) Addition – substitution – thermal decomposition.

(C) Elimination – thermal decomposition.

(D) Thermal decomposition – elimination.

---

46 When a hydrocarbon reacts with chlorine, only one product is formed.

Which of the following is correct?

(A) The hydrocarbon is an alkane.

(B) The hydrocarbon is a saturated compound.

(C) The reaction is an addition reaction.

(D) The reaction is a substitution reaction.

---

47 Which compound decolourizes bromine dissolved in CCl_4 ?

(A) Cyclohexane. (B) Pentane. (C) 1-hexene. (D) Cyclopentane.

---

48 The reaction of ethene with bromine is represented by the balanced equation .....

(A) $C_2H_4 + Br_2 \rightarrow C_2H_3Br + HBr$

(B) $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$

(C) $C_2H_4 + 2Br_2 \rightarrow C_2Br_4 + 2H_2$

(D) $C_2H_4 + 2Br_2 \rightarrow C_2H_4Br_4$

---

49 The colour of bromine dissolved in carbon tetrachloride disappears when it is added to the compound .....

(A) $CH_3CH_2CH_2CH_2CH_2CO_2H$

(B) $CH_3CH_2CH_2CH_2CH_2CH_3$

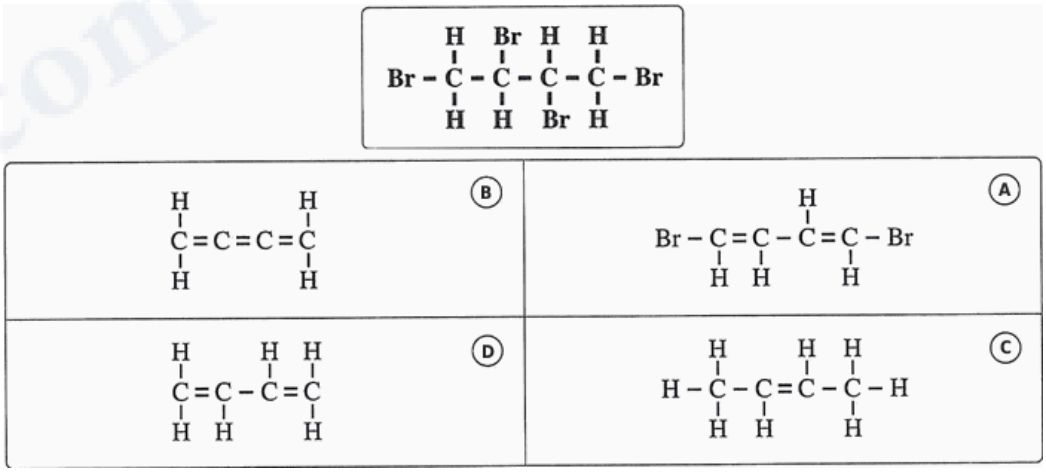
(C) $CH_3CHCHCH_2CH_2CH_2OH$

(D) $CH_3CH_2CH_2CO_2CH_2CH_3$

---

50 The opposite compound is produced from the reaction of compound (X) with bromine dissolved in carbon tetrachloride.

What is the structural formula of compound (X)?



51 What is the chemical formula of the liquid hydrocarbon that decolourizes bromine dissolved in carbon tetrachloride?

(A) C_2H_4 (B) C_4H_8 (C) C_7H_{16} (D) $C_{10}H_{20}$

52 One mole of hydrocarbon (X) reacts by addition with three moles of bromine dissolved in carbon tetrachloride.

What is the molecular formula of hydrocarbon (X)?

(A) C_3H_6 (B) C_4H_6 (C) C_5H_8 (D) C_6H_8

53 A liquid organic compound (A), whose elements are C, H and O, gives a colourless gas that decolourizes bromine dissolved in carbon tetrachloride when heated to 180°C with concentrated sulphuric acid.

What is the chemical formula of compound (A)?

(A) C_2H_5OH (B) C_6H_5OH (C) C_2H_5CHO (D) CH_3COCH_3

54 A hydrocarbon whose molecule includes 6 carbon atoms and 3 (C=C) bonds.

What is the molecular formula of the compound produced from its reaction with excess bromine dissolved in CCl_4 ?

(A) $C_6H_{10}Br_3$ (B) $C_6H_8Br_3$ (C) $C_6H_8Br_6$ (D) C_6H_{14}

55 A 2.1 g sample of an unsaturated hydrocarbon whose molecule contains one double bond reacts completely with 8 g of Br_2

What is the molecular formula of this hydrocarbon?

[C = 12 , H = 1 , Br = 80]

(A) C_5H_{10} (B) C_3H_6 (C) C_4H_8 (D) C_4H_6

56 0.15 mol of an unsaturated organic compound reacts completely with 0.3 mol of iodine I_2

What is the number of (C=C) bonds in one mole of this compound?

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

57 Which of the following represents an open-chain hydrocarbon?

(A) C_8H_{18} , boiling point 126°C , reaction with bromine ✓

(B) C_8H_{16} , boiling point 122.5°C , reaction with bromine ✗

(C) C_4H_{10} , boiling point 36°C , reaction with bromine ✗

(D) C_4H_8 , boiling point −6.5°C , reaction with bromine ✓

58 What is the formula of the compound produced from the reaction of a symmetrical alkene with Cl_2 ?

(A) $CH_3(CHCl)_2CH_3$ (B) $CH_2ClCHClCH_2CH_3$

(C) $CH_3CHClCH_2Cl$ (D) $CH_3CCl_2CH_2CH_3$

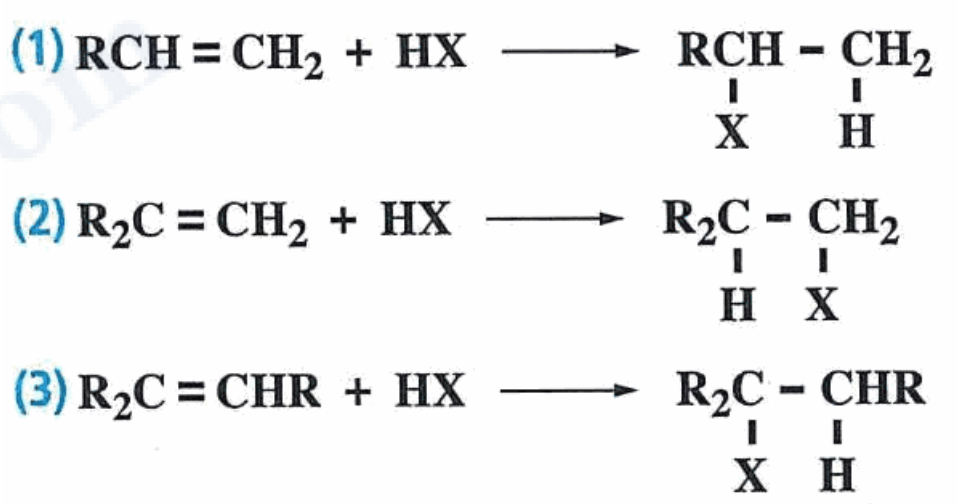
59 What is the product of the reaction of 2-methylpropene with HBr ?

(A) 1-bromobutane. (B) 1-bromo-2-methylpropane.

(C) 2-bromobutane. (D) 2-bromo-2-methylpropane.

60 The three opposite equations represent addition reactions:

Which of these reactions are correct?



(A) Reaction (1) ✓ , reaction (2) ✗ , reaction (3) ✓

(B) Reaction (1) ✗ , reaction (2) ✓ , reaction (3) ✗

(C) Reaction (1) ✓ , reaction (2) ✗ , reaction (3) ✗

(D) Reaction (1) ✗ , reaction (2) ✗ , reaction (3) ✓

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61 Which of the following are applications of Markovnikov's rule?

Reaction (1): propene + HBr → 1-bromopropane

Reaction (2): vinyl chloride + HI → 1-chloro-2-iodoethane

(A) Reaction (1) ✓ , reaction (2) ✗

(B) Reaction (1) ✗ , reaction (2) ✗

(C) Reaction (1) ✓ , reaction (2) ✓

(D) Reaction (1) ✗ , reaction (2) ✓

---

62 What is the product of adding HBr to 3-methyl-1-butene ?

(A) $CH_3CHBrCH(CH_3)_2$

(B) $CH_3CH_2CBr(CH_3)_2$

(C) $CH_3CHBrCHCH_3$

(D) $BrCH_2CH_2CH(CH_3)_2$

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63 Which alkene reacts with HBr forming an alkane derivative that includes 3 methyl groups?

(A) 2-propene.

(B) 2-butene.

(C) 2-methyl-2-butene.

