Chemistry · Organic Chemistry

Alkynes (Acetylenes)

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Multiple choice questions — 58 questions

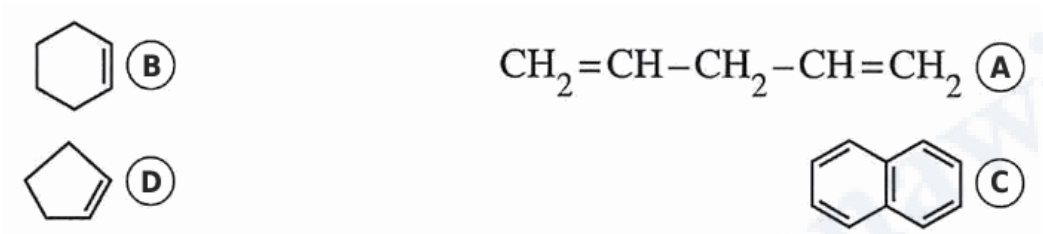
1 The compound whose molecular formula is C_4H_6 has the general formula .....

(A) C_nH_{2n+2} (B) C_nH_{2n-2} (C) C_nH_{2n} (D) C_nH_{2n+1}

2 The homologous series that starts with acetylene includes a compound whose molar mass is ..... [C = 12 , H = 1]

(A) 44 g/mol (B) 40 g/mol (C) 56 g/mol (D) 58 g/mol

3 The chemical formulas of the following compounds follow the general formula of alkynes, except .....



4 What is the number of sigma bonds in one molecule of a branched alkyne with the molecular formula C_7H_{12}?

(A) 14 (B) 16 (C) 18 (D) 20

5 What is the number of carbon atoms in the simplest branched alkyne molecule?

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

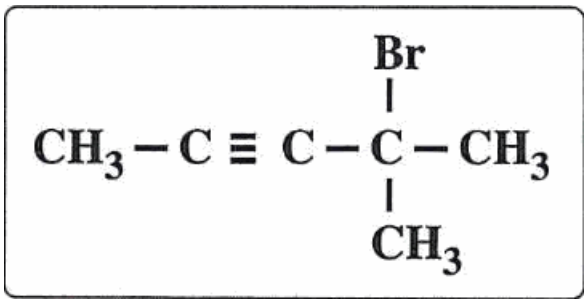
6 What is the IUPAC name of the opposite compound?

$CH_3-CH_2-C\equiv C-CH_3$

(A) 3-pentyne. (B) 1-methyl-1-butyne.

(C) 2-pentyne. (D) 1,3-dimethyl-1-propyne.

7 What is the IUPAC name of the opposite compound?



(A) 4-methyl-4-bromo-2-pentyne.
(B) 4-bromo-4-methyl-2-pentyne.
(C) 2-bromo-2-methyl-3-pentyne.
(D) 2-methyl-2-bromo-3-pentyne.

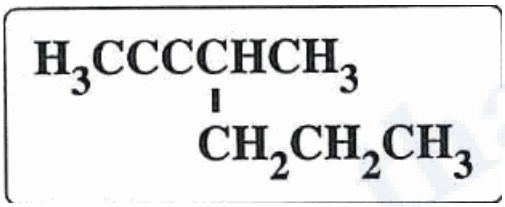
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8 What is the IUPAC name of the compound $CH_3(CH_2)_2C_2CH_3$?

(A) 2-hexene.
(B) 4-hexyne.
(C) 2-hexyne.
(D) 4-hexene.

---

9 What is the IUPAC name of the opposite compound?



(A) 4-propyl-2-pentyne.
(B) 4-methyl-5-heptyne.
(C) 2-propyl-3-pentyne.
(D) 4-methyl-2-heptyne.

---

10 What is the IUPAC name of the compound $HCCC(CH_3)_3$?

(A) 2,2-dimethyl-2-butyne.
(B) 2,2-dimethyl-3-pentyne.
(C) 3,3-dimethyl-1-butyne.
(D) 1-hexyne.

---

11 What is the IUPAC name of the compound $CH_3CH(C_2H_5)C_2H$?

(A) 1-hexyne.
(B) 3-methyl-1-pentyne.
(C) 2-ethyl-2-butyne.
(D) 4-ethyl-1-butyne.

---

12 Which of the following is a correct name according to the IUPAC system?

(A) 2-methyl-4-pentyne.
(B) 2-methyl-3-butyne.
(C) 4-ethyl-2-heptyne.
(D) 5-ethyl-2-hexyne.

---

13 What is the IUPAC name of dimethylacetylene?

(A) 1-butyne.
(B) 2-butyne.
(C) 1-methylpropyne.
(D) 1,2-dimethylethyne.

14 Which of the following expresses the number of hydrogen atoms and the number of methyl groups in one molecule of 4-methyl-2-pentyne?

(A) number of H atoms : 10 , number of (CH_3-) groups : 3
(B) number of H atoms : 10 , number of (CH_3-) groups : 1
(C) number of H atoms : 9 , number of (CH_3-) groups : 3
(D) number of H atoms : 9 , number of (CH_3-) groups : 1

15 Which of the following compounds contains a methylene group?

(A) Propyne.
(B) 1-butyne.
(C) 2-butyne.
(D) 4,4-dimethyl-2-pentyne.

16 What is the number of branched isomers of an alkyne with a molecular mass of 82 g/mol? [C = 12 , H = 1]

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

17 What is the number of open-chain isomers for the molecular formula C_3H_2ClBr?

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

18 Which of the following contains the largest number of hydrogen atoms?

(A) 0.1 mol of pentane.
(B) 0.2 mol of 2-butene.
(C) 0.1 mol of propyne.
(D) 0.5 mol of hydrogen.

19 Which of the following expresses the substance used to prepare ethyne and propyne by hydrolysis?

(A) ethyne : CaC_2 , propyne : CaC_2
(B) ethyne : Mg_2C_3 , propyne : Mg_2C_3
(C) ethyne : CaC_2 , propyne : Mg_2C_3
(D) ethyne : Mg_2C_3 , propyne : CaC_2

20 What is the volume of the gas produced (at STP) when 6.43 g of water reacts completely with excess calcium carbide? [H_2O = 18 g/mol]

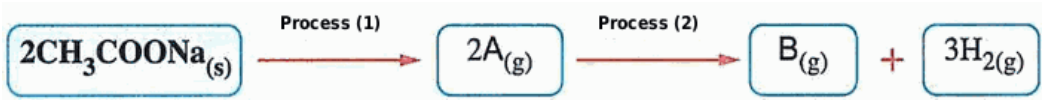
(A) 4 L (B) 8 L (C) 36 L (D) 72 L

21 What is the number of moles of ethyne gas that can be obtained from 9 mol of methane gas?

(A) 18 mol (B) 9 mol (C) 4.5 mol (D) 2.25 mol

22 From the opposite chart:

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



(A) In process (1), COONa is replaced by a hydrogen atom.

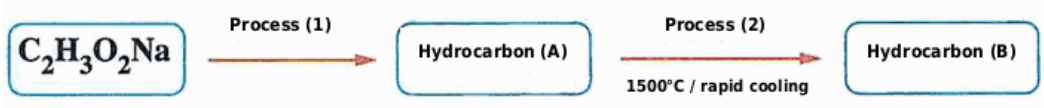
(B) Compound (A) is used to obtain carbon black.

