Chemistry · Organic Chemistry

Ethanol

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Multiple choice questions — 93 questions

1 Sucrose is hydrolysed in the presence of H^+ forming .....

(A) a glucose molecule and a fructose molecule.

(B) a glucose molecule and a galactose molecule.

(C) two glucose molecules.

(D) two fructose molecules.

---

2 The following pairs of compounds are isomers, except .....

(A) glucose , fructose.

(B) hexene , cyclohexane.

(C) pentane , cyclopentane.

(D) ethanol , dimethyl ether.

---

3 When flour, sugar and yeast are mixed with water, CO_2 gas is given off in addition to forming an amount of .....

(A) CH_3COOH (B) C_2H_5OH (C) $C_6H_{12}O_6$ (D) H_2O

---

4 From the following scheme:

Glucose → stage (1) → dilute ethanol solution → stage (2) → 90% ethanol

Which of the following represents each of stages (1) and (2)?

(A) (1): hydrolysis , (2): alcoholic fermentation.

(B) (1): catalytic hydration , (2): distillation.

(C) (1): hydrolysis , (2): catalytic hydration.

(D) (1): alcoholic fermentation , (2): distillation.

---

5 Ethanol is prepared from glucose by process (X), from ethene by process (Y) and from ethanal by process (Z).

Which of the following is correct?

(A) (X): alcoholic fermentation , (Y): catalytic hydration , (Z): reduction.

(B) (X): fractional distillation , (Y): catalytic hydration , (Z): oxidation.

(C) (X): alcoholic fermentation , (Y): simple distillation , (Z): reduction.

(D) (X): fractional distillation , (Y): simple distillation , (Z): oxidation.

---

6 When propene is treated with dilute phosphoric acid and heated, ... is formed.

(A) propanone (B) propanal (C) 1-propanol (D) 2-propanol

7 Which of the following compounds reacts with sulphuric acid and water to form isopropyl alcohol?

(A) Ethylene. (B) Propane.
(C) Propylene. (D) 2-Methylpropene.

8 2-Methyl-2-butanol is formed by the catalytic hydration of .....

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

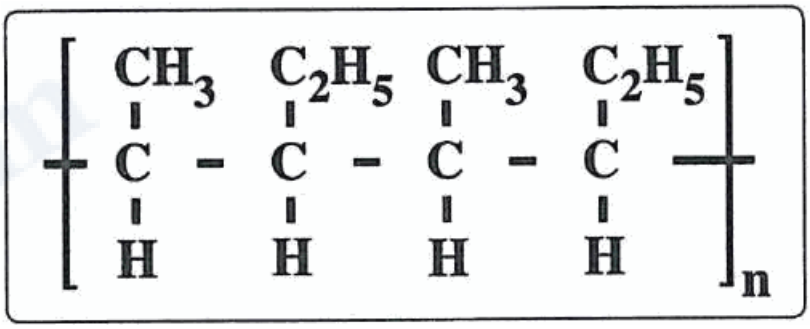
9 The catalytic hydration of 2-methyl-1-butene in the presence of hot H_2SO_4 forms .....

(A) pentyl hydrogen sulphate. (B) 2-methyl-2-butanol.
(C) 2-methyl-1-butanol. (D) secondary butyl hydrogen sulphate.

10 Compound (X) reacts with H_3PO_4 then with H_2O on heating to form isopropyl alcohol. All of the following describe compound (X), except that it .....

(A) is an unsaturated hydrocarbon.
(B) can be hydrogenated.
(C) has 9 atoms in its molecule.
(D) has 3 moles of carbon atoms in its molecule.

11 The monomer of the opposite polymer is used to prepare .....



(A) a secondary alcohol of molecular formula $C_4H_{10}O$

(B) a tertiary alcohol of molecular formula $C_4H_{10}O$

(C) a secondary alcohol of molecular formula $C_5H_{12}O$

(D) a tertiary alcohol of molecular formula $C_5H_{12}O$

---

12 Which substance reacts with ethyl bromide to form a substance used to prepare ethylene gas in the laboratory?

(A) Ethanol.

(B) Acetic acid.

(C) Aqueous KOH.

(D) Alcoholic $AgNO_3(aq)$.

---

13 All of the following are methods of preparing ethanol, except .....

(A) the catalytic hydration of one of the products of thermal cracking of petroleum.

(B) heating an ethyl halide with an aqueous solution of potassium hydroxide.

(C) the hydrolysis of sodium ethoxide.

(D) the reaction of ethene with hydrogen peroxide.

---

14 From the following scheme:

Ethene → (reaction (A) with HBr) → compound (X) → (reaction (B) with NaOH(aq)) → compound (Y)

Which of the following is correct?

(A) Reaction (A): addition , (X): bromoethane , reaction (B): addition , (Y): ethanol

(B) Reaction (A): addition , (X): bromoethane , reaction (B): substitution , (Y): ethanol

(C) Reaction (A): substitution , (X): bromoethene , reaction (B): neutralization , (Y): ethanoic acid

(D) Reaction (A): substitution , (X): bromoethene , reaction (B): substitution , (Y): ethanoic acid

15 Which compound reacts with excess aqueous KOH forming acetaldehyde?

(A) 1,2-Dichloroethane.
(B) 1,1-Dichloroethane.
(C) Chloroacetic acid.
(D) Ethyl chloride.

---

16 According to the two opposite reactions:

Reaction (1): $CH_2{=}CHCH_2CH_2CH_3$ + (X) gives 2-chloropentane.

Reaction (2): heating 2-chloropentane with NaOH(aq) gives (Y).

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

(A) (X): Cl_2 , (Y): $CH_3(CH_2)_2CHOHCH_3$
(B) (X): HCl , (Y): $CH_3(CH_2)_2CHOHCH_3$
(C) (X): Cl_2 , (Y): $CH_3(CH_2)_4OH$
(D) (X): HCl , (Y): $CH_3(CH_2)_4OH$

---

17 From the following scheme:

Scheme: CH_3CH_3 reacts with Cl_2 (reaction (1)) to form CH_3CH_2Cl, which then reacts with substance (2) to form substance (X), then (X) is heated with H_2SO_4 (reaction (3)) to form CH_2CH_2

Which of the following represents the condition of each of reactions (1) and (3), and what is substance (2)?