(D) 3,3-dimethyl-1-butene.

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64 An olefin whose molecule contains 4 carbon atoms.
How many of its isomers react with HCl according to Markovnikov's rule?

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

65 The opposite reaction: $C_3H_7OH \rightarrow A + H_2O$
All of the following describe compound (A), except that it .....

(A) can be changed into a saturated compound.
(B) reacts with Br_2 and gives 1,2-dibromopropane.
(C) follows Markovnikov's rule when it reacts with Br_2
(D) has no open-chain isomer.

66 Alkenes take part in all the following reactions, except .....

(A) halogenation. (B) hydrogenation.
(C) catalytic hydration. (D) hydrolysis.

67 All of the following are properties of alkenes, except that they .....

(A) decolourize bromine dissolved in CCl_4
(B) react with hydrogen forming the corresponding alkanes.
(C) contain only the elements carbon and hydrogen.
(D) form organic acids by catalytic hydration.

68 Alkenes can be changed into alcohols by .....

(A) hydrolysis by dilute H_2SO_4 acid only.
(B) adding water in the presence of KOH(aq) only.
(C) hydrolysis by dilute H_2SO_4 acid or adding water in the presence of KOH(aq)
(D) oxidation by $KMnO_4$ in an alkaline medium or adding water in the presence of H_2SO_4 acid

69 Which of the following reactions of ethene is not an addition process?

(A) The reaction with bromine. (B) The reaction with hydrogen.
(C) The reaction with oxygen. (D) The reaction with water.

70 The catalytic hydration of 2-methylpropene in an acidic medium gives .....

(A) $CH_3(CH_2)_3OH$
(B) $CH_3COH(CH_3)_2$
(C) $CH_2OHCH(CH_3)_2$
(D) $CH_3CHOHC_2H_5$

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71 The catalytic hydration of hydrocarbon (X) forms a compound of molecular formula C_2H_6O, and when 14 g of substance (X) is burnt completely in air, two substances are formed.
What is the number of molecules of the product that is used to dilute concentrated solutions?
[C = 12 , H = 1]

(A) 6.02×10^{23}
(B) 12.04×10^{23}
(C) 6.02×10^{22}
(D) 12.04×10^{22}

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72 Which of the following describes the properties of one of the following alkenes?

(A) Propylene: decolourizes bromine ✓ , symmetrical alkene ✗ , changes into an alcohol by catalytic hydration ✗
(B) 1-butene: decolourizes bromine ✗ , symmetrical alkene ✗ , changes into an alcohol by catalytic hydration ✓
(C) Ethylene: decolourizes bromine ✓ , symmetrical alkene ✓ , changes into an alcohol by catalytic hydration ✓
(D) 2-butene: decolourizes bromine ✗ , symmetrical alkene ✓ , changes into an alcohol by catalytic hydration ✗

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73 What chemical processes are needed to change the isomer of the simplest aliphatic ether into a hydrocarbon whose molecular mass is greater than that of the main component of natural gas by 14 g ?
[C = 12 , H = 1]

(A) Substitution – hydrolysis – addition.
(B) Hydrolysis – addition – substitution.
(C) Substitution – thermal decomposition – addition.
(D) Thermal decomposition – addition – substitution.

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74 Baeyer's reagent is potassium permanganate solution in a(n) ..... medium.

(A) alkaline
(B) acidic
(C) neutral
(D) alcoholic

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75 Which of the following shows the importance of Baeyer's reagent?

(A) Detecting a double bond.
(B) Reduction processes.
(C) Oxidation processes.
(D) Detecting methane.

76 Which of the following compounds decolourizes potassium permanganate solution in an alkaline medium?



77 Treating ethene with potassium permanganate in an alkaline solution gives .....

(A) ethanol.
(B) ethylene glycol.
(C) acetic acid.
(D) water and carbon dioxide.

78 What is the reagent used to distinguish between the two opposite compounds (1) and (2)?

Compound (2)	Compound (1)
$CH_3 - CH_2 - \overset{\overset{Cl}{\vert}}{C} = CH - CH_3$	C_7H_{16}

(A) Chlorine gas.
(B) Hydrogen peroxide solution.
(C) Hydrogen gas.
(D) Baeyer's reaction.

79 All of the following describe treating an olefin with an alkaline solution of the compound used as an oxidizing agent and disinfectant, except .....

(A) an oxidation process.
(B) an addition process.
(C) breaking the pi bond.
(D) a substitution process.

80 Adding ethylene glycol to water causes .....

(A) raising its boiling and freezing points.

(B) lowering its boiling and freezing points.

(C) raising its boiling point and lowering its freezing point.

(D) lowering its boiling point and raising its freezing point.

---

81 From the following statements:

(1): It prevents the formation of the hexagonal shape in ice crystals.

(2): Its molecules are linked to each other by hydrogen bonds.

(3): It freezes at a temperature below 0°C

Which of the following represents the statements that explain the role of ethylene glycol when it dissolves in water?

(A) Statement (1) ✓ , statement (2) ✓ , statement (3) ✓

(B) Statement (1) ✗ , statement (2) ✓ , statement (3) ✗

(C) Statement (1) ✗ , statement (2) ✓ , statement (3) ✓

(D) Statement (1) ✓ , statement (2) ✗ , statement (3) ✗

---

82 Which of the following represents one of the reactions of propene and the compound produced?

(A) Substance added: bromine dissolved in CCl_4 , compound produced: 2-bromopropane

(B) Substance added: acidified potassium permanganate solution , compound produced: $CH_2OHCH_2CH_2OH$

(C) Substance added: hydrogen chloride , compound produced: 2-chloropropane

(D) Substance added: steam , compound produced: $CH_3CH_2CH_2OH$

---

83 Large numbers of molecule (X) link in reaction (Y) to produce a long chain of molecule (Z).

Which of the following is correct?

(A) (X) : polymer , (Y) : addition , (Z) : monomer.

(B) (X) : monomer , (Y) : addition , (Z) : polymer.

(C) (X) : polymer , (Y) : cracking , (Z) : monomer.

(D) (X) : monomer , (Y) : cracking , (Z) : polymer.

---

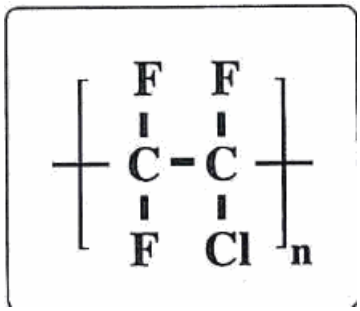
84 When excess ethene gas is heated at 400°C under high pressure, ... is formed.

(A) carbon and hydrogen
(B) polyethylene
(C) methane and hydrogen
(D) butene

85 Which of the following is common to ethene and polyethene?

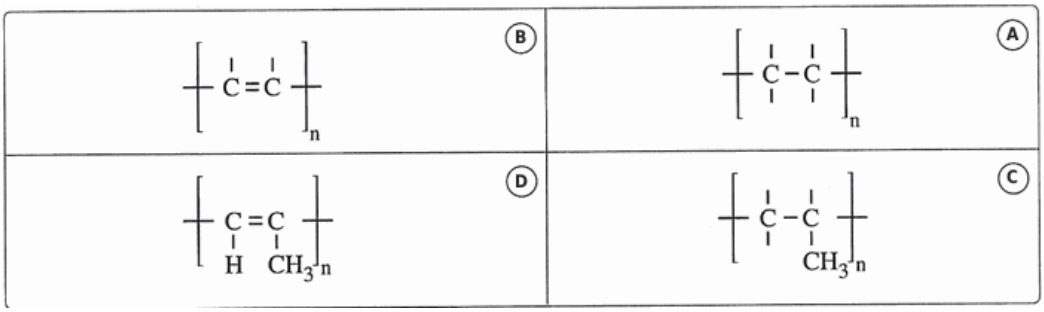
(A) The molar mass.
(B) The presence of π bonds.
(C) The boiling point.
(D) The presence of σ bonds.