(C) Compound (B) follows the general formula C_nH_{2n-2}

(D) Process (2) takes place at 1000°C in the absence of air.

23 From the opposite chart:

Which of the following is correct?



(A) (1) : fractional distillation , (A) : unsaturated , (B) : saturated.

(B) (1) : dry distillation , (A) : saturated , (B) : unsaturated.

(C) (2) : fractional distillation , (A) : saturated , (B) : unsaturated.

(D) (2) : dry distillation , (A) : unsaturated , (B) : saturated.

24 Which of the following hydrocarbons is the most chemically active?

(A) C_2H_6 (B) C_2H_2 (C) C_2H_4 (D) CH_4

25 All of the following are properties of ethyne gas, except that it .....

(A) does not dissolve in water. (B) is flammable.

(C) is a saturated compound. (D) has no isomers.

26 When acetylene burns in the air, ... is/are produced.

(A) $CO_2(g)$, $H_2O(v)$
(B) $CO(g)$, $H_2O(v)$
(C) $C(s)$, $CO(g)$, $H_2O(v)$
(D) $C(s)$, $CO_2(g)$, $H_2O(v)$

27 The number of moles of oxygen needed for the complete combustion of one mole of alkynes equals ..... (where n is the number of carbon atoms in the alkyne molecule)

(A) $(n - 1)$
(B) $(3n - 1)/2$
(C) $(n + 1)$
(D) $(3n + 1)/2$

28 The number of moles of water vapour produced by burning one mole of an alkyne equals ..... (where n is the number of carbon atoms in the alkyne molecule)

(A) n
(B) $(n + 1)$
(C) 2n
(D) $(n - 1)$

29 400 g of ethyne gas are burned. Half the amount burns completely and the other half burns incompletely.

What is the mass of the gases and vapours produced by the two combustion processes? [C_2H_2 = 26 g/mol , CO_2 = 44 g/mol , H_2O = 18 g/mol]

(A) 0.93 kg
(B) 1.29 kg
(C) 1.55 kg
(D) 2.5 kg

30 What is the number of moles of gases and vapours in a closed container after the complete combustion of a mixture of 1 mol of ethyne with 4 mol of oxygen?

(A) 3 mol
(B) 4.5 mol
(C) 5.5 mol
(D) 6 mol

31 1 mol of an organic compound burns completely using 2.5 mol of O_2 gas

What is this organic compound?

(A) C_2H_5OH only.
(B) C_2H_5OH or C_2H_2
(C) C_2H_2 only.
(D) C_2H_2 or CH_3CHO

32 The complete combustion reaction of ethyne is used in .....

(A) welding metals.
(B) obtaining carbon black.
(C) preparing methane.
(D) condensation polymerization.

33 The flame used to cut metals is produced by the complete reaction of a number of moles of the oxidizing gas (X) with a volume of gas (Y).
Which of the following expresses the number of moles of gas (X) and the volume of gas (Y) (at STP)?

(A) (X) : 2 mol , (Y) : 17.92 L
(B) (X) : 2 mol , (Y) : 100 L
(C) (X) : 5 mol , (Y) : 60.12 L
(D) (X) : 5 mol , (Y) : 250 L

34 Which gases must be present for the rusting and the welding of iron?

(A) rusting of iron : oxygen , nitrogen / welding of iron : oxygen , ethyne
(B) rusting of iron : oxygen , nitrogen / welding of iron : air , ethyne
(C) rusting of iron : oxygen , water vapour / welding of iron : oxygen , ethyne
(D) rusting of iron : oxygen , water vapour / welding of iron : air , ethyne

35 What is the name of the compound produced by the complete hydrogenation of 2-butyne?

(A) 1,2-dimethylethene.
(B) 1,2-dimethylethane.
(C) 2-butene.
(D) butane.

36 When a number of moles of hydrogen is added to an equal number of moles of an alkyne, ... is formed.

(A) an alkane
(B) an alkene
(C) an aldehyde
(D) an alcohol

37 What is the mass of calcium carbide needed to prepare 14 g of ethene? [Ca = 40 , C = 12 , H = 1]

(A) 1.6 g
(B) 3.2 g
(C) 34.46 g
(D) 32 g

38 The following three reactions show the steps for preparing polyethene from calcium carbide:

(1) $CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$

(2) $C_2H_2 + H_2 \rightarrow C_2H_4$

(3) $nC_2H_4 \rightarrow -[CH_2-CH_2]_n-$

What mass of the polymer can be obtained from 64 kg of CaC_2? [Ca = 40 , C = 12 , H = 1]

(A) 7 kg
(B) 14 kg
(C) 21 kg
(D) 28 kg

39 1 mol of compound (X) reacts with 2 mol of hydrogen gas to form 1 mol of compound (Y).
Which of the following expresses each of compounds (X) and (Y)?

(A) (X) : 4-methyl-1-hexyne , (Y) : 4-methylhexane.

(B) (X) : 4-chloro-2-pentyne , (Y) : 2-chloropentene.

(C) (X) : 4-chloro-2-pentyne , (Y) : 4-chloropentane.

(D) (X) : 4-methyl-1-hexyne , (Y) : 3-methylhexane.

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40 Which of the following expresses the similarity (similarities) between 1-butyne and 2-butyne?

(A) general formula ✗ , flammability ✗ , reaction with H_2 ✓ , number of methylene groups ✓

(B) general formula ✓ , flammability ✓ , reaction with H_2 ✓ , number of methylene groups ✗

(C) general formula ✓ , flammability ✗ , reaction with H_2 ✗ , number of methylene groups ✗

(D) general formula ✗ , flammability ✓ , reaction with H_2 ✗ , number of methylene groups ✓

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41 All of the following may decolourize bromine dissolved in carbon tetrachloride, except .....

(A) the monomer of PE

(B) marsh gas.

(C) propyne.

(D) vinyl chloride.

---

42 Which pair of the following non-cyclic compounds can be distinguished using bromine dissolved in CCl_4?

(A) C_3H_8 , C_2H_6 (B) C_5H_8 , C_4H_6 (C) C_4H_8 , C_5H_{10} (D) C_4H_{10} , C_6H_{10}

---

43 When the carbide of a metal is treated with water, a gas is formed. When this gas is passed through bromine dissolved in CCl_4 , the colour of bromine disappears.
What is the name of this gas?

(A) Methane. (B) Ethane. (C) Acetylene. (D) Ethylene.

---

44 When 1 mol of propyne reacts with 2 mol of a halogen, a compound is formed whose molecule contains all of the following, except .....

(A) 4 halogen atoms.
(B) 2 methyl groups.
(C) 3 carbon atoms.
(D) 4 (C – H) bonds.

45 What is the number of moles of bromine dissolved in CCl_4 needed to distinguish between 1 mol of propene gas and 1 mol of propyne gas when each reacts separately?