(A) Condition (1): 400°C , substance (2): CH_3OH , condition (3): 180°C
(B) Condition (1): UV , substance (2): CH_3OH , condition (3): 140°C
(C) Condition (1): 400°C , substance (2): aqueous KOH , condition (3): 180°C
(D) Condition (1): UV , substance (2): aqueous KOH , condition (3): 140°C

---

18 From the following scheme:

Scheme: $C(CH_3)_2CHCH_3$ reacts with HX to form (A), then (A) is heated with aqueous KOH to form (B)

What is the name of compound (B)?

(A) Pentanol.
(B) 2-Methyl-2-butanol.
(C) 3-Methyl-2-butanol.
(D) 3-Methyl-3-butanol.

---

19 What is the number of H atoms in a sample of sucrose of mass 3.4 g?
[C = 12 , H = 1 , O = 16]

(A) 6×10^{23} atom (B) 1.3×10^{23} atom (C) 3.8×10^{22} atom (D) 6×10^{21} atom

20 What is the volume of carbon dioxide gas produced by the alcoholic fermentation of a glucose sample of mass 10.3 g (at STP)?
[C = 12 , H = 1 , O = 16]

(A) 1.28 L (B) 1.42 L (C) 2.33 L (D) 2.56 L

21 When 2 mol of glucose condense, 1 mol of maltose and 1 mol of water are formed.
What is the molar mass of maltose? And what is its relation to sucrose?
[C = 12 , H = 1 , O = 16]

(A) 342 g/mol / isomers.
(B) 342 g/mol / they differ by a methylene group.
(C) 360 g/mol / isomers.
(D) 360 g/mol / they differ by a methylene group.

22 All of the following are true for the hydroxyl group in aliphatic alcohols, except that it is a(n) ..... group.

(A) ionized (B) polar
(C) hydrogen-bond forming (D) active

23 Which of the following compounds dissolves in water?

(A) Ethyne. (B) Benzene. (C) Butane. (D) Ethanol.

24 What bonds are present in a mixture of water and glycerol?

(A) Hydrogen ✓ , covalent ✓ , ionic ✗ (B) Hydrogen ✓ , covalent ✓ , ionic ✓
(C) Hydrogen ✗ , covalent ✓ , ionic ✗ (D) Hydrogen ✗ , covalent ✗ , ionic ✓

25 Which of the following compounds has the highest boiling point?

(A) Propane. (B) Diethyl ether. (C) Ethanol. (D) 1-Propanol.

26 The boiling point of methanol is higher than that of propane, because .....
[C = 12 , H = 1 , O = 16]

(A) its molar mass is greater.
(B) it has fewer hydrogen atoms.
(C) its molecules are bonded to each other by hydrogen bonds.
(D) it has fewer carbon atoms.

---

27 Which of the following gives the boiling points of methanol and ethane?

(A) Methanol: 64.7°C , ethane: 35°C
(B) Methanol: −64.7°C , ethane: −64.7°C
(C) Methanol: −64.7°C , ethane: 35°C
(D) Methanol: 64.7°C , ethane: −88.6°C

---

28 Which of the following shows the correct order of the boiling points of the compounds? (from highest to lowest)

(A) $CH_3CH_2CH_3$ then CH_3CH_2OH then $CH_3CH_2CH_2OH$
(B) $CH_3CH_2CH_2OH$ then CH_3CH_2OH then $CH_3CH_2CH_3$
(C) $CH_3CH_2CH_3$ then $CH_3CH_2CH_2OH$ then CH_3CH_2OH
(D) CH_3CH_2OH then $CH_3CH_2CH_2OH$ then $CH_3CH_2CH_3$

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29 Alcohols with the same number of carbon atoms are arranged by boiling point as follows: primary alcohol higher than secondary alcohol higher than tertiary alcohol.
Which of the following shows the order of boiling point of the following alcohols? (from highest to lowest)

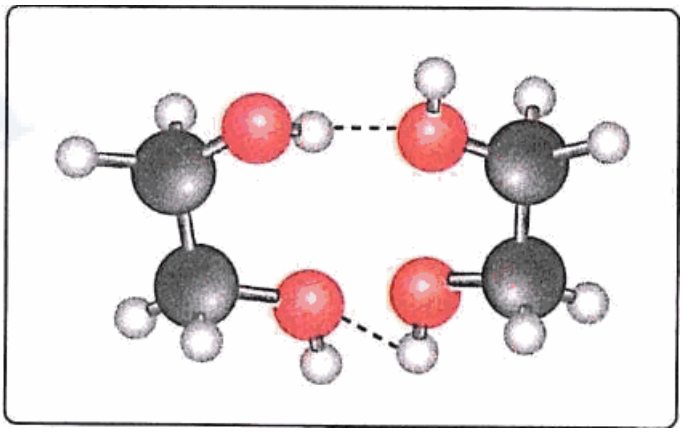
(A) 2-methyl-2-butanol then 3-methyl-2-butanol then 1-pentanol.
(B) 3-methyl-2-butanol then 2-methyl-2-butanol then 1-pentanol.
(C) 1-pentanol then 3-methyl-2-butanol then 2-methyl-2-butanol.
(D) 1-pentanol then 2-methyl-2-butanol then 3-methyl-2-butanol.

---

30 All of the following are properties of ethanol, except .....

(A) neutral and colourless.
(B) a volatile liquid.
(C) its boiling point is lower than that of water.
(D) it bonds with benzene by hydrogen bonds.

31 The opposite figure shows the reason for .....



(A) the miscibility of ethylene glycol with water.

(B) the high boiling point of ethylene glycol.

(C) the high boiling point of ethanol.

(D) the miscibility of ethanol with water.

---

32 Which of the following describes the physical properties of 1-propanol?

(A) An oily liquid, miscible with water, with a boiling point of 78.5°C

(B) A light (non-viscous) liquid, miscible with water, with a boiling point of 97°C

(C) A light (non-viscous) liquid, immiscible with water, with a boiling point of 97°C

(D) An oily liquid, immiscible with water, with a boiling point of 78.5°C

---

33 Which of the following equations represents the combustion of hydrocarbons?

(1) $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

(2) $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

(3) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

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

---

34 Some reactions of organic compounds:

(1): catalytic hydration of ethene. (2): combustion of ethanol. (3): alcoholic fermentation of glucose.