86 The opposite polymer can be produced from the monomer .....



(A) CF_3CCl_2F
(B) CF_2CClF
(C) CF_3CClHF
(D) CF_2CF_2

87 Which of the following represents the polymer produced from the polymerization of the second member of the alkenes?



88 The polymer $-CH_2CCl_2CH_2CCl_2-$ is formed from the polymerization of the monomer .....

(A) HC=CCl
(B) ClHC=CClH
(C) $Cl_2C=CH_2$
(D) $H_2C=CClH$

89 Which of the following describes addition polymerization and condensation polymerization?

(A) Addition: its monomer molecules contain a C=C bond and form the polymer only , condensation: its monomer molecules contain a C=C bond and form the polymer only

(B) Addition: its monomer molecules contain a C=C bond and form the polymer only , condensation: its monomer molecules react to form a polymer and a simple molecule

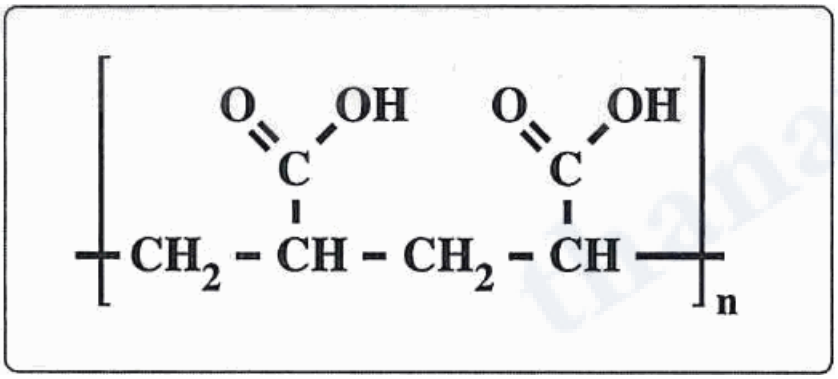
(C) Addition: its monomer molecules react to form a polymer and a simple molecule , condensation: its monomer molecules contain a C=C bond and form the polymer only

(D) Addition: its monomer molecules react to form a polymer and a simple molecule , condensation: its monomer molecules react to form a polymer and a simple molecule

---

90 The opposite figure represents the polymer formed from the acid CH_2=CHCOOH

What type of reaction formed this polymer?



(A) Addition polymerization.

(B) Condensation polymerization.

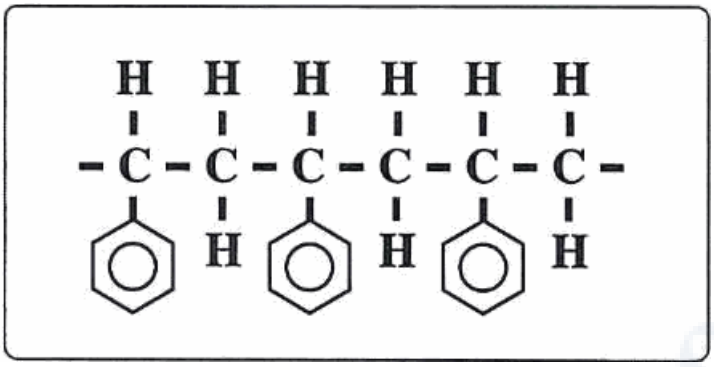
(C) Dehydration.

(D) Substitution.

---

91 The opposite figure shows a section of a polymer.

What is the name of the monomer used to produce this polymer?



(A) Ethylbenzene.

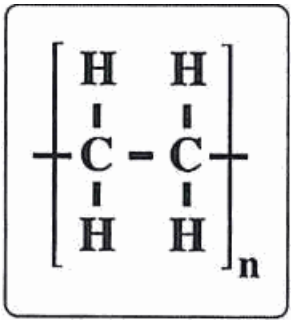
(B) Vinylethene.

(C) Methylbenzene.

(D) Vinylbenzene.

---

92 The polymer shown in the opposite figure has a molar mass of 10080 g/mol
What is the number of monomer units used to form one mole of this polymer?
[C = 12 , H = 1]



(A) 180 (B) 360 (C) 625 (D) 710

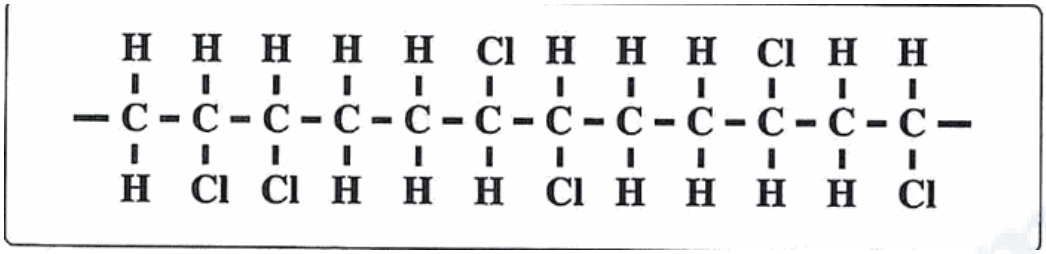
93 The reaction of hydrogen peroxide with the monomer of the polymer used in making carpets gives .....

(A) an organic acid. (B) an alcohol. (C) an alkane. (D) an ether.

94 All of the following are properties of the monomer used in making floor insulators, except .....

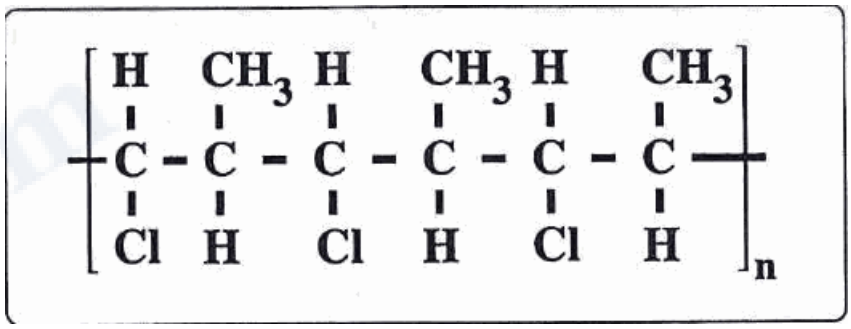
(A) it reacts with HCl according to Markovnikov's rule.
(B) it is not affected by H_2O_2 solution
(C) it decolourizes bromine dissolved in CCl_4
(D) it reacts with chlorine forming 1,1,2-trichloroethane.

95 The opposite figure shows a section of a polymer molecule.
What monomer is used to produce this polymer by addition?



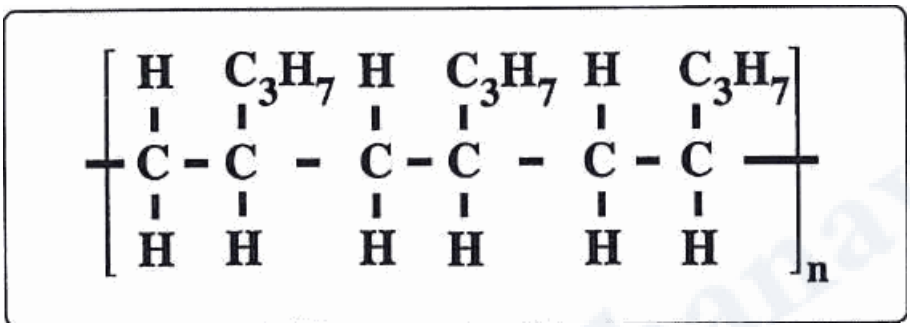
(A) 1,3-dichloro-2-butene. (B) Chloroethene.
(C) 2-chloroethene. (D) 2,3-dichloro-2-butene.

96 What is the monomer used to prepare the polymer shown in the opposite figure?



(A) $CHCl=CH-CH_3$ (B) $CH_2=C(Cl)CH_3$ (C) $(CH_3)_2CHCl$ (D) $CH_2=CHCl$

97 The opposite polymer is produced from the polymerization of the compound .....



(A) C_2H_4 (B) C_3H_6 (C) C_4H_8 (D) C_5H_{10}

98 The opposite section represents part of a polymer.

$-CH_2-CHCl-CH_2-CHCl-$

Which of the following represents the name of this polymer?