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

46 HBr reacts with an alkyne of molar mass 40 g/mol to form compound (X).
Which of the following is correct? [C = 12 , H = 1]

(A) number of moles of HBr : 1 mol , compound (X) : 1-bromo-1-propene
(B) number of moles of HBr : 1 mol , compound (X) : 3-bromo-1-propene
(C) number of moles of HBr : 2 mol , compound (X) : 2,2-dibromopropane
(D) number of moles of HBr : 2 mol , compound (X) : 1,2-dibromopropane

47 Alkynes react with hydrogen halides in two steps.
Which of the following expresses the alkyne and the products of its reaction with hydrogen bromide?

(A) alkyne : 3-hexyne , first-step product : 3-bromo-3-hexene , second-step product : 4,4-dibromohexane
(B) alkyne : 1-hexyne , first-step product : 1-bromo-1-hexene , second-step product : 1,1-dibromohexane
(C) alkyne : 3-hexyne , first-step product : 3-bromo-4-hexene , second-step product : 3,3-dibromohexane
(D) alkyne : 1-hexyne , first-step product : 2-bromo-1-hexene , second-step product : 2,2-dibromohexane

48 Substance (X) reacts with a compound (Y) whose molecular formula is C_6H_{10} to form the opposite compound (Z): $CH_3(CH_2)_2CClCHCH_3$

Which of the following expresses each of compounds (X) , (Y) , (Z)?

(A) (X) : Cl_2 , (Y) : 2-hexyne , (Z) : 4-chloro-5-hexene.

(B) (X) : HCl , (Y) : 1-hexyne , (Z) : 3-chloro-2-hexene.

(C) (X) : Cl_2 , (Y) : 1-hexyne , (Z) : 4-chloro-5-hexene.

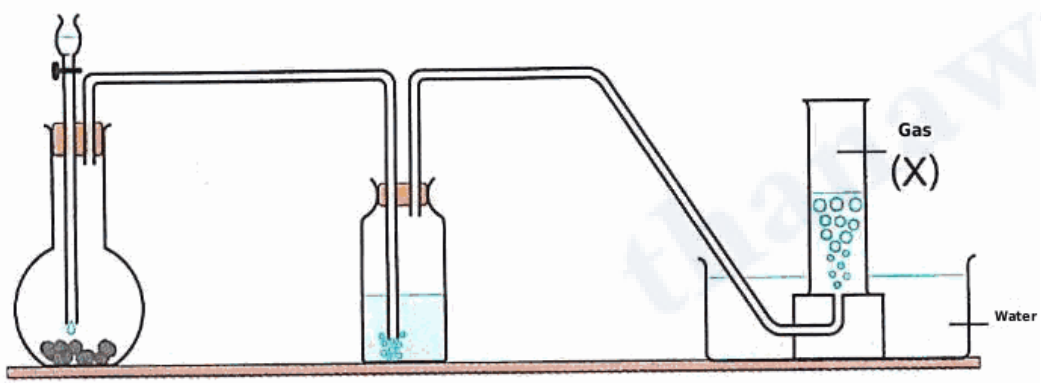
(D) (X) : HCl , (Y) : 2-hexyne , (Z) : 3-chloro-2-hexene.

---

49 The following figure shows the apparatus used to prepare gas (X), which reacts with each of:

- H_2 gas, forming gas (Y).
- HBr gas, forming liquid (Z).

Which of the following expresses each of (X) , (Y) , (Z)?



(A) (X) : ethyne , (Y) : ethane , (Z) : 1,1,2,2-tetrabromoethane

(B) (X) : ethene , (Y) : ethyne , (Z) : 2-bromoethene

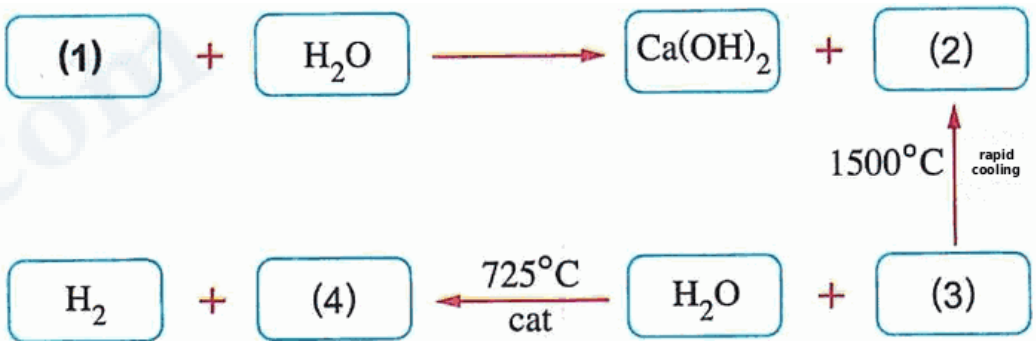
(C) (X) : ethyne , (Y) : ethane , (Z) : 1,1-dibromoethane

(D) (X) : ethene , (Y) : ethyne , (Z) : 1,1-dibromoethane

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50 From the opposite chart:

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



(A) (1) : calcium carbide , (3) : the simplest hydrocarbon.

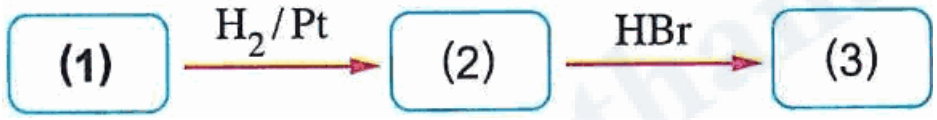
(B) (2) : follows the formula (C_nH_{2n-2}) , (4) : a reducing agent.

(C) (1) : decolourizes red bromine , (3) : chemically active.

(D) (2) : reacts with a hydrogen halide , (4) : an inorganic compound.

---

51 From the opposite chart: which of the following indicates each of compounds (1) , (2) , (3)?



(A) (1) : $HC{\equiv}C(CH_2)_2CH_3$, (2) : $H_3C(CH_2)_3CH_3$, (3) : $CH_2Br(CH_2)_3CH_3$

(B) (1) : $HCCCH_2CH_2CH_3$, (2) : $H_2CCH(CH_2)_2CH_3$, (3) : $CH_2Br(CH_2)_3CH_3$

(C) (1) : $H_2CCHCH_2CH_2CH_3$, (2) : $H_3C(CH_2)_3CH_3$, (3) : $CH_3CH_2Br(CH_2)_2CH_3$

(D) (1) : $HC{\equiv}C(CH_2)_2CH_3$, (2) : $H_2CCH(CH_2)_2CH_3$, (3) : $CH_3CHBr(CH_2)_2CH_3$

---

52 Which of the following reactions produces 2,2-dibromopropane?

(A) $CH_2BrC{\equiv}CH + 2HBr \rightarrow$

(B) $CH_3C{\equiv}CH + 2HBr \rightarrow$

(C) $CH_3CH{=}CH_2 + HBr \rightarrow$

(D) $CH_3CH{=}CHBr + HBr \rightarrow$

---

53 Which of the following is used to prepare the monomer of the polymer PVC?

(A) ethylene , HCl , H_2O

(B) calcium carbide , HCl , H_2O

(C) methane , HCl , H_2O

(D) ethanal , HCl , H_2O

---

54 Which of the following is needed when water is added to an alkyne?

(A) An acidic medium only.