In which reaction(s) is the molar mass of the carbon-containing product less than the molar mass of the reacting compound?

[C = 12 , O = 16 , H = 1]

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

35 What is the least number of moles of oxygen needed for the complete combustion of 40 g of methanol?

[C = 12 , H = 1 , O = 16]

(A) 1.88 mol (B) 2.5 mol (C) 3.75 mol (D) 5 mol

36 From the opposite table:

Molar heat of combustion: methane −880 kJ/mol , ethanol −1380 kJ/mol , propane −2200 kJ/mol , butene −2716 kJ/mol

What is the chemical formula of the fuel that produces the largest amount of heat energy when 1 g of it burns?

[C = 12 , H = 1 , O = 16]

(A) C_2H_5OH (B) C_4H_8 (C) CH_4 (D) C_3H_8

37 Which of the following compounds has the weakest acidic character?

(A) HNO_3 (B) HCl (C) C_2H_6 (D) CH_3OH

38 With which substance does ethanol react to form a compound containing an ionic bond?

(A) Hydrochloric acid. (B) Sodium hydroxide.

(C) Sodium metal. (D) Acetic acid.

39 An organic compound (X) reacts with sodium and does not react with sodium hydroxide solution.

Which of the following can represent compound (X)?

(A) 3-pentanol ✗ , 1-propanol ✗ (B) 3-pentanol ✓ , 1-propanol ✗

(C) 3-pentanol ✓ , 1-propanol ✓ (D) 3-pentanol ✗ , 1-propanol ✓

40 A student assumed that the following statements describe sodium ethoxide:

(1): it is prepared by the reaction of sodium with ethanol.

(2): it is an organic compound prepared by the reaction of sodium hydroxide with ethanol.

(3): it is hydrolysed forming an aqueous mixture whose pH is more than 7

Which of the following describes sodium ethoxide?

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

41 2.3 g of sodium [Na = 23] reacts with methyl alcohol to form .....

(A) 0.05 mol of oxygen gas.
(B) 0.1 mol of hydrogen gas.
(C) 0.05 mol of hydrogen gas.
(D) 0.01 mol of oxygen gas.

42 On hydrolysis of the two organic compounds:
(A): the confirmatory reagent for the cations of the third analytical group is formed.
(B): the confirmatory reagent for the cations of the fifth analytical group is formed.
Which of the following is correct?

(A) (A): decomposes on heating forming an alkene / (B): its solution turns litmus red.
(B) (A): produced by the reaction of ethanol with sodium hydroxide / (B): decomposes on heating (at 180°C).
(C) (A): its solution turns litmus blue / (B): decomposes on heating forming an alkene.
(D) (A): is hydrolysed forming an alkyne / (B): produced by the reaction of ethanol with sodium hydroxide.

43 Which of the following represents the esterification reaction?

$$RCOOH + \grave{R}OH \xrightarrow{conc.H_2SO_4} \grave{R}COOR + H_2O \quad (A)$$

$$\grave{R}COOH + ROH \xrightarrow{NaOH} RCOO\grave{R} + H_2O \quad (B)$$

$$RCOOH + \grave{R}OH \xrightarrow{conc.H_2SO_4} RCOO\grave{R} + H_2O \quad (C)$$

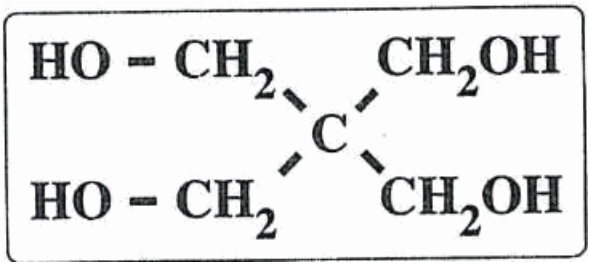
$$\grave{R}COOH + ROH \xrightarrow{NaOH} \grave{R}COOR + H_2O \quad (D)$$

44 When water is added to sodium ethoxide, then acetic acid is added to the organic product, ... is formed.

(A) a polymer (B) an ester (C) a primary alcohol (D) an aldehyde

45 Which of the following describes the opposite compound?

[H = 1 , C = 12 , O = 16]



(A) It does not react with acidified potassium permanganate solution.

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

(C) It reacts with methanoic acid forming a salt and water.

(D) One mole of it reacts with excess sodium forming 2 mol of hydrogen gas.

---

46 From the following two reactions:

$CH_3CH{=}CHCH_3 + H_2O \rightarrow (X)\ (H_2SO_4\ ,\ \Delta)$

$CH_3COOH + (X) \rightarrow (Y) + H_2O\ (H_2SO_4)$

What is the chemical formula of compound (Y)?

(A) $CH_3CH_2CH(CH_3)COOCH_3$

(B) $CH_3COOCH(CH_3)CH_2CH_3$

(C) $CH_3CH_2CH_2COOCH_3$

(D) $CH_3COOCH_2CH_2CH_2CH_3$

---

47 The opposite scheme shows some chemical reactions.

Ethanol → (X) → acetic acid

Acetic acid → (Y) → methyl acetate

Acetic acid → (Z) → ethyl acetate

Which of the following processes represents an oxidation process?

(A) (X) only.

(B) (Y) only.

(C) (X) , (Y) only.

(D) (X) , (Y) , (Z).

---

48 When 1-propanol reacts with HBr, ... is formed.

(A) 2-bromopropane + water

(B) 1-bromopropane + water

(C) ethyl bromide + methanol

(D) 2-bromo-1-propanol + hydrogen

---

49 What is the number of methyl groups in the compound produced by the reaction of 1-propanol with a hydrogen halide?

(A) 1

(B) 2

(C) 3

(D) 4

50 What are the numbers of methyl groups and methylene groups, respectively, in the compound produced by the reaction of 2-butanol with a hydrogen halide?