(A) Poly(2-chloropropane) ✓ , poly(chloroethene) ✓ , PVC ✓

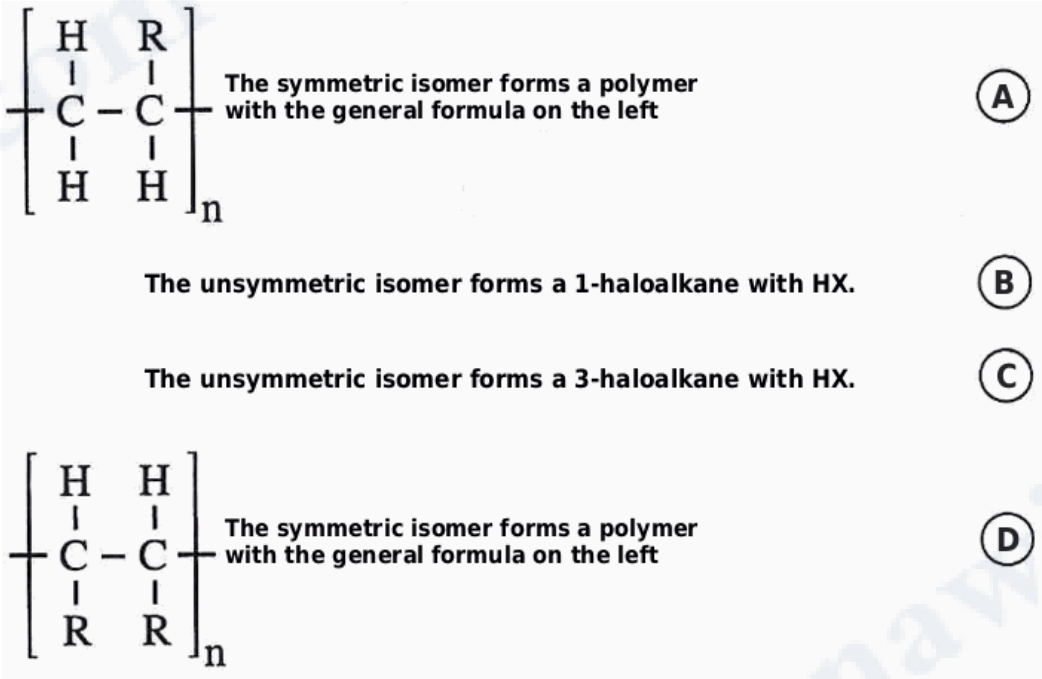
(B) Poly(2-chloropropane) ✗ , poly(chloroethene) ✓ , PVC ✗

(C) Poly(2-chloropropane) ✗ , poly(chloroethene) ✓ , PVC ✓

(D) Poly(2-chloropropane) ✓ , poly(chloroethene) ✗ , PVC ✓

99 The compound with the highest boiling point in the butagas mixture is produced from the hydrogenation of two alkene isomers.

Which of the following represents one of these two isomers?



100 From the following chart:

Alcohol with boiling point 78.4°C → hydrocarbon (A) → saturated hydrocarbon (B)

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

(A) (A): decolourizes bromine , (B): prepared by dry distillation.

(B) (A): chemically active , (B): relatively chemically inactive.

(C) (A): reacts by addition , (B): reacts by substitution.

(D) (A): cannot be polymerized , (B): can be polymerized.

Essay questions — 11 questions

1 How can you distinguish between the compound C_4H_8 and the compound C_4H_{10} by a practical experiment? State the type of reaction that takes place.

2 Monomer (X) is used to produce a polymer that is flexible and not affected by chemicals, and this polymer is used to make plastic sheets.

Write the balanced chemical equation for obtaining each of the following from monomer (X):

(1) a monohydric alcohol.

(2) a dihydric alcohol.

3 The opposite structural formula represents an organic compound: $CH_3–CH_2–CH=CH–CH_3$

(1) Write the IUPAC name of this compound.

(2) Classify this compound by completing the following chart:



4 State two reasons why PVC is preferred to iron for making water pipes.

5 Compare addition polymerization and condensation polymerization in terms of:

(1) the monomers used.

(2) the mass of the polymer produced compared with the mass of the monomers used.

6 Draw the structural formula of each of the following:

(1) 2-hexene.

(2) 4-chloro-1-butene.

7 Of the hydrocarbon compounds:

- Compound (1): 2,5,7-trimethyl-3-octene.
- Compound (2): 2,3-dimethyl-1-pentene.

(1) Draw the structural formula of the compound with the higher boiling point.

(2) What is the number of methyl groups in the compound with the lower boiling point?

8 State the number of unsaturated isomers of the molecular formula C_5H_{10} that have:

(1) a straight chain.

(2) a branched chain.

9 Show by symbolic equations how to obtain 1,2-dibromoethane from ethanol.

10 What is the name of the saturated compound produced from the reaction of hydrogen chloride with the compound $H_3C–CH=C(CH_3)_2$?

11 Normal hexane and 2-hexene are aliphatic hydrocarbons. Compare them in terms of:

(1) their classification as open-chain compounds.

(2) the general formula.

Past exam questions — 24 questions

1 Which of the following represents the correct role of sodium hydroxide in preparing paraffins and the role of concentrated sulphuric acid in preparing olefins, respectively? (Sample exam 2026)

(A) Removing water from alcohols in preparing olefins, and a flux in preparing paraffins.

(B) It removes the carboxylate group in preparing olefins and removes water in preparing paraffins.

(C) It removes the carboxylate group in preparing paraffins and removes water in preparing olefins.

(D) It absorbs water vapour in preparing paraffins and neutralizes the acid vapours in preparing olefins.

---

2 Which of the following represents the number of alkene isomers that contain an ethyl group and have the molecular formula C_5H_{10} ? (Sample exam 2026)

(A) 6 (B) 5 (C) 4 (D) 3

---

3 Two compounds (X) and (Y), each with the formula shown: (Sample exam 2026)

(X) : $(C_2H_5)C_2H(CH_3)_2$

(Y) : $CH_3CHC(CH_3)_2$

Which of the following gives the IUPAC names of the compounds produced from adding hydrogen bromide to compounds (X) and (Y)?

(A) Product of (X): 2-bromo-2-methylpentane , product of (Y): 2-bromo-2-methylbutane

(B) Product of (X): 2-bromo-2-methylpentane , product of (Y): 2-bromo-3-methylpentane

(C) Product of (X): 2-bromo-4-methylbutane , product of (Y): 1-bromo-3-methylbutane

(D) Product of (X): 2-bromo-3-methylbutane , product of (Y): 2-bromo-2-methylbutane

---

4 Which of the following is the correct IUPAC name of a compound with the general formula $C_nH_{2n-2}BrCl$? (Sample exam 2026)

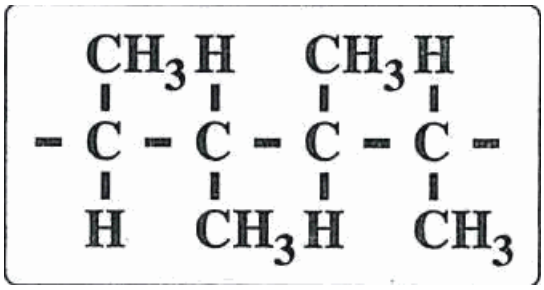
(A) 3-bromo-1-chloropropyne. (B) 1-bromo-3-chloropropene.

(C) 2-bromo-1-chlorobutane. (D) 1-chloro-2-bromo-2-butene.

---

5 The opposite figure is of a polymer: (Sample exam 2026)

Which of the following describes the properties of the monomer of this polymer?



(A) It reacts by addition according to Markovnikov's rule.

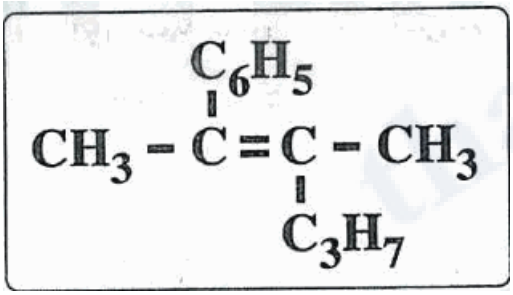
(B) It reacts with HBr and gives 1-bromobutane.

(C) It reacts by catalytic hydration and gives 2-butanol.

(D) It reacts with bromine and gives 1,2-dibromobutane.

---

6 Which of the following is the IUPAC name of the opposite compound? (Sample exam 2026)



(A) 3-propyl-2-phenyl-2-butene.

(B) 2,3-dimethyl-4-phenyl-3-pentene.

(C) 3,4-dimethyl-2-phenyl-2-pentene.

(D) 2-phenyl-3-methyl-2-hexene.

---

7 Two organic compounds (A) and (B) are open-chain hydrocarbons. When a mole of compound (A) burns, 3 mol of CO_2 are produced, while when a mole of compound (B) burns, 5 mol of H_2O are produced. (Sample exam 2026)

If you know that (A) reacts by substitution, while (B) reacts by addition in one step, then .....

(A) (A): gaseous alkane , (B): liquid alkane.

(B) (A): liquid alkane , (B): liquid alkene.

(C) (A): gaseous alkane , (B): liquid alkene.

(D) (A): gaseous alkene , (B): liquid alkyne.

---

8 The following table gives the molecular formulas of three hydrocarbons (A), (B) and (C): (2nd session 2024)

(A) : C_3H_6 , (B) : C_3H_4 , (C) : C_3H_8

Which of the following choices is correct?

(A) (C) is an unsaturated hydrocarbon and is used in making hoses.

(B) (A) is an unsaturated hydrocarbon and is used in making cooking pots.

(C) (B) is a saturated hydrocarbon and is used in welding and cutting metals.

(D) (A) is an unsaturated hydrocarbon and is used in making carpets.