(B) $HgSO_4$ + a base

(C) A neutral medium only.

(D) $HgSO_4$ + an acid

55 Four organic compounds:

• ethene. • ethanol. • ethanal. • ethanoic acid.

How many of them contain an odd number of sigma (σ) bonds?

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

---

56 What chemical processes are needed to convert ethanal into the monomer of the substance used to make plastic films and bags?

(A) hydrogenation – substitution – thermal decomposition.

(B) thermal decomposition – hydrogenation – substitution.

(C) reduction – replacement – thermal decomposition.

(D) replacement – thermal decomposition – reduction.

---

57 When acidified $KMnO_4$ solution reacts with $CH_3(CH_2)_5CHO$, ... is formed.

(A) $CH_3(CH_2)_5COOH$ (B) $CH_3(CH_2)_5CH_2OH$

(C) $CH_3(CH_2)_4COCH_3$ (D) $C_4H_9OC_3H_7$

---

58 An aliphatic hydrocarbon (A) has a molar mass less than the molar mass of the simplest olefin by $(2\ g)$.

What chemical processes are needed to obtain ethanoic acid from compound (A)?

(A) Hydrogenation, then treatment with acidified $KMnO_4(aq)$.

(B) Hydrogenation, then reduction.

(C) Catalytic hydration, then treatment with acidified $KMnO_4(aq)$.

(D) Catalytic hydration, then reduction.

Essay questions — 12 questions

1 (X) and (Y) are two compounds:

• Compound (X): a symmetrical alkyne that contains 4 carbon atoms.

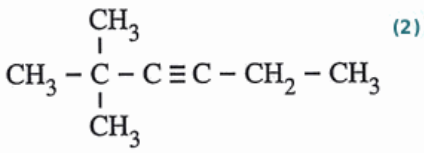
• Compound (Y): an alkyne that contains 3 carbon atoms.

(1) Draw the structural formula of compound (X).

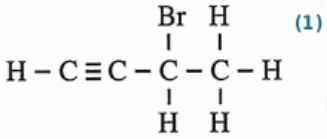
(2) What is observed when 3 mol of bromine dissolved in CCl_4 is added to 1 mol of compound (Y)? Explain.

---

2 Write the IUPAC name of each of the following:



(2)



(1)

---

3 Draw the possible structural formulas of the open-chain alkyne isomers for the following molecular formulas:

(1) C_4H_6

(2) C_5H_8

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4 A compound was named wrongly: 4-hexyne.

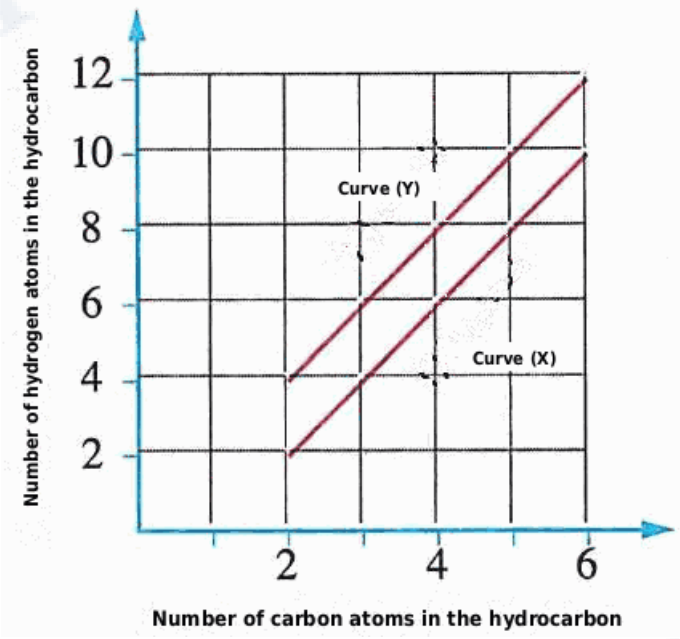
(1) What is the reason for this wrong name?

(2) What is the correct IUPAC name of this compound?

---

5 Curves (X) and (Y) shown in the opposite graph represent two homologous series of open-chain hydrocarbons.

State the name of each of them, and explain your answer.



6 An alkyne has a molar mass of 54 g/mol:

(1) Deduce its molecular formula.

(2) Draw its possible structural formulas.

[C = 12 , H = 1]

7 Write the chemical equations for adding 2 mol of HCl gas to 1 mol of ethyne gas, then halogenating the product using 4 mol of Cl_2 gas

8 Show by chemical equations how you can obtain ethane from calcium carbide.

9 Show by chemical equations how you can obtain ethanal from the smallest saturated hydrocarbon.

10 Compound (A) has the chemical formula CH_3CCCH_3 :

(1) How many moles of hydrogen are needed to convert compound (A) into a saturated compound?

(2) Write the IUPAC name of compound (B) produced by adding 2 mol of HBr to 1 mol of compound (A).

11 The following two compounds are unsaturated aliphatic hydrocarbons:

The first compound: $CH_2=CH-C\equiv CH$

The second compound: $H_3C-CH_2-C\equiv CH$

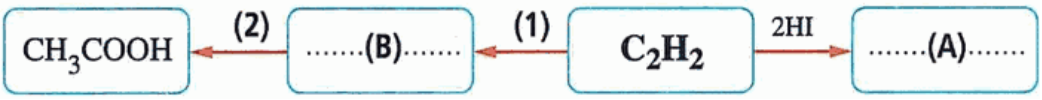
(1) Calculate the number of sigma bonds and pi bonds in the first compound.

(2) How many moles of hydrogen are needed to convert the second compound into a saturated compound?

12 From the following chart:

(1) Write the structural formula of each of: (a) compound (A). (b) compound (B).

(2) State the reaction condition in: (a) step (1). (b) step (2).



Past exam questions — 21 questions

1 Three hydrocarbons (A , B , C): (Sample exam 2026)

(A) : a gas, one of the components of butagas, found in a smaller percentage in hot countries.

(B) : contains the same number of carbon atoms as compound (A), and its molecular formula has two hydrogen atoms fewer than compound (A).

(C) : unsaturated, and its molecular formula has two hydrogen atoms fewer than compound (B).

Which of the following expresses the products of complete hydrogenation, in the presence of a catalyst, of each of the above compounds?

(A) hydrogenation product of (A) : propane , hydrogenation product of (B) : propane , hydrogenation product of (C) : propane

(B) hydrogenation product of (A) : butane , hydrogenation product of (B) : propane , hydrogenation product of (C) : propene

(C) hydrogenation product of (A) : butane , hydrogenation product of (B) : cyclopropane , hydrogenation product of (C) : propyne

(D) hydrogenation product of (A) : propane , hydrogenation product of (B) : propene , hydrogenation product of (C) : propyne

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2 Each of the following is correct for the chemical formula and the IUPAC name, except ..... (Sample exam 2026)

(A) $(CH_3)_3CC(CH_3)_3$: 2,2,3,3-tetramethylbutane

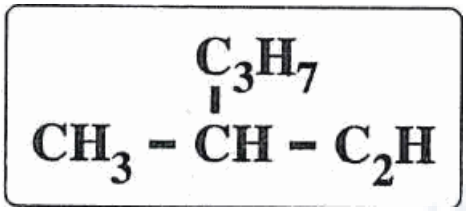
(B) $(CH_3)_2CC(CH_3)_2$: 2,3-dimethyl-2-butene

(C) $(CH_3)_3CC(C_2H_5)_3$: 3,3-diethyl-2,2-dimethylpentane

(D) $(CH_3)_3CCH_2C_2H$: 4,4-dimethyl-2-butene

---

3 The correct name of the opposite compound according to the IUPAC system is ..... (Sample exam 2026)



(A) 2,4-dimethyl-1-pentyne.