(A) Methyl: 1 , methylene: 2
(B) Methyl: 2 , methylene: 1
(C) Methyl: 2 , methylene: 2
(D) Methyl: 1 , methylene: 1

51 The compound that can be prepared from ethanol by substitution is .....

(A) ethene.
(B) ethanoic acid.
(C) ethanal.
(D) bromoethane.

52 In the reaction: $CH_3OH + HBr \rightarrow (X) + H_2O$ (in the presence of a catalyst)
Which of the following shows one of the properties of compound (X) compared with CH_3OH?
[C = 12 , H = 1 , O = 16 , Br = 79.9]

(A) Its boiling point is lower.
(B) Its tendency to form polymers is greater.
(C) Its molar mass is smaller.
(D) Its solubility in water is greater.

53 From the reaction of $(CH_3)_3COH$ with HCl under suitable conditions.
What is the IUPAC name of the organic product?

(A) 1,1-Dimethyl-1-chloroethane.
(B) Tertiary butyl chloride.
(C) 1-Chloro-1,1-dimethylethane.
(D) 2-Chloro-2-methylpropane.

54 From the opposite scheme: propene is changed by process (1) into compound (A), (A) is changed by process (2) into 2-propanol, and 2-propanol is changed by process (3) into (A).
Which of the following is correct?

(A) (1): addition , (2): elimination , (3): substitution
(B) (1): addition , (2): substitution , (3): substitution
(C) (1): elimination , (2): addition , (3): addition
(D) (1): substitution , (2): elimination , (3): elimination

55 From the opposite reactions:

• Oxidation of compound (1) gives compound (2), and oxidation of compound (2) gives a carboxylic acid.

• Oxidation of compound (3) gives a ketone.

• Compound (4) is not oxidized (no reaction takes place).

Which of the following is correct?

(A) (1): secondary alcohol , (2): ketone , (3): primary alcohol , (4): tertiary alcohol

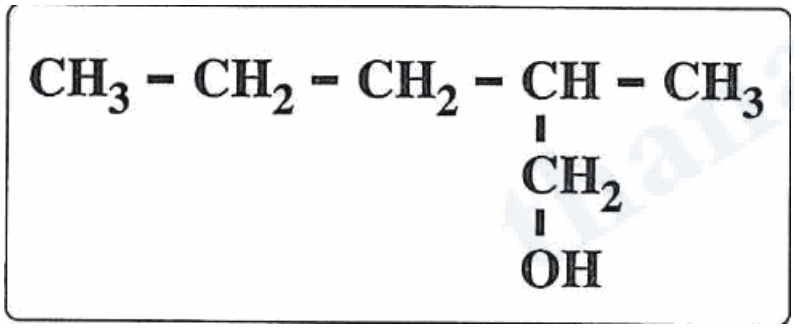
(B) (1): primary alcohol , (2): aldehyde , (3): tertiary alcohol , (4): secondary alcohol

(C) (1): primary alcohol , (2): aldehyde , (3): secondary alcohol , (4): tertiary alcohol

(D) (1): secondary alcohol , (2): ketone , (3): tertiary alcohol , (4): secondary alcohol

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56 The opposite figure shows the structural formula of an organic compound. When this compound reacts with acidified potassium dichromate solution, ... is formed.



(A) an ether (B) an ester (C) a carboxylic acid (D) a ketone

---

57 Alcohol (X) is oxidized forming an organic acid whose molar mass is 88 g/mol

What is the molecular formula of alcohol (X)?

[C = 12 , H = 1 , O = 16]

(A) $CH_3CH_2CH(OH)CH_3$ (B) $CH_3CH_2CH_2CH_2CH_2OH$

(C) $CH_3CH_2CH_2CH_2OH$ (D) $CH_3CH_2CH(OH)CH_2CH_3$

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58 From the opposite scheme: the catalytic thermal cracking of decane gives C_4H_{10} + 2X
The following processes were carried out in order on compound (X):
(reaction with HX - alkaline hydrolysis - treatment with hot chromic acid) and the organic compound (Y) was formed.
Which of the following represents the functional group of compound (Y)?

(A) –OH
(B) –CHO
(C) –COOH
(D) –CO– (carbonyl)

59 When acetone is reduced, ... is formed.

(A) isopropyl alcohol
(B) propane
(C) propene
(D) 1-propanol

60 A secondary alcohol is formed when the compound ..... is reduced.

(A) $CH_3CH_2COCH_3$ (ketone)
(B) $CH_3CH_2COOCH_3$
(C) $CH_3CH_2OCH_3$
(D) $CH_3CH_2NH_2$

61 What compound is produced by adding excess hydrogen gas to the compound $CH_2CHCOCHCH_2$ under suitable conditions?

(A) 3-Pentanal.
(B) 2-Pentanol.
(C) Divinyl-3-pentanol.
(D) 3-Pentanol.

62 All of the following represent possible oxidation reactions, except .....

(A) the change of 1-propanol into propanal.
(B) the change of $CH_3CH(CH_3)OH$ into CH_3CH_2COOH
(C) the change of propanal into propanoic acid.
(D) the change of $C_6H_5CH_2OH$ into C_6H_5CHO

63 Compound (X) has the molecular formula C_2H_6O:

- It can be oxidized to compound (Y).
- It reacts with compound (Y) forming compound (Z) and water.

To which homologous series do compounds (X), (Y) and (Z) belong?

(A) (X): alcohols , (Y): carboxylic acids , (Z): esters

(B) (X): alcohols , (Y): aldehydes , (Z): esters

(C) (X): ethers , (Y): ketones , (Z): carboxylic acids

(D) (X): ethers , (Y): carboxylic acids , (Z): salts of organic acids

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64 Alcohol (G) is oxidized by acidified potassium dichromate solution forming acid (H). When alcohol (G) reacts with acid (H), the ester ..... is formed.

(A) $HCOOC_5H_{11}$ (B) $CH_3COOC_4H_9$ (C) $C_2H_5COOC_3H_7$ (D) $C_3H_7COOC_2H_5$

---

65 Cane sugar is converted into acetic acid by .....

(A) hydrolysis, then oxidation, then alcoholic fermentation.

(B) oxidation, then alcoholic fermentation, then hydrolysis.