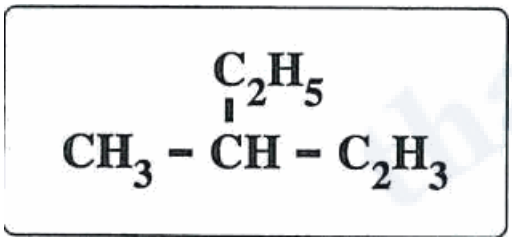
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9 The number of methylene groups in 2,2-dimethylbutane equals the number of methyl groups in ..... (2nd session 2021)

(A) propene. (B) propane. (C) pentane. (D) ethyne.

---

10 The correct IUPAC name of the opposite compound is ..... (1st session 2023)



(A) 3-methyl-1-pentene. (B) 2-methylbutane.

(C) 2-ethylbutane. (D) 3-methyl-4-pentene.

---

11 Two organic compounds (A) and (B) are open-chain hydrocarbons; compound (A) has 3 carbon atoms and compound (B) has 6 carbon atoms, and compound (B) is chemically more active than compound (A). (2nd session 2021)

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

(A) (A) a gaseous alkane , (B) a liquid alkene.

(B) (A) a liquid alkane , (B) a liquid alkene.

(C) (A) a gaseous alkane , (B) a gaseous alkene.

(D) (A) a gaseous alkane , (B) a liquid alkane.

---

12 When one mole of an alkane (X) and of an alkene (Y) are burnt completely, each on its own, the number of moles of water vapour produced from (X) and (Y) is ..... (1st session 2021)
«where n is the number of carbon atoms»

(A) from X $(n + 1)$, from Y (n)
(B) from X $(n - 1)$, from Y $(n + 1)$
(C) from X $(3n + 1)/2$, from Y $(3n)/2$
(D) from X $(3n + 1)$, from Y $(3n)$

---

13 When 1 mol of ethene reacts with excess chlorine, the number of moles of chlorine needed to obtain a halogen compound containing no hydrogen (under the conditions suitable for these reactions) equals ..... (2nd session 2021)

(A) 1 mol
(B) 5 mol
(C) 2.5 mol
(D) 1.5 mol

---

14 The following reactions take place under suitable conditions to obtain compounds (A), (B) and (C) as follows: (1st session 2021)

$R–CH_2OH \rightarrow$ (strong mineral acid) (A) $\rightarrow (\Delta)$ (B) $\rightarrow$ (hydrogenation) (C)

If you know that (B) follows Markovnikov's rule, then compounds (A), (B) and (C) are .....

(A) (A) ethyl hydrogen sulphate , (B) ethene , (C) ethane.
(B) (A) ethene , (B) ethyl hydrogen sulphate , (C) ethane.
(C) (A) propyl hydrogen sulphate , (B) propene , (C) propane.
(D) (A) propene , (B) propane , (C) propyl hydrogen sulphate.

---

15 When potassium permanganate solution in an alkaline medium was added to substances (A) and (B), each on its own, the colour disappeared with substance (A) only and did not disappear with substance (B). (Trial exam / June 2021)

Which of the following is correct?

(A) Compound (A) is 2-methyl-2-pentene and the addition took place at carbon atoms 2 and 3
(B) Compound (A) is 2-methyl-2-pentene and the addition took place at carbon atoms 1 and 2
(C) Compound (B) is propene and the addition took place at carbon atoms 2 and 3
(D) Compound (B) is propene and the addition took place at carbon atoms 1 and 2

---

16 The reaction of 1-butene with (colourless) hydrogen peroxide is a(n) ..... (2nd session 2021)

(A) oxidation-reduction reaction and is considered a test for the double bond.

(B) oxidation reaction only and is not considered a test for the double bond.

(C) oxidation-reduction reaction and is not considered a test for the double bond.

(D) oxidation reaction only and is considered a test for the double bond.

---

17 The reaction of ethene gas with potassium permanganate solution in an alkaline medium is ..... (2nd session 2022)

(A) oxidation-reduction, and the reaction is not considered a test for the double bond.

(B) oxidation-reduction, and the reaction is considered a test for the double bond.

(C) oxidation only, and the reaction is considered a test for the double bond.

(D) oxidation only, and the reaction is not considered a test for the double bond.

---

18 An olefin has a total of (18) atoms in one molecule, so the number of its unbranched isomers is ..... (1st session 2022)

(A) 13 (B) 6 (C) 4 (D) 3

---

19 The number of methylene groups in ethylbutene equals ..... (1st session 2021)

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

---

20 The correct IUPAC name of the compound 2-bromo-5-ethyl-4-hexene is ..... (Trial exam / May 2021)

(A) 6-bromo-3-methyl-3-heptene.

(B) 6-bromo-2-ethyl-2-hexene.

(C) 2-bromo-5-methyl-4-heptene.

(D) 2-bromo-5-ethyl-4-pentene.

---

21 The structural formula of 2-methyl-2-butene is ..... (2nd session 2022)

(B) $CH_3 - \underset{\displaystyle H}{\underset{|}{C}} = CH - CH_3$

(A) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{C}} = CH_2$

(D) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{C}} = CH - CH_3$

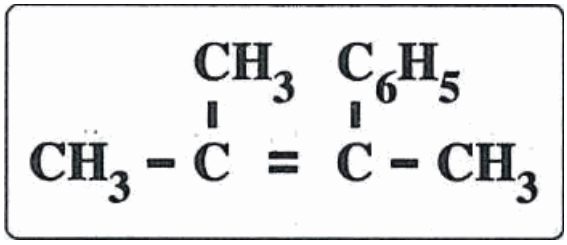
(C) $CH_3 - \underset{\displaystyle C_2H_5}{\underset{|}{C}} = CH - CH_3$

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22 An aliphatic hydrocarbon derivative containing the group (>CH–OH) reacts with a concentrated strong mineral acid to prepare an unsymmetrical alkene; the alkene is ..... (Trial exam / June 2021)

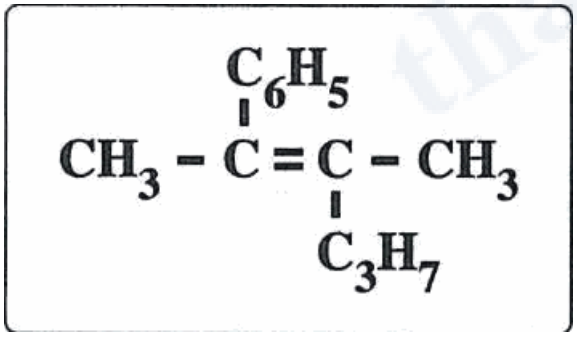
(A) propene.
(B) 2-butene.
(C) ethene.
(D) 2-methylpropene.

23 The opposite compound, according to IUPAC, is named ..... (1st session 2022)



(A) 2-phenyl-3-methyl-2-butene.
(B) 2,3-dimethyl-2-nonene.
(C) 2-methyl-3-phenylbutene.
(D) 2-methyl-3-phenyl-2-butene.

24 The correct IUPAC name of the opposite compound is ..... (Trial exam / March 2023)



(A) 4,5-dimethyldecane.
(B) 2-phenyl-3-methyl-2-hexene.
(C) 3-methyl-2-phenyl-2-hexene.
(D) 2-propyl-3-phenylbutane.

Answer key and solutions

Multiple choice questions

1 C	2 C	3 C	4 C	5 C	6 C	7 C	8 D	9 D	10 C
11 C	12 C	13 C	14 D	15 B	16 C	17 A	18 A	19 A	20 C
21 C	22 A	23 B	24 C	25 C	26 D	27 D	28 C	29 A	30 B
31 C	32 D	33 C	34 B	35 B	36 B	37 B	38 C	39 D	40 C
41 A	42 B	43 C	44 D	45 A	46 C	47 C	48 B	49 C	50 D
51 D	52 D	53 A	54 C	55 B	56 B	57 D	58 A	59 D	60 A
61 B	62 A	63 C	64 B	65 C	66 D	67 D	68 D	69 C	70 B
71 A	72 C	73 C	74 A	75 A	76 C	77 B	78 D	79 D	80 C
81 A	82 C	83 B	84 B	85 D	86 B	87 C	88 C	89 B	90 A
91 D	92 B	93 B	94 B	95 B	96 A	97 D	98 C	99 D	100 D

1 **Answer (C)**

The general formula of alkenes is C_nH_{2n}

$2n = 10$, $n = 5$, so the alkene is C_5H_{10}

Molar mass = $(5 \times 12) + (10 \times 1) = 70$ g/mol

2 **Answer (C)**

The first member is C_2H_4 and the second member is C_3H_6 (propene).