(B) 3-propyl-1-butene.

(C) 2-ethyl-1-butene.

(D) 3-methyl-1-hexyne.

4 Which of the following expresses the correct order of some organic compounds according to the amount of oxygen needed to burn one mole of each completely? (Sample exam 2026)

(A) methane > ethane > ethene.
(B) ethane > ethene > ethyne.
(C) ethyne > ethene > ethane.
(D) ethyne > ethene > methane.

5 Which of the following is the name of one of the compounds produced when an ethyl group is bonded to the simplest branched alkyne? (1st session 2025)

(A) 2-methyl-3-hexyne.
(B) 2-methyl-1-pentyne.
(C) 4-methyl-1-hexyne.
(D) 3-methyl-1-pentyne.

6 (A) , (B) , (C) are three hydrocarbons. When HBr is added to each of them separately: (2nd session 2024)

(A) : gives 1,1-dibromoethane. (B) : gives bromoethane. (C) : does not react.

Which of the following choices expresses these compounds?

(A) (B) : ethene , (C) : ethyne.
(B) (A) : ethane , (B) : ethene.
(C) (C) : ethene , (B) : ethane.
(D) (A) : ethyne , (C) : ethane.

7 The following reactions take place under suitable conditions for compounds (X) and (Y), as shown in the chart: (1st session 2022)

(X) → (HBr) (Y) → (hydration) (Z)

Compound (Z) is .....

(A) ethyne bromide.
(B) ethyl bromide.
(C) 1-bromoethanol.
(D) vinyl bromide.

8 The number of isomers of an alkyne made of three carbon atoms, a bromine atom and a chlorine atom equals ..... (Trial exam / March 2023)

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

9 (X) , (Y) , (Z) are three open-chain hydrocarbons. If: (Trial exam / May 2021)

(X) : reacts by addition in two stages.

(Y) : all its bonds are strong sigma bonds.

(Z) : decolourizes potassium permanganate solution in an alkaline medium.

Which of the following choices correctly expresses compounds (X , Y , Z)?

(A) X : alkyne , Y : alkane , Z : alkene
(B) X : alkene , Y : alkyne , Z : alkane
(C) X : alkane , Y : alkene , Z : alkyne
(D) X : alkene , Y : alkane , Z : alkyne

10 When 2 mol of red bromine solution dissolved in carbon tetrachloride are added to 1 mol of each of the compounds (2-butyne , pentane , 2-hexene), the correct choice for what happens to the colour of the solution is ..... (Trial exam / May 2021)

(A) 2-butyne : stays the same , pentane : stays the same , 2-hexene : stays the same

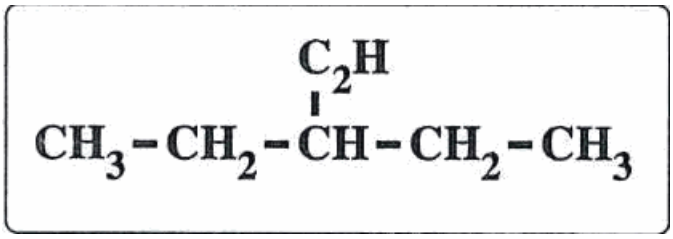
(B) 2-butyne : the colour disappears , pentane : stays the same , 2-hexene : stays the same

(C) 2-butyne : stays the same , pentane : stays the same , 2-hexene : the colour disappears

(D) 2-butyne : stays the same , pentane : the colour disappears , 2-hexene : stays the same

---

11 The correct IUPAC name of the opposite compound is ..... (1st session 2024)



(A) 3-methyl-1-pentene.

(B) 3-ethyl-1-pentyne.

(C) 3-methylpentane.

(D) 3-ethyl-1-pentene.

---

12 0.5 mol of a hydrocarbon reacts with 1 mol of bromine dissolved in carbon tetrachloride, so the formula of the product is ..... (Trial exam / June 2021)

(A) $C_nH_{2n-2}Br_4$ (B) $C_nH_{2n-2}Br_2$ (C) $C_nH_{2n}Br_4$ (D) $C_nH_{2n}Br_2$

---

13 The opposite table shows the molecular formulas of substances (X) and (Y). One mole of bromine dissolved in carbon tetrachloride is added to one mole of each of substances (X) and (Y) separately. (1st session 2021)

(X) : $C_2H_2Br_2$, (Y) : C_4H_6

Which of the following is correct?

(A) The colour of bromine disappears with (X) and does not disappear with (Y).

(B) The colour of bromine does not disappear with (X) or with (Y).

(C) The colour of bromine disappears with (X) and disappears with (Y).

(D) The colour of bromine does not disappear with (X) and disappears with (Y).

---

14 From the opposite chart: (1st session 2022)

(A) → (HX) (B) → (HX) (C)

Compounds (A) , (B) , (C) are .....

(A) (A) : an alkene derivative , (B) : an alkyne , (C) : an alkane derivative.

(B) (A) : an alkyne , (B) : an alkene derivative , (C) : an alkane derivative.

(C) (A) : an alkyne , (B) : an alkane derivative , (C) : an alkene derivative.

(D) (A) : an alkene derivative , (B) : an alkene derivative , (C) : an alkane derivative.

---

15 The compounds to which Markovnikov's rule can apply are ..... (1st session 2022)

(A) $CH_3CHCHCH_3$, CH_3CCCH_3

(B) $CH_2CHCH_2CH_3$, CH_3CCCH_3

(C) $CH_3(CH_2)_2CH_3$, $(CH_3)_2CCH_2$

(D) CH_3CCCH_3 , $(CH_3)_2CHCH_3$

---

16 From the opposite reactions: (Trial exam / March 2023)

C_2H_6 + excess HCl → (A)

C_2H_4 + excess HCl → (B)

C_2H_2 + excess HCl → (C)

The order of the molar masses of the organic products (A) , (B) , (C) is .....