(C) hydrolysis, then alcoholic fermentation, then oxidation.

(D) alcoholic fermentation, then hydrolysis, then oxidation.

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66 Which of the following represents ions and groups that are not oxidized?

(A) Nitrate and carboxyl. (B) Nitrite and carboxyl.

(C) Nitrate and formyl. (D) Nitrite and formyl.

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67 Ethyl methyl ketone can be prepared by the oxidation of .....

(A) 2-propanol. (B) 1-butanol.

(C) 2-butanol. (D) tertiary butyl alcohol.

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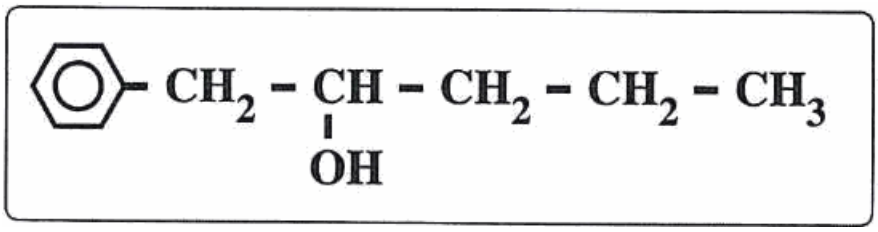
68 The following statements may describe the compound shown in the opposite figure:

(1): this compound is named 1-phenyl-2-pentanol.

(2): it is oxidized, changing into 1-phenyl-2-pentanal.

(3): on further oxidation it easily forms one organic acid.

Which of the following represents the statement(s) that describe this compound?



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

69 An organic compound (X) of general formula $C_nH_{2n+2}O$ is completely oxidized by ordinary oxidizing agents forming a compound of general formula $C_nH_{2n}O$. What type of compound is (X)?

(A) Primary alcohol. (B) Secondary alcohol.

(C) Ether. (D) Aldehyde.

70 Which of the following describes the oxidation of ethanol by $K_2Cr_2O_7$ solution acidified with H_2SO_4?

(A) It is accompanied by the evolution of CO_2 gas

(B) It is used to detect whether drivers have drunk alcohol.

(C) The elements C and H are reduced

(D) The functional group in the product is (C=O).

71 What substance is used to convert 1-propanol into propanoic acid?

(A) Hydrogen. (B) Hot chromic acid.

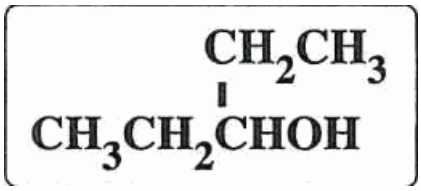
(C) Copper(II) chromate. (D) Dry hydrogen chloride gas.

72 Which of the following substances is oxidized forming a ketone?

(A) $(CH_3)_3COH$ (B) $CH_3CH_2CH_2OH$

(C) $(CH_3)_2CHCH_2OH$ (D) $CH_3CHOHCH_3$

73 Which of the following is correct when potassium dichromate solution acidified with sulphuric acid is added to the opposite colourless compound?



(A) An orange colour forms.
(B) No colour change occurs.
(C) A green colour forms.
(D) The violet colour disappears.

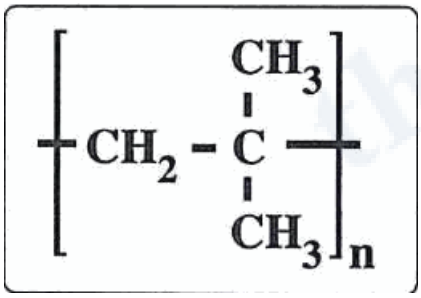
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74 The following alcohols decolourize acidified potassium permanganate, except .....

(A) 2-hexanol.
(B) 2-methyl-2-pentanol.
(C) hexanal.
(D) 2-methyl-3-pentanol.

---

75 What substance is produced by the catalytic hydration of the monomer of the opposite polymer?



(A) An alcohol that is oxidized forming an organic acid.
(B) An aldehyde that is oxidized forming an organic acid.
(C) An alcohol that is oxidized forming a ketone.
(D) An alcohol that is not oxidized by ordinary oxidizing agents.

---

76 Three organic compounds share the molecular formula C_3H_8O:

- (1): contains a terminal carbinol group.
- (2): contains a middle carbinol group.
- (3): does not contain a carbinol group.

Which of the following describes each of the compounds (1), (2) and (3)?

(A) (1): is oxidized giving the smell of vinegar , (2): prepared by hydration of propene , (3): reacts with sodium hydroxide

(B) (1): reacts with sodium , (2): reacts with sodium hydroxide , (3): reacts with sodium

(C) (1): neutral colourless substance , (2): is oxidized forming an organic acid , (3): does not react with sodium hydroxide

(D) (1): light liquid miscible with water , (2): prepared by hydration of propene , (3): does not react with sodium metal

---

77 The molecular formula ($C_4H_{10}O$) has several isomers.

- (A): the number of isomers that dissolve in water.
- (B): the number of isomers that form an alkoxide.
- (C): the number of isomers affected by $KMnO_4$(aq) acidified with H_2SO_4

Which of the following represents (A , B , C)?

(A) (A): 4 , (B): 4 , (C): 4

(B) (A): 4 , (B): 4 , (C): 3

(C) (A): 3 , (B): 3 , (C): 3

(D) (A): 3 , (B): 3 , (C): 4

---

78 The following scheme shows the conversion of compound (A) into an organic solvent (B) containing a carbonyl group:

Compound (A) reacts with HX forming a halogen derivative, which is hydrolysed in an alkaline medium forming a hydroxyl derivative, which is oxidized by $Cr_2O_7^{2-}$ / H^+ forming compound (B).

What are the molecular formulas of compounds (A) and (B)?

(A) (A): C_2H_4 , (B): C_3H_6O

(B) (A): C_3H_6 , (B): C_3H_6O

(C) (A): C_3H_6 , (B): $C_3H_6O_2$

(D) (A): C_2H_4 , (B): $C_3H_6O_2$

---

79 Forming ROR compounds from ROH compounds is one of the ..... reactions.

(A) dehydration (B) dehydrogenation (C) hydration (D) hydrogenation

---

80 Compound (X) is produced by the reaction of ethanol with conc. sulphuric acid at 140°C
What is the molecular formula of compound (X)?