3 **Answer (C)**

Ethylene C_2H_4 and propylene C_3H_6 belong to the same series, so they have the same general formula C_nH_{2n}

4 **Answer (C)**

Equal volumes of gases (at STP) contain the same number of moles.

Moles of ethane = 6 ÷ 30 = 0.2 mol

Mass of ethene = 0.2 × 28 = 5.6 g

5 **Answer (C)**

(W) C_3H_6 , (X) C_4H_8 , (Z) C_6H_{12} follow C_nH_{2n}

(Y) has a mass of 72, so it is C_5H_{12}, which follows C_nH_{2n+2}

6 **Answer (C)**

An ethene molecule $H_2C{=}CH_2$ has 5 sigma bonds (4 C–H and 1 C–C) and one pi bond.

$\sigma = 5 \times 6.02 \times 10^{23} = 30.1 \times 10^{23}$

$\pi = 1 \times 6.02 \times 10^{23} = 6.02 \times 10^{23}$

7 **Answer (C)**

The alkene is C_nH_{2n} , 2n = 10 , n = 5

8 **Answer (D)**

(W) are saturated alkanes and (X) are unsaturated, divided into alkenes and alkynes.

Compounds (Z) are unsaturated, so they have pi bonds between carbon atoms, so statement (D) is wrong.

9 **Answer (D)**

Ethene and propene have no open-chain isomers.

Butene (4 carbon atoms) has isomers: 1-butene, 2-butene and methylpropene.

10 **Answer (C)**

The longest chain has 5 carbon atoms, and the double bond starts at carbon atom number 2: 2-pentene.

11 **Answer (C)**

$CH_2{=}C(CH_3){-}CH_2{-}CH_3$ has the formula C_5H_{10}

σ bonds: 4 C–C bonds + 10 C–H bonds = 14

π bonds: 1

12 **Answer (C)**

The longest chain containing the double bond has 4 carbon atoms (it includes C_2H_5).

The double bond is at atom 1 and the methyl group at atom 2: 2-methyl-1-butene.

13 **Answer (C)**

The double bond is at atom 2 from either end, and the branches are at 2 and 3 in both cases.

The groups are arranged alphabetically (bromo before methyl) and bromo takes the lower number: 2-bromo-3-methyl-2-butene.

14 **Answer (D)**

$CH_3–CH=C(CH_3)–CH_3$ is numbered from the end nearer to the double bond and the branch, so its name is 2-methyl-2-butene.

So the name 3-methyl-2-butene is wrong.

15 **Answer (B)**

2-pentene $CH_3–CH=CH–CH_2–CH_3$ has one methylene group (CH_2).

16 **Answer (C)**

Methylbutene C_5H_{10} has 14 sigma bonds.

The double bond starts at carbon atom number 1 (as in 2-methyl-1-butene and 3-methyl-1-butene).

So the branch is at atom 2 or 3

17 **Answer (A)**

C_4H_9Br has 4 isomers (1- and 2-bromobutane, 1-bromo-2-methylpropane and 2-bromo-2-methylpropane).

Acyclic C_4H_8 has 3 , C_3H_6 has 1 , $C_2H_4Cl_2$ has 2

18 **Answer (A)**

Both are alkenes, so they are similar in chemical activity.

1-butene has one CH_2 group in the chain and 2-heptene has 3 groups, so they differ.

19 **Answer (A)**

$C_2BrClFI$ is an alkene of formula C_2X_4, and the four atoms are distributed on the two carbon atoms, two on each.

The possible distributions: (Br, Cl / F, I), (Br, F / Cl, I) and (Br, I / Cl, F), i.e. 3 isomers.

20 **Answer (C)**

$CH_2=CH–C(CH_3)_3$: the longest chain has 4 atoms and the double bond is at atom 1 and the two methyl groups are on atom 3: 3,3-dimethyl-1-butene.

21 **Answer (C)**

$C_2H_3CH(CH_3)_2$ is $CH_2=CH-CH(CH_3)-CH_3$: 3-methyl-1-butene.

22 **Answer (A)**

The main chain: $CH_3-CH=CH-CH(CH_3)-CH_2-CH_3$

The double bond is at atom 2 and the methyl at atom 4: 4-methyl-2-hexene.

23 **Answer (B)**

An alkene with 6 carbon atoms and 4 methyl groups is $(CH_3)_2C=C(CH_3)_2$

Its name is 2,3-dimethyl-2-butene.

24 **Answer (C)**

$(CH_3)_2C=C(CH_3)_2$: the longest chain has 4 atoms, the double bond is at atom 2 and the methyl groups at 2 and 3

Its name is 2,3-dimethyl-2-butene.

25 **Answer (C)**

Pentene C_5H_{10} has 15 atoms, and its unsaturated isomers are 5:

1-pentene, 2-pentene, 2-methyl-1-butene, 3-methyl-1-butene, 2-methyl-2-butene.

26 **Answer (D)**

The longest chain containing the double bond: $CH_2=CH-CH(C_3H_7)-CH_2-CH_2-CH_2Br$ (6 atoms).

Numbering from the double-bond end: 6-bromo-3-propyl-1-hexene.

27 **Answer (D)**

3-ethyl-4-methyl-1-pentene has 5 + 2 + 1 = 8 carbon atoms, so its formula is C_8H_{16}, not C_9H_{18} and each of the others has 9 carbon atoms.

28 **Answer (C)**

The ethyl group at atom 2 lengthens the chain to 8 atoms:

$CH_3-CH=C(Br)-CH_2-CH_2-CH(CH_3)-CH_2-CH_3$

The correct name: 3-bromo-6-methyl-2-octene.

29 **Answer (A)**

The formula of a dibromo-alkene is $C_nH_{2n-2}Br_2$

$12n + 2n - 2 + (2 \times 79.9) = 185.8$, n = 2

The compound is $C_2H_2Br_2$ and has two isomers: $CH_2=CBr_2$ and CHBr=CHBr

30 **Answer (B)**

Ethene is prepared by removing water from ethanol with concentrated sulphuric acid at 180°C

31 **Answer (C)**

NaOH solution reacts with the acid vapours that come out with the ethylene (neutralization) and absorbs water.

32 **Answer (D)**

The isomer of dimethyl ether is ethanol, and the main test reagent for the iodide ion is concentrated sulphuric acid.

Ethanol with concentrated sulphuric acid at 180°C gives ethene $H_2C=CH_2$

33 **Answer (C)**

(X) concentrated sulphuric acid removes water from ethanol, so ethene is formed.

(Y) sodium hydroxide solution absorbs the acid vapours that come out with the ethene.

34 **Answer (B)**

(X) NaOH solution absorbs the acid vapours but stays alkaline (pH > 7).

(Y) is water; ethene does not dissolve in it and does not change the medium, so pH stays 7

35 **Answer (B)**

The compound is a non-polar hydrocarbon, so it does not dissolve in water.

36 **Answer (B)**

Decolourizing $KMnO_4$ is a chemical property, not a physical one.

37 **Answer (B)**

0.25 mol of ethanol gives 0.5 mol CO_2

0.5 mol of ethene C_2H_4 gives $2 \times 0.5 = 1$ mol CO_2

38 **Answer (C)**

The moles of H_2O are greater than those of CO_2 when alkanes burn.

$C_4H_{10} + 6.5O_2 \rightarrow 4CO_2 + 5H_2O$

39 **Answer (D)**

The largest gaseous alkene is butene C_4H_8, so one mole of it gives 4 mol CO_2

$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$

Mass of $CaCO_3 = 4 \times 100 = 400$ g

40 **Answer (C)**

NaOH absorbed 50 − 30 = 20 mL of CO_2

The oxygen that reacted = 60 − 30 = 30 mL

10 mL X + 30 mL O_2 → 20 mL CO_2 , i.e. $X + 3O_2 \rightarrow 2CO_2 + 2H_2O$

So the hydrocarbon is C_2H_4

41 **Answer (A)**

$C_6H_{12} + 9O_2 \rightarrow 6CO_2 + 6H_2O$

Tube (P) absorbs water: 6 × 18 = 108 g

Tube (Q) absorbs CO_2: 6 × 44 = 264 g

Ratio = 108 / 264 = 9 / 22

42 **Answer (B)**

Hydrogenation is the addition of H_2 to the double bond, so butene changes into butane.

43 **Answer (C)**

The compound is 1,3,5-hexatriene (6 carbon atoms, 3 double bonds) and it is not cyclic.

Adding 3 mol of H_2 gives normal hexane.

44 **Answer (D)**

Ethylbutene is like $CH_2{=}C(C_2H_5){-}CH_2{-}CH_3$

On hydrogenation it gives $CH_3{-}CH(C_2H_5){-}CH_2{-}CH_3$, whose name is 3-methylpentane.