(A) C > B > A (B) A > C > B (C) A > B > C (D) B > C > A

---

17 The product of the catalytic hydration of propyne is ..... (1st session 2022)

(A) CH_3CH_2CHO (B) CH_3COCH_3 (C) $CH_3CH_2CH_2OH$ (D) $CH_3CHOHCH_3$

---

18 The monomer needed to obtain the polymer used to make floor insulators can be prepared from the reaction of ..... (2nd session 2023)

(A) ethyne with Cl_2 (B) ethyne with HCl (C) ethene with HCl (D) ethene with Cl_2

---

19 (A) and (B) are unsaturated aliphatic hydrocarbons that do not belong to the same homologous series. When bromine water is added to each of them separately, the products may be ..... (2nd session 2023)

(A) C_2H_5Br , $C_2H_2Br_2$

(B) C_2H_5Br , C_2H_3Br

(C) $C_2H_4Br_2$, $C_2H_2Br_2$

(D) $C_2H_4Br_2$, C_2H_3Br

---

20 Three open-chain hydrocarbons (A) , (B) , (C). (1st session 2024)

When 1 mol of each of them burns in excess oxygen:

(A) : gives a number of moles of $H_2O(v)$ < the number of moles of $CO_2(g)$

(B) : gives a number of moles of $H_2O(v)$ = the number of moles of $CO_2(g)$

(C) : gives a number of moles of $H_2O(v)$ > the number of moles of $CO_2(g)$

Which of the following choices is correct?

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

(B) (B) : ethene , (C) : reacts by addition.

(C) (A) : propyne , (B) : gives a dihydroxy alcohol by oxidation.

(D) (A) : ethyne , (C) : gives acetaldehyde by catalytic hydration.

---

21 To obtain hexachloroethane from ethyne, the following processes are needed ..... (1st session 2022)

(A) adding chlorine, then removing hydrogen.

(B) adding hydrogen, then adding chlorine.

(C) adding chlorine, then substituting hydrogen.

(D) adding chlorine, then adding hydrogen.

Answer key and solutions

Multiple choice questions

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

1 **Answer (B)**

C_4H_6 follows C_nH_{2n-2} (at n = 4 : C_4H_6), so it is an alkyne.

2 **Answer (B)**

The molar masses of alkynes follow 14n − 2 : 26 , 40 , 54 , ...

So the second compound (propyne) has a mass of 40 g/mol

3 **Answer (C)**

(A) C_5H_8 , (B) C_6H_{10} , (D) C_5H_8 follow C_nH_{2n-2}

(C) naphthalene $C_{10}H_8$ does not follow it.

4 **Answer (C)**

Open-chain C_7H_{12} has 19 atoms.

The number of sigma bonds = the number of atoms − 1 = 18

5 **Answer (C)**

The simplest branched alkyne is 3-methyl-1-butyne $HC{\equiv}C{-}CH(CH_3){-}CH_3$, and it has 5 carbon atoms.

6 **Answer (C)**

Numbering from the end nearer to the triple bond: $CH_3–C\equiv C–CH_2–CH_3$

The bond is at carbon atom 2 : 2-pentyne.

7 **Answer (B)**

The chain has 5 carbon atoms and the triple bond is at carbon 2

On carbon 4 there are a methyl group and a bromine atom, and the groups are arranged alphabetically (bromo before methyl).

The name: 4-bromo-4-methyl-2-pentyne.

8 **Answer (C)**

$CH_3–CH_2–CH_2–C\equiv C–CH_3$ is a chain of 6 atoms and the triple bond is at carbon 2 : 2-hexyne.

9 **Answer (D)**

The longest chain containing the triple bond: $CH_3–C\equiv C–CH(CH_3)–CH_2–CH_2–CH_3$ (7 atoms).

The bond is at carbon 2 and a methyl group at carbon 4 : 4-methyl-2-heptyne.

10 **Answer (C)**

$HC\equiv C–C(CH_3)_3$: the chain has 4 atoms and the bond is at carbon 1

and two methyl groups are on carbon 3 : 3,3-dimethyl-1-butyne.

11 **Answer (B)**

The longest chain: $HC\equiv C–CH(CH_3)–CH_2–CH_3$ (5 atoms).

The bond is at carbon 1 and a methyl group at carbon 3 : 3-methyl-1-pentyne.

12 **Answer (C)**

In (A) and (B) the numbering did not start from the end nearer to the triple bond.

In (D) the longest chain has 7 atoms, not 6

(C) 4-ethyl-2-heptyne is a correct name.

13 **Answer (B)**

Dimethylacetylene: $CH_3–C\equiv C–CH_3$, which is 2-butyne.

14 **Answer (A)**

4-methyl-2-pentyne : $CH_3–C\equiv C–CH(CH_3)–CH_3$

Its formula is C_6H_{10} (10 H atoms) and it has 3 methyl groups.

15 **Answer (B)**

The methylene group $(-CH_2-)$ is found in 1-butyne : $HC\equiv C-CH_2-CH_3$

16 **Answer (C)**

$14n - 2 = 82$, $n = 6$: C_6H_{10} (hexyne).

The branched isomers: 3-methyl-1-pentyne , 4-methyl-1-pentyne , 4-methyl-2-pentyne , 3,3-dimethyl-1-butyne.

Their number is 4

17 **Answer (B)**

The isomers (alkynes): $Cl-C\equiv C-CH_2Br$, $Br-C\equiv C-CH_2Cl$, $HC\equiv C-CHClBr$

Their number is 3

18 **Answer (B)**

(A) $0.1 \times 12 = 1.2$ mol H

(B) $0.2 \times 8 = 1.6$ mol H

(C) $0.1 \times 4 = 0.4$ mol H

(D) $0.5 \times 2 = 1$ mol H

So the largest is (B).

19 **Answer (C)**

Ethyne comes from the hydrolysis of calcium carbide CaC_2

Propyne comes from the hydrolysis of magnesium carbide Mg_2C_3

20 **Answer (A)**

$CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$

The number of moles of water = $6.43 \div 18 = 0.357$ mol

Moles of $C_2H_2 = 0.357 \div 2 = 0.179$ mol

The volume = $0.179 \times 22.4 = 4$ L

21 **Answer (C)**

$2CH_4 \rightarrow C_2H_2 + 3H_2$ (at 1500°C, then rapid cooling)

9 mol of methane give 4.5 mol of ethyne.

22 **Answer (D)**

Process (1) : $2CH_3COONa + 2NaOH \rightarrow 2CH_4 + 2Na_2CO_3$ ($A = CH_4$)

Process (2) : $2CH_4 \rightarrow C_2H_2 + 3H_2$ ($B = C_2H_2$) and it takes place at 1500°C, then rapid cooling.

So statement (D) is wrong (1000°C in the absence of air gives carbon black).

23 **Answer (B)**

$C_2H_3O_2Na$ is sodium acetate, and process (1) is dry distillation with soda lime.

(A), methane, is saturated, and (B), ethyne, is unsaturated.

24 **Answer (B)**

Ethyne C_2H_2 has two weak pi bonds, so it is the most active.

25 **Answer (C)**

Ethyne is an unsaturated compound (it has a triple bond).

26 **Answer (D)**

Ethyne burns in the air incompletely with a smoky flame.

So carbon, CO_2 and water vapour are produced.

27 **Answer (B)**

$C_nH_{2n-2} + O_2 \rightarrow nCO_2 + (n-1)H_2O$

Oxygen atoms $= 2n + (n-1) = 3n - 1$

Number of moles of $O_2 = (3n-1)/2$

28 **Answer (D)**

The alkyne C_nH_{2n-2} has $(2n-2)$ H atoms, so it gives $(n-1)$ moles of water.