(A) $CH_3–O–CH_3$ (B) $C_2H_5HSO_4$ (C) $C_2H_5OC_2H_5$ (D) C_2H_4

81 When an alkyl halide reacts with a sodium alkoxide, sodium halide and ..... are formed.

(A) an aldehyde (B) a ketone (C) an ether (D) a carboxylic acid

82 All of the following are reactions forming alkenes from alcohols by removing a water molecule, except .....

(A) ethene from ethanol.
(B) 2-methyl-2-butene from 2-methyl-2-butanol.
(C) 2-propene from 2-propanol.
(D) 3-ethyl-2-pentene from 3-ethyl-3-pentanol.

83 From the following scheme:
The simplest branched alkene (A) reacts with HCl forming (B), then (B) is heated with KOH(aq) forming (C).
All of the following are correct, except .....

(A) (B): the compound 2-chloro-2-methylpropane.
(B) (C): reacts with H_2SO_4(l) (at 180°C) forming (A).
(C) (C): is affected by acidified $K_2Cr_2O_7$ solution.
(D) (A): its atoms are bonded in the molecule by 11 sigma bonds.

84 Organic compound (A) reacts with sodium metal forming compound (B), and when excess compound (A) is heated with conc. sulphuric acid, diethyl ether is formed.
Which of the following represents compounds (A) and (B)?

(A) (A): C_3H_7OH , (B): CH_3ONa (B) (A): CH_3OH , (B): CH_3ONa
(C) (A): C_4H_9OH , (B): C_4H_9ONa (D) (A): C_2H_5OH , (B): C_2H_5ONa

85 The reactions shown in the following scheme take place under the suitable conditions for each reaction:

C_4H_9ONa reacts with C_2H_5I forming (X) + NaI, and C_4H_9ONa is hydrolysed forming (Y).

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

(A) (X): ethyl butyl ether , (Y): is reduced forming a ketone.

(B) (X): symmetrical ether , (Y): is reduced forming an aldehyde.

(C) (X): symmetrical ether , (Y): a symmetrical ether is prepared from it.

(D) (X): butyl ethyl ether , (Y): dibutyl ether is prepared from it.

---

86 A saturated aliphatic monohydric alcohol has a molecular mass of $(74\ g/mol)$.

How many of its isomers do not react with sodium metal?

[H = 1 , C = 12 , O = 16]

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

---

87 Denatured alcohol is a mixture of compound (X), compound (Y), water and some dyes, "where (X) and (Y) belong to the same homologous series".

All of the following describe compounds (X) and (Y), except .....

(A) they dissolve in water.

(B) they are light liquids.

(C) they react with each other to form an ester and water.

(D) their boiling points are different.

---

88 There are many industrial uses for the mixture of .....

(A) ethanol and methanol. (B) phenol and methanol.

(C) ethanol and phenol. (D) 1-propanol and ethanol.

---

89 Ethanol is used in making deodorants and after-shave lotion, because it .....

(A) is flammable and volatile.

(B) is a good solvent and an antiseptic.

(C) is flammable and mixes easily with water.

(D) is colourless and has a low freezing point.

---

90 The opposite figure shows filling a car with a fuel that has high combustion efficiency.

What are the two substances (A) and (B) that make up this fuel?

(A) (A): ethanol , (B): methanol
(B) (A): gasoline , (B): ethanol
(C) (A): gasoline , (B): isooctane
(D) (A): methanol , (B): isooctane

91 What is the physical state of ethylene glycol (at 25°C)?

(A) A white solid.
(B) A liquid.
(C) A gas.
(D) A brown solid.

92 From the opposite scheme: C_2H_5OH is heated with conc. H_2SO_4 at 180°C forming A, then A reacts with H_2O_2 forming B

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

(A) (A): an olefin , (B): a very viscous liquid.
(B) (A): decolourizes bromine water , (B): used in preparing Dacron fibres.
(C) (A): the monomer of the plastic bags polymer , (B): used in printing inks.
(D) (A): produced by cracking petroleum products , (B): does not dissolve in water.

93 The following equation shows the explosion reaction of the organic substance (X):

$2X(s) \rightarrow 2C(s) + 12CO(g) + 5H_2(g) + 3N_2(g)$

What is substance (X), and what is the total volume of the gases produced by the explosion of 1 mol of this substance (at STP)?

(A) TNT , 224 L
(B) glycerol trinitrate , 492.8 L
(C) TNT , 448 L
(D) glycerol trinitrate , 224 L

Essay questions — 16 questions

1. Show by symbolic equations, writing the reaction conditions, how to obtain each of the following from chloromethane:
   (1) an alcohol.
   (2) a Freon.