45 **Answer (A)**

Ethanol with conc. H_2SO_4 forms ethyl hydrogen sulphate (substitution).

On heating at 180°C it decomposes thermally into ethene.

Ethene + H_2 → ethane (addition).

46 **Answer (C)**

An alkene reacts with chlorine by addition and gives one product.

An alkane reacts by substitution and gives two products (a halogen derivative + HCl).

47 **Answer (C)**

1-hexene is an unsaturated alkene, so it decolourizes bromine; the others are saturated compounds.

48 **Answer (B)**

Bromine adds across the double bond: $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$

49 **Answer (C)**

$CH_3CH=CHCH_2CH_2CH_2OH$ has a double bond, so it decolourizes bromine.

50 **Answer (D)**

The product $BrCH_2–CHBr–CHBr–CH_2Br$ has 4 bromine atoms on 4 consecutive carbon atoms.
So compound (X) is $CH_2=CH–CH=CH_2$

51 **Answer (D)**

C_2H_4 and C_4H_8 are gases, and C_7H_{16} is an alkane that does not decolourize bromine.
$C_{10}H_{20}$ is a liquid alkene that decolourizes bromine.

52 **Answer (D)**

One mole reacts with 3 mol Br_2, so it has 3 pi bonds.
C_6H_8, such as $CH_2=CH–CH=CH–CH=CH_2$, has 3 double bonds.

53 **Answer (A)**

Ethanol with conc. H_2SO_4 at 180°C gives ethene, which decolourizes bromine.

54 **Answer (C)**

The compound $CH_2=CH–CH=CH–CH=CH_2$ has the formula C_6H_8
It adds 3 molecules of Br_2, so $C_6H_8Br_6$ is formed

55 **Answer (B)**

Moles of Br_2 = 8 ÷ 160 = 0.05 mol = moles of the hydrocarbon.
Molar mass = 2.1 ÷ 0.05 = 42 g/mol , so it is C_3H_6

56 **Answer (B)**

Every 0.15 mol reacts with 0.3 mol I_2 , i.e. one mole reacts with 2 mol
So the molecule has two C=C bonds

57 **Answer (D)**

C_4H_8 is an open-chain gaseous alkene (boiling point −6.5°C) and reacts with bromine.
C_8H_{18} is an alkane that does not react with bromine, and open-chain C_8H_{16} does react with it.

58 **Answer (A)**

The simplest symmetrical alkene that reacts with Cl_2 here is 2-butene $CH_3CH=CHCH_3$
The product is $CH_3CHClCHClCH_3$ = $CH_3(CHCl)_2CH_3$

59 **Answer (D)**

According to Markovnikov's rule, the hydrogen adds to the carbon atom richer in hydrogen.

$(CH_3)_2C=CH_2 + HBr \rightarrow (CH_3)_2CBr-CH_3$: 2-bromo-2-methylpropane.

60 **Answer (A)**

The halogen adds to the carbon atom with fewer hydrogen atoms.

(1) correct , (2) wrong (X was added to CH_2) , (3) correct.

61 **Answer (B)**

Propene + HBr gives 2-bromopropane, not 1-

Vinyl chloride + HI gives 1-chloro-1-iodoethane, not 1-chloro-2-

So both are wrong.

62 **Answer (A)**

According to Markovnikov: $CH_2=CH-CH(CH_3)_2 + HBr \rightarrow CH_3-CHBr-CH(CH_3)_2$

63 **Answer (C)**

$(CH_3)_2C=CH-CH_3 + HBr \rightarrow (CH_3)_2CBr-CH_2-CH_3$, which has 3 methyl groups.

64 **Answer (B)**

The isomers of butene: 1-butene, 2-butene, methylpropene.

2-butene is symmetrical, so only the two unsymmetrical isomers follow Markovnikov's rule.

65 **Answer (C)**

(A) is propene $CH_3-CH=CH_2$

Markovnikov's rule applies when HX is added, not Br_2

66 **Answer (D)**

Alkenes react by addition, such as halogenation, hydrogenation and catalytic hydration, and they are not hydrolysed.

67 **Answer (D)**

The catalytic hydration of alkenes forms alcohols, not acids.

68 **Answer (D)**

In catalytic hydration, sulphuric acid is needed as a catalyst.

And on oxidation by Baeyer's reagent a dihydroxy alcohol is formed.

69 **Answer (C)**

The reaction with oxygen is combustion, not addition.

70 **Answer (B)**

According to Markovnikov, OH adds to the carbon atom with fewer hydrogens:

$(CH_3)_2C=CH_2 + H_2O \rightarrow (CH_3)_3COH = CH_3COH(CH_3)_2$

71 **Answer (A)**

(X) is ethene, and 14 g of it = 0.5 mol

$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$, so 1 mol of water is formed.

Number of water molecules = 6.02×10^{23}

72 **Answer (C)**

Ethylene decolourizes bromine, is a symmetrical alkene and changes into ethanol by catalytic hydration.

73 **Answer (C)**

The isomer of the simplest ether (dimethyl ether) is ethanol, and the required hydrocarbon has a mass of 16 + 14 = 30, i.e. ethane.

Ethanol + conc. $H_2SO_4 \rightarrow$ ethyl hydrogen sulphate (substitution).

It decomposes thermally at 180°C into ethene, then H_2 is added to it (addition).

74 **Answer (A)**

Baeyer's reagent is potassium permanganate solution in an alkaline medium.

75 **Answer (A)**

Baeyer's reagent is used to detect the double bond, as its violet colour disappears.

76 **Answer (C)**

$CH_3CH=CHCH_2CH_3$ is an alkene, so it decolourizes the permanganate; the others are saturated compounds.

77 **Answer (B)**

$H_2C=CH_2 + H_2O + [O] \rightarrow HOCH_2–CH_2OH$ (ethylene glycol).

78 **Answer (D)**

C_7H_{16} is a saturated alkane and compound (2) is an unsaturated alkene.

Baeyer's reagent loses its colour with compound (2) only.

79 **Answer (D)**

The reaction of an olefin with alkaline $KMnO_4$ is oxidation and addition in which the pi bond breaks, not substitution.

80 **Answer (C)**

Ethylene glycol raises the boiling point of water and lowers its freezing point.

81 **Answer (A)**

Ethylene glycol forms hydrogen bonds, so it prevents the formation of the hexagonal shape of ice crystals.

So water freezes at a temperature below 0°C

82 **Answer (C)**

Propene + HCl gives 2-chloropropane (Markovnikov).

With bromine it gives 1,2-dibromopropane, and with water it gives 2-propanol.

83 **Answer (B)**

Monomers link by addition to form the polymer.

84 **Answer (B)**

At 400°C and high pressure, ethene polymerizes into polyethylene.

85 **Answer (D)**

Polyethene is saturated and contains no π bonds; what they have in common is σ bonds.

86 **Answer (B)**

The monomer of the polymer $-CF_2-CFCl-$ is $CF_2=CFCl$ (CF_2CClF).

87 **Answer (C)**

The second member of the alkenes is propene $CH_2=CH-CH_3$

Its polymerization gives $-[CH_2-CH(CH_3)]_n-$

88 **Answer (C)**

The polymer unit is $-CH_2-CCl_2-$, so the monomer is $Cl_2C=CH_2$

89 **Answer (B)**

Addition polymerization: the monomer has C=C and only the polymer is formed.

Condensation polymerization: the polymer and a simple molecule such as water are formed.

90 **Answer (A)**

The polymer is a saturated carbon chain formed by opening the double bond in CH_2=CHCOOH, so it is addition polymerization.

91 **Answer (D)**

The polymer unit is $-CH_2-CH(C_6H_5)-$ and its monomer is $C_6H_5-CH=CH_2$ (vinylbenzene).

92 **Answer (B)**

The monomer is ethene C_2H_4 with a mass of 28 g/mol

Number of units = 10080 ÷ 28 = 360

93 **Answer (B)**

Carpets are made of polypropylene, whose monomer is propene.

Propene with H_2O_2 gives a dihydroxy alcohol.

94 **Answer (B)**

Floor insulators are made of PVC, whose monomer is vinyl chloride CH_2=CHCl

It is an alkene that is affected by H_2O_2 solution, so statement (B) is wrong.

95 **Answer (B)**

The repeating unit is $-CH_2-CHCl-$ and its monomer is CH_2=CHCl (chloroethene).