29 **Answer (B)**

Each half = 200 g = 200 ÷ 26 = 7.69 mol

Complete combustion: $2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$

It produces 15.38 mol CO_2 (676.9 g) and 7.69 mol H_2O (138.5 g)

Incomplete combustion: $2C_2H_2 + 3O_2 \rightarrow 2C + 2CO_2 + 2H_2O$

It produces 7.69 mol CO_2 (338.5 g) and 7.69 mol H_2O (138.5 g) (and the carbon is solid)

Total = 676.9 + 138.5 + 338.5 + 138.5 ≈ 1292 g ≈ 1.29 kg

30 **Answer (B)**

$C_2H_2 + 2.5O_2 \rightarrow 2CO_2 + H_2O$

4 − 2.5 = 1.5 mol O_2 remain

Total = 1.5 + 2 + 1 = 4.5 mol

31 **Answer (D)**

$C_2H_2 + 2.5O_2 \rightarrow 2CO_2 + H_2O$

$CH_3CHO + 2.5O_2 \rightarrow 2CO_2 + 2H_2O$

C_2H_5OH needs 3 mol O_2

32 **Answer (A)**

The oxyacetylene flame (the complete combustion of ethyne) is used in welding and cutting metals.

33 **Answer (A)**

$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$

The ratio of moles of O_2 to C_2H_2 = 5 : 2

In (A): 17.92 ÷ 22.4 = 0.8 mol C_2H_2 , and the ratio 2 : 0.8 = 5 : 2

34 **Answer (C)**

The rusting of iron needs oxygen and water vapour.

Welding iron with the oxyacetylene flame: oxygen and ethyne.

35 **Answer (D)**

$CH_3–C\equiv C–CH_3 + 2H_2 \rightarrow CH_3–CH_2–CH_2–CH_3$ (butane)

36 **Answer (B)**

Adding 1 mol of hydrogen to each 1 mol of alkyne breaks one pi bond, so an alkene is formed.

37 **Answer (D)**

14 g of ethene = 14 ÷ 28 = 0.5 mol

$CaC_2 \rightarrow C_2H_2$, $C_2H_2 + H_2 \rightarrow C_2H_4$

0.5 mol CaC_2 is needed = 0.5 × 64 = 32 g

38 **Answer (D)**

64 kg of CaC_2 = 1 kmol

1 kmol $CaC_2 \rightarrow$ 1 kmol $C_2H_2 \rightarrow$ 1 kmol C_2H_4

The mass of the polymer = the mass of ethene = 28 kg

39 **Answer (D)**

Adding 2 mol H_2 to 1 mol means that (X) is an alkyne and (Y) is an alkane.

4-methyl-1-hexyne $\rightarrow CH_3CH_2CH(CH_3)CH_2CH_2CH_3$, which is named 3-methylhexane (numbering from the end nearer to the branch).

40 **Answer (B)**

The two compounds: C_nH_{2n-2} , flammable , react with H_2

1-butyne has one methylene group and 2-butyne has none.

41 **Answer (B)**

Marsh gas (methane) is saturated, so it does not decolourize bromine.

Ethene, propyne and vinyl chloride are unsaturated, so they remove its colour.

42 **Answer (D)**

C_4H_{10} is saturated and does not decolourize bromine, and C_6H_{10} is unsaturated and decolourizes it.

43 **Answer (C)**

Calcium carbide + water → acetylene, which is unsaturated, so it removes the colour of bromine.

44 **Answer (B)**

$CH_3–C\equiv CH + 2X_2 \rightarrow CH_3–CX_2–CHX_2$

The product has 4 halogen atoms, 3 carbon atoms, 4 C–H bonds and only one methyl group.

45 **Answer (B)**

Propene consumes 1 mol of bromine and propyne consumes 2 mol

When 2 mol are added to each: the colour of bromine disappears with propyne and remains with propene.

46 **Answer (C)**

$14n - 2 = 40$, $n = 3$: propyne.

$CH_3–C\equiv CH + 2HBr \rightarrow CH_3–CBr_2–CH_3$ (2,2-dibromopropane) according to Markovnikov's rule.

47 **Answer (D)**

According to Markovnikov's rule, the bromine atom goes to the carbon atom with fewer hydrogens.

$CH\equiv C–C_4H_9 + HBr \rightarrow CH_2=CBr–C_4H_9$ (2-bromo-1-hexene)

then $+ HBr \rightarrow CH_3–CBr_2–C_4H_9$ (2,2-dibromohexane)

48 **Answer (D)**

(Z) : $CH_3CH_2CH_2–CCl=CH–CH_3$, which is 3-chloro-2-hexene.

It is produced by adding 1 mol HCl to 2-hexyne $CH_3C\equiv CCH_2CH_2CH_3$

49 **Answer (C)**

The apparatus is for preparing ethyne (X) from calcium carbide and water.

$C_2H_2 + 2H_2 \rightarrow C_2H_6$ (Y)

$C_2H_2 + 2HBr \rightarrow CH_3CHBr_2$ (Z) : 1,1-dibromoethane.

50 **Answer (C)**

(1) CaC_2 , (2) C_2H_2 , (3) CH_4 , (4) CO

$2CH_4 \rightarrow C_2H_2 + 3H_2$, $CH_4 + H_2O \rightarrow CO + 3H_2$

Calcium carbide (1) does not decolourize bromine, so statement (C) is wrong.

51 **Answer (D)**

(2) reacts with HBr, so it is an alkene: 1-pentene $H_2C{=}CH(CH_2)_2CH_3$

(1) is 1-pentyne $HC{\equiv}C(CH_2)_2CH_3$

(3) according to Markovnikov: 2-bromopentane $CH_3CHBr(CH_2)_2CH_3$

52 **Answer (B)**

$CH_3C{\equiv}CH + 2HBr \rightarrow CH_3CBr_2CH_3$ (2,2-dibromopropane)

53 **Answer (B)**

The monomer of PVC is vinyl chloride $CH_2{=}CHCl$

$CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$, $C_2H_2 + HCl \rightarrow CH_2{=}CHCl$

54 **Answer (D)**

The catalytic hydration of an alkyne needs H_2SO_4 (40%) and $HgSO_4$ at 60°C

55 **Answer (B)**

Number of sigma bonds: ethene 5 , ethanol 8 , ethanal 6 , ethanoic acid 7

The compounds with an odd number: ethene and ethanoic acid = 2

56 **Answer (C)**

The monomer of polyethylene is ethene.

Ethanal is reduced to ethanol, then OH is replaced by a halogen, then HX is removed by heating, forming ethene.

57 **Answer (A)**

The aldehyde is oxidized by acidified $KMnO_4$ solution to the corresponding carboxylic acid: $CH_3(CH_2)_5COOH$

58 **Answer (C)**

The simplest olefin is C_2H_4 (28 g/mol), so compound (A) has a mass of 26 g/mol and is ethyne C_2H_2

Catalytic hydration: $C_2H_2 + H_2O \rightarrow CH_3CHO$

Then oxidation with acidified $KMnO_4$: $CH_3CHO \rightarrow CH_3COOH$

Essay questions

1 **Model answer**

(1) Compound (X) : $CH_3–C\equiv C–CH_3$ (2-butyne).