2. Write the symbolic equation for converting an alkyl halide containing 5 carbon atoms into a tertiary alcohol.

3. Show by symbolic equations how to obtain ethyl chloride from glucose.

4. Show by symbolic equations how to obtain ethylene from sodium ethoxide.

5. Show by symbolic equations how to obtain propanone from 2-bromopropane.

6. Show by symbolic equations how to obtain diethyl ether from ethyl bromide.

7. Show by symbolic equations how to obtain a secondary alcohol from a primary alcohol.

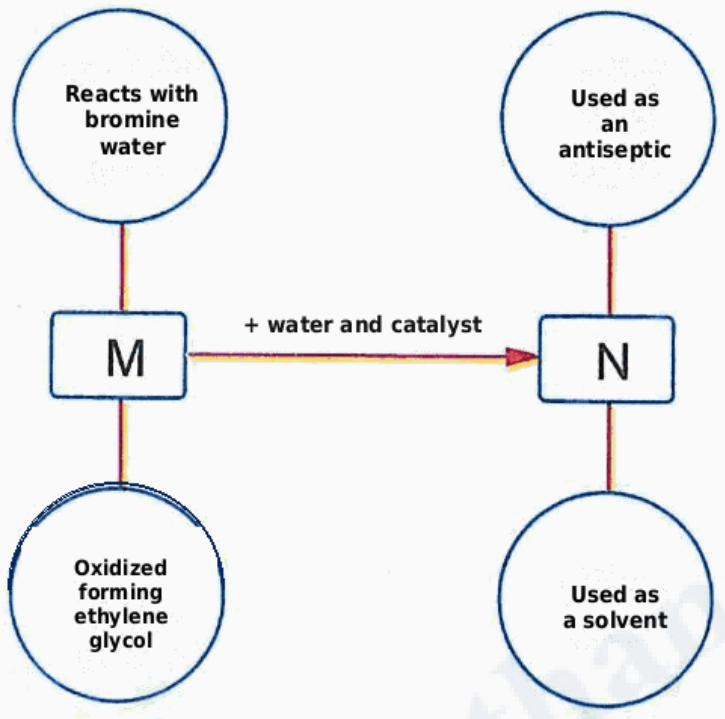
8. Two compounds that do not react with sodium:
   • Compound (A): its molecular formula is C_3H_8O
   • Compound (B): its molecular formula is $C_4H_{10}O$
   (1) What is the name of compound (A)?
   (2) Draw the possible structural formulas of compound (B).

9 The opposite scheme shows some properties of the two compounds (M) and (N).

Compare these two compounds in terms of:

(1) solubility in water.

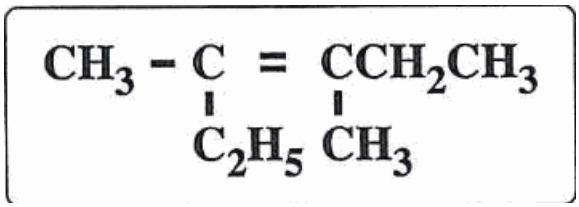
(2) the type of their reaction with HX



10 The opposite figure represents the chemical formula of an organic compound:

(1) Write the IUPAC name of this compound.

(2) What type of alcohol is produced by the catalytic hydration of this compound, according to the attachment of the carbinol group, and what do you observe when potassium permanganate solution is added to this alcohol? Explain.



11 Draw the structural formula of the simplest alkene whose hydration produces:

(1) a secondary monohydric alcohol.

(2) a tertiary monohydric alcohol.

12 Dipropyl ether is formed from 2 mol of compound (X) in the presence of hot conc. sulphuric acid:

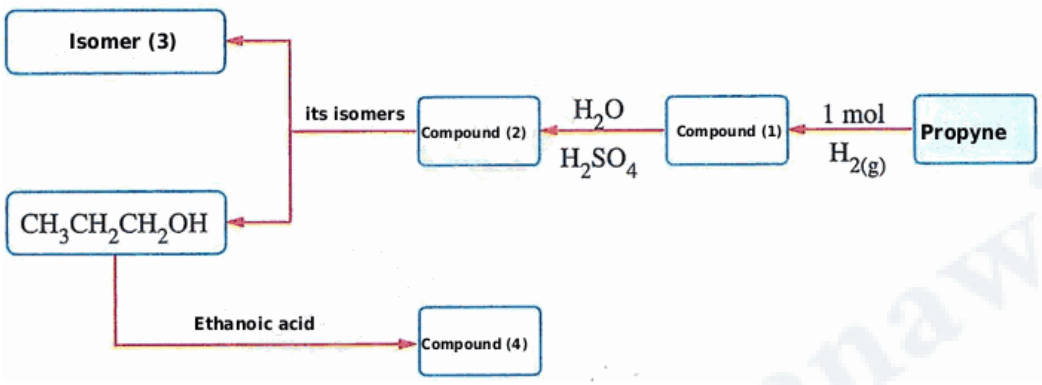
(1) Write the symbolic equation for the reaction.

(2) Write the symbolic equation for converting 1 mol of compound (X) into the corresponding alkene.

13 The following scheme shows some chemical reactions:

(1) Draw the structural formula of: (a) compound (1). (b) isomer (3).

(2) What is the IUPAC name of: (a) compound (2). (b) compound (4).

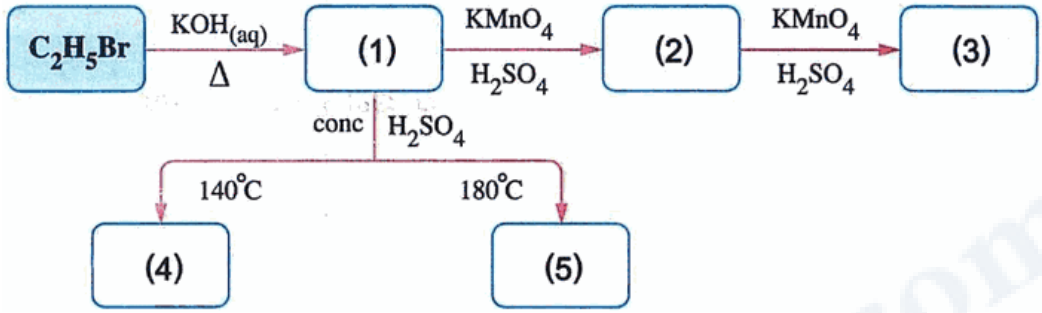


14 Draw the branched unsaturated isomers of the molecular formula C_5H_{10}, stating which of them gives a tertiary alcohol on hydration.

15 From the following scheme:

(1) Write the chemical formula of: (a) compound (2). (b) compound (4).

(2) Write the chemical formula of the product of: (a) the reaction of compound (1) with compound (3) in the presence of a dehydrating agent. (b) the catalytic hydration of compound (5).



16 Compounds (A) and (B) are produced by the alkaline hydrolysis of the following two compounds, respectively.

- $CH_3CH_2CH_2CH_2Cl$
- $(CH_3)_3CCl$

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

(2) How can you distinguish between compounds (A) and (B)?

Past exam questions — 52 questions

1 Which of the following shows the correct order of the chemical processes needed to obtain, from cane sugar, an organic compound used as an antifreeze for water? (Sample exam 2026)

(A) Hydrolysis – alcoholic fermentation – dehydration / 140°C – addition of hydrogen peroxide.

(B) Alcoholic fermentation – hydrolysis – dehydration / 180°C – Baeyer's reaction.