96 **Answer (A)**

The repeating unit is $-CHCl-CH(CH_3)-$ and its monomer is CHCl=CH–CH_3

97 **Answer (D)**

The repeating unit is $-CH_2-CH(C_3H_7)-$ and its monomer is CH_2=CH–C_3H_7 = C_5H_{10}

98 **Answer (C)**

The unit $-CH_2-CHCl-$ comes from vinyl chloride (chloroethene), so the polymer is poly(chloroethene) = PVC

99 **Answer (D)**

Butane (the highest boiling in butagas) is produced from the hydrogenation of 1-butene or 2-butene.

2-butene is symmetrical and its polymerization gives $-[CHR-CHR]_n-$ where R = CH_3

And 1-butene with HX gives a 2-haloalkane.

100 **Answer (D)**

(A) is ethene and (B) is ethane.

Ethene can be polymerized and ethane cannot, so statement (D) is wrong.

Essay questions

1 **Model answer**

By passing each gas through bromine dissolved in CCl_4 : C_4H_8 decolourizes the bromine and C_4H_{10} does not change its colour (addition reaction – halogenation).

Or by passing them through violet $KMnO_4$ solution in an alkaline medium: C_4H_8 decolourizes it and C_4H_{10} does not change it (oxidation reaction).

2 **Model answer**

The polymer is polyethylene, so monomer (X) is ethylene.

(1) $C_2H_4 + H_2O \rightarrow C_2H_5OH$ (in the presence of H_2SO_4 at 110°C)

(2) $C_2H_4 + H_2O + [O] \rightarrow HOCH_2–CH_2OH$ ($KMnO_4$ in an alkaline medium)

3 **Model answer**

(1) 2-pentene.

(2) Hydrocarbon → aliphatic → open-chain → unsaturated → alkene.

4 **Model answer**

(1) Because it is a strong polymer.

(2) Because it does not rust.

5 **Model answer**

(1) Addition polymerization: one type of unsaturated monomer , condensation polymerization: two different types of monomers.

(2) Addition polymerization: the mass of the polymer produced equals the mass of the monomers , condensation polymerization: the mass of the polymer produced is less than the mass of the monomers.

6 **Model answer**

(1) 2-hexene: $CH_3–CH=CH–CH_2–CH_2–CH_3$

(2) 4-chloro-1-butene: $CH_2=CH–CH_2–CH_2Cl$

7 **Model answer**

(1) Compound (1) (its mass is greater): $CH_3–CH(CH_3)–CH=CH–CH(CH_3)–CH_2–CH(CH_3)–CH_3$

(2) Compound (2): 3 methyl groups.

8 **Model answer**

(1) Two isomers: 1-pentene and 2-pentene.

(2) 3 isomers: 2-methyl-1-butene, 3-methyl-1-butene, 2-methyl-2-butene.

9 **Model answer**

$C_2H_5OH \rightarrow C_2H_4 + H_2O$ (conc. H_2SO_4 acid at 180°C)

$C_2H_4 + Br_2 \rightarrow BrCH_2–CH_2Br$ (in CCl_4)

10 **Model answer**

$H_3C–CH=C(CH_3)_2 + HCl \rightarrow CH_3–CH_2–CCl(CH_3)_2$

Its name: 2-chloro-2-methylbutane.

11 **Model answer**

(1) Normal hexane: alkane , 2-hexene: alkene.

(2) Normal hexane: C_nH_{2n+2} , 2-hexene: C_nH_{2n}

Past exam questions

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

1 **Answer (C)**

NaOH (in soda lime) removes the carboxylate group from the salt of the acid, so the paraffin is formed.

Conc. H_2SO_4 removes water from the alcohol, so the olefin is formed.

2 **Answer (D)**

The alkene isomers of C_5H_{10} that end with an ethyl group $(-CH_2CH_3)$:

1-pentene, 2-pentene, 2-methyl-1-butene.

Their number is 3

3 **Answer (A)**

(X) : $CH_3CH_2-CH=C(CH_3)_2$ and (Y) : $CH_3-CH=C(CH_3)_2$

According to Markovnikov, bromine bonds to the carbon atom with fewer hydrogens (the one carrying the two methyl groups).

(X) gives 2-bromo-2-methylpentane , (Y) gives 2-bromo-2-methylbutane.

4 **Answer (B)**

$C_nH_{2n-2}BrCl$ corresponds to an alkene in which Br and Cl have replaced two hydrogen atoms.

$CH_2Br-CH=CHCl$ is named 1-bromo-3-chloropropene and follows the formula.

5 **Answer (C)**

The monomer of the polymer is 2-butene $CH_3-CH=CH-CH_3$

Its catalytic hydration gives 2-butanol.

6 **Answer (C)**

Taking C_3H_7 as an isopropyl group $CH(CH_3)_2$:

The longest chain with the double bond has 5 atoms: $CH_3-C(C_6H_5)=C(CH_3)-CH(CH_3)-CH_3$

The name: 3,4-dimethyl-2-phenyl-2-pentene.

7 **Answer (C)**

(A) has 3 carbon atoms and reacts by substitution: propane (a gaseous alkane).

(B) gives 5 mol H_2O so it has 10 H and reacts by addition in one step: C_5H_{10} (a liquid alkene).

8 **Answer (D)**

(A) propene is unsaturated, and from it comes polypropylene, used in making carpets.

9 **Answer (A)**

2,2-dimethylbutane $CH_3-C(CH_3)_2-CH_2-CH_3$ has one methylene group.

Propene $CH_2=CH-CH_3$ has one methyl group.

10 **Answer (A)**

The compound: $CH_3–CH(C_2H_5)–CH=CH_2$

The longest chain with the double bond has 5 atoms, numbered from the double-bond end.

The name: 3-methyl-1-pentene.

11 **Answer (A)**

(A) is a gaseous alkane (3 carbon atoms).

(B) is a liquid alkene (6 carbon atoms) and more active than the alkane.

12 **Answer (A)**

The alkane C_nH_{2n+2} gives $(n + 1)$ mol of water, and the alkene C_nH_{2n} gives n mol of water.

13 **Answer (B)**

1 mol of chlorine adds across the double bond → $C_2H_4Cl_2$

then 4 mol of chlorine replace the four hydrogen atoms → C_2Cl_6

Total 5 mol

14 **Answer (C)**

(B) follows Markovnikov's rule, so it is an unsymmetrical alkene (propene), not ethene.

$R–CH_2OH$ is propanol, and with sulphuric acid it gives (A) propyl hydrogen sulphate.

On heating it gives (B) propene, and on hydrogenation it gives (C) propane.

15 **Answer (A)**

The permanganate colour disappearing with (A) only means that (A) is an alkene.

In 2-methyl-2-pentene $CH_3–C(CH_3)=CH–CH_2CH_3$ the double bond is between atoms 2 and 3, so the addition takes place on them.

16 **Answer (C)**

Hydrogen peroxide oxidizes the alkene to a glycol, so it is an oxidation-reduction reaction.

But it is colourless, so there is no colour change showing the double bond, so it is not considered a test.

17 **Answer (B)**

Permanganate (an oxidizing agent) oxidizes ethene to ethylene glycol and is itself reduced, so the reaction is oxidation-reduction.

And the violet colour of the permanganate disappears, so it is a test for the double bond (Baeyer's reagent).

18 **Answer (D)**

The olefin is C_nH_{2n} : number of atoms 3n = 18 , n = 6, so it is hexene C_6H_{12}

Its unbranched isomers: 1-hexene, 2-hexene, 3-hexene = 3

19 **Answer (A)**

Ethylbutene: $CH_2=C(C_2H_5)-CH_2-CH_3$ (2-ethyl-1-butene).

Its CH_2 groups: $=CH_2$ and the two CH_2 groups in the two ethyl groups, so the number is 3

20 **Answer (A)**

The compound: $CH_3-CHBr-CH_2-CH=C(C_2H_5)-CH_3$

The longest chain through the ethyl group has 7 carbon atoms, numbered from the end nearer to the double bond.

The name: 6-bromo-3-methyl-3-heptene.

21 **Answer (D)**

2-methyl-2-butene: a chain of 4 carbon atoms, with the double bond at carbon atom 2 carrying a methyl group.

$CH_3-C(CH_3)=CH-CH_3$

22 **Answer (A)**

The compound is a secondary alcohol, and removing water from 2-propanol gives propene $CH_2=CH-CH_3$, an unsymmetrical alkene.

23 **Answer (D)**

The longest chain has 4 atoms: $CH_3-C(CH_3)=C(C_6H_5)-CH_3$

The name: 2-methyl-3-phenyl-2-butene.

24 **Answer (C)**

The longest chain with the double bond has 6 atoms: $CH_3-C(C_6H_5)=C(CH_3)-CH_2CH_2CH_3$

The name: 3-methyl-2-phenyl-2-hexene.