(2) Compound (Y) is propyne. The red colour of bromine does not disappear (the colour becomes lighter), because 1 mol of bromine remains unreacted after 2 mol are used up in breaking the two pi bonds.

2 **Model answer**

(1) 3-bromo-1-butyne.

(2) 2,2-dimethyl-3-hexyne.

3 **Model answer**

(1) $HC\equiv C–CH_2–CH_3$ (1-butyne) , $CH_3–C\equiv C–CH_3$ (2-butyne).

(2) $HC\equiv C–CH_2–CH_2–CH_3$ (1-pentyne) , $CH_3–C\equiv C–CH_2–CH_3$ (2-pentyne) , $HC\equiv C–CH(CH_3)–CH_3$ (3-methyl-1-butyne).

4 **Model answer**

(1) Because the numbering of the carbon chain did not start from the end nearer to the triple bond.

(2) 2-hexyne.

5 **Model answer**

(1) Curve (X) : alkynes / because they follow the general formula C_nH_{2n-2}

(2) Curve (Y) : alkenes / because they follow the general formula C_nH_{2n}

6 **Model answer**

(1) The general formula of alkynes is C_nH_{2n-2}

$12n + 2n - 2 = 54$

$14n = 56$, $n = 4$

The molecular formula: C_4H_6

(2) $HC\equiv C-CH_2-CH_3$, $CH_3-C\equiv C-CH_3$

7 **Model answer**

$HC\equiv CH + 2HCl \rightarrow CH_3-CHCl_2$

$CH_3-CHCl_2 + 4Cl_2 \rightarrow (UV)\ CCl_3-CCl_3 + 4HCl$

8 **Model answer**

$CaC_2(s) + 2H_2O(l) \rightarrow C_2H_2(g) + Ca(OH)_2(aq)$

$C_2H_2(g) + 2H_2(g) \rightarrow (Ni)\ C_2H_6(g)$

9 **Model answer**

$2CH_4(g) \rightarrow (1500°C,\ \text{then rapid cooling})\ C_2H_2(g) + 3H_2(g)$

$C_2H_2(g) + H_2O(l) \rightarrow (H_2SO_4\ 40\%\ /\ HgSO_4\ /\ 60°C)\ CH_3CHO(l)$

10 **Model answer**

(1) 2 mol

(2) 2,2-dibromobutane.

11 **Model answer**

(1) 7 sigma bonds , 3 pi bonds.

(2) 2 mol

12 **Model answer**

(1) (a) Compound (A) : CH_3-CHI_2 (1,1-diiodoethane).

(b) Compound (B) : CH_3-CHO (ethanal).

(2) (a) Step (1) : H_2SO_4 (40%) / $HgSO_4$ / 60°C

(b) Step (2) : acidified potassium permanganate solution.

Past exam questions

1	2	3	4	5	6	7	8	9	10
A	D	D	B	A	D	C	D	A	B

11	12	13	14	15	16	17	18	19	20
B	A	C	B	B	A	B	B	C	C

21
C

1 **Answer (A)**

(A) is propane C_3H_8 , (B) is C_3H_6 (propene), and (C) is C_3H_4 (propyne).

The complete hydrogenation of any of them gives propane, and (A) itself is propane.

2 **Answer (D)**

The correct name of $(CH_3)_3CCH_2C{\equiv}CH$ is 4,4-dimethyl-1-pentyne.

So the name in (D) is wrong.

3 **Answer (D)**

The longest chain containing the triple bond: $HC{\equiv}C{-}CH(CH_3){-}CH_2CH_2CH_3$

6 carbon atoms, numbered from the triple-bond end: 3-methyl-1-hexyne.

4 **Answer (B)**

Moles of O_2 to burn one mole: ethane 3.5 , ethene 3 , ethyne 2.5 , methane 2

ethane > ethene > ethyne

5 **Answer (A)**

The simplest branched alkyne: 3-methyl-1-butyne $HC{\equiv}C{-}CH(CH_3)_2$

Bonding the ethyl to the terminal carbon atom gives $C_2H_5{-}C{\equiv}C{-}CH(CH_3)_2$: 2-methyl-3-hexyne.

6 **Answer (D)**

(A) gives 1,1-dibromoethane, so it is ethyne.

(B) gives bromoethane, so it is ethene, and (C) does not react, so it is ethane.

7 **Answer (C)**

(X) is ethyne; it reacts with HBr, forming vinyl bromide (Y) $CH_2{=}CHBr$

The hydration of (Y) according to Markovnikov gives $CH_3{-}CHBr(OH)$: 1-bromoethanol.

8 **Answer (D)**

The isomers: $CHBrCl{-}C{\equiv}CH$, $BrC{\equiv}C{-}CH_2Cl$, $ClC{\equiv}C{-}CH_2Br$

Their number is 3

9 **Answer (A)**

(X) reacts by addition in two stages: an alkyne.

(Y) all its bonds are sigma: an alkane.

(Z) decolourizes alkaline permanganate: an alkene.

10 **Answer (B)**

One mole of 2-butyne reacts with 2 mol of bromine, so the colour disappears.

Pentane does not react, and 2-hexene reacts with 1 mol only, so the colour remains.

11 **Answer (B)**

The longest chain with the triple bond: $HC{\equiv}C{-}CH(C_2H_5){-}CH_2{-}CH_3$

The name: 3-ethyl-1-pentyne.

12 **Answer (A)**

The ratio is 0.5 : 1, i.e. 1 : 2, so the compound is an alkyne that adds two moles of bromine.

The product is $C_nH_{2n-2}Br_4$

13 **Answer (C)**

(X) $C_2H_2Br_2$ has a double bond, and (Y) C_4H_6 is unsaturated, so both decolourize bromine.

14 **Answer (B)**

(A), an alkyne, adds HX, forming (B), an alkene derivative, which adds HX again, forming (C), an alkane derivative.

15 **Answer (B)**

Markovnikov's rule applies to unsaturated compounds.

$CH_2{=}CHCH_2CH_3$ (1-butene) and $CH_3C{\equiv}CCH_3$ (2-butyne) are unsaturated.

16 **Answer (A)**

(A) : ethane does not react with HCl

(B) : C_2H_5Cl (64.5 g/mol) , (C) : CH_3CHCl_2 (99 g/mol)

C > B > A

17 **Answer (B)**

The catalytic hydration of propyne gives acetone CH_3COCH_3

18 **Answer (B)**

Floor insulators are made of PVC , and its monomer is vinyl chloride.

It is prepared from the reaction of ethyne with HCl

19 **Answer (C)**

Adding bromine to an alkene (ethene) gives $C_2H_4Br_2$ and to an alkyne (ethyne) gives $C_2H_2Br_2$

20 **Answer (C)**

(A) is an alkyne , (B) an alkene , (C) an alkane.

(A) propyne is correct, and the alkene (B) gives a dihydroxy alcohol by oxidation.

21 **Answer (C)**

Adding chlorine to ethyne breaks the π bonds, forming 1,1,2,2-tetrachloroethane.

Then substituting the two hydrogen atoms with chlorine gives hexachloroethane.