(C) Hydrolysis – alcoholic fermentation – dehydration / 180°C – addition of hydrogen peroxide.

(D) Hydrolysis – alcoholic fermentation – dehydration / 80°C – addition of hydrogen peroxide.

---

2 The general formula $C_4H_{10}O$ represents three alcohol isomers (A), (B) and (C): (Sample exam 2026)

(A): contains two methyl groups.

(B): contains three methyl groups.

(C): contains one methyl group.

Which of the following gives the correct IUPAC name of the product of adding acidified potassium permanganate to each of (A), (B) and (C)?

(A) (A): 2-butanone , (B): 2-methylpropanoic , (C): no reaction

(B) (A): 2-methylpropanoic , (B): no reaction , (C): 2-butanone

(C) (A): no reaction , (B): 2-methylpropanoic , (C): 2-butanone

(D) (A): 2-methylpropanoic , (B): no reaction , (C): butanoic acid

---

3 Which of the following alcohols is oxidized by acidified potassium dichromate, and does not give 2-methyl-1-butene when dehydrated by conc. sulphuric acid at 180°C? (Sample exam 2026)

(A) 2,3-Dimethyl-2-butanol.

(B) 2,2-Dimethyl-1-propanol.

(C) 2-Methyl-2-propanol.

(D) 2-Methyl-1-butanol.

---

4 Which of the following shows the correct order of the processes needed to obtain (a saturated hydrocarbon) from an alcohol that is not oxidized by ordinary oxidizing agents? (Sample exam 2026)

(A) Dehydration of ethanol at 180°C then hydrogenation.

(B) Dehydration of 1-propanol with sulphuric acid at 180°C

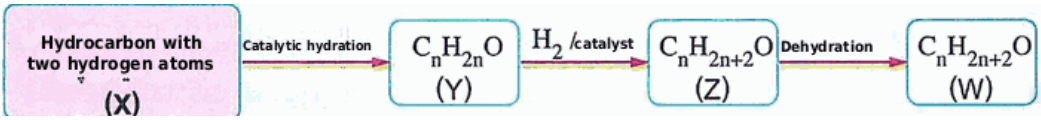
(C) Dehydration of 2-methyl-2-propanol then hydrogenation.

(D) Dehydration of 2-propanol with sulphuric acid at 180°C

---

5 From the following scheme: (Sample exam 2026)

Which of the following is correct for compounds (W , Z , Y , X)?



(A) Compound (X) reacts by addition in one step.

(B) Compound (Y) is propanal.

(C) Compound (Z) is a primary alcohol.

(D) Compound (W) reacts with sodium metal.

---

6 An alcohol cannot be prepared by catalytic hydration. All of the following apply to this alcohol, except ..... (Sample exam 2026)

(A) it can be prepared by the general method of preparing alcohols.

(B) it has structural isomers.

(C) it has harmful effects on human health.

(D) it is used in preparing esters.

---

7 Which of the following is the product of the alkaline hydrolysis of 1-bromo-2-methylpropane? (Sample exam 2026)

(A) Secondary propyl alcohol.

(B) Isobutyl alcohol.

(C) 2-Methyl-2-propanol.

(D) Tertiary butyl alcohol.

---

8 Two organic compounds (X , Y): (Sample exam 2026)

(X): 1-bromo-1-propanol.

(Y): 2-bromo-2-propanol.

The processes (alkaline hydrolysis then reduction) were carried out on each of compounds (X) and (Y) separately.

Which of the following represents the product of these processes for each of compounds (X) and (Y)?

(A) (X): propanal , (Y): propanone

(B) (X): propanal , (Y): 2-propanol

(C) (X): 1-propanol , (Y): 2-propanol

(D) (X): 1-propanol , (Y): propanone

---

9 Which of the following describes the properties of each type of the following alcohols? (Sample exam 2026)

(A) Primary and secondary alcohols react with sodium metal, while tertiary alcohols do not.

(B) Only primary alcohols are oxidized, forming a mixture of aldehyde and ketone at the end of the reaction.

(C) Primary alcohols have a continuous carbon chain, while secondary and tertiary alcohols have branched carbon chains.

(D) Primary and secondary alcohols react with acidified potassium permanganate, while tertiary alcohols do not.

---

10 (X , Y) are two isomers of the formula C_4H_8O with different functional groups. (X) turns acidified potassium dichromate solution (acidified with sulphuric acid) green, while (Y) does not decolourize acidified potassium permanganate. (Sample exam 2026)

Which of the following represents (X) or (Y)?

(A) (X): 2-methyl-1-propanol.

(B) (Y): 2-methylpropanal.

(C) (X): 2-methylpropanal.

(D) (Y): 3-methyl-2-butanone.

---

11 (X , Y , Z) are three hydrocarbon derivatives with the following molecular formulas: (Sample exam 2026)

(X): CH_2O , (Y): C_2H_6O , (Z): $C_2H_6O_2$

Which of the following represents (X , Y , Z)?

(A) (X): ketone , (Y): aliphatic ether , (Z): dihydric primary alcohol

(B) (X): aldehyde , (Y): monohydric primary alcohol , (Z): dihydric primary alcohol

(C) (X): carboxylic acid , (Y): monohydric secondary alcohol , (Z): aliphatic ester

(D) (X): aldehyde , (Y): aliphatic ether , (Z): carboxylic acid

---

12 (X , Y , Z) are three organic compounds with the molecular formula C_3H_8O: (Sample exam 2026)

(X): decolourizes acidified potassium permanganate solution, forming a compound that reacts with sodium carbonate.

(Y): decolourizes acidified potassium permanganate solution, forming a compound that does not respond to the acidity test.

(Z): does not decolourize acidified potassium permanganate solution.

Which of the following gives the number of methyl groups in each of (X , Y , Z)?

(A) (X): 1 , (Y): 0 , (Z): 2

(B) (X): 2 , (Y): 1 , (Z): 2

(C) (X): 2 , (Y): 2 , (Z): 1

(D) (X): 1 , (Y): 2 , (Z): 2

---

13 By the alkaline hydrolysis of compound (X), we obtain the simplest alcohol containing an ethyl branch. (Sample exam 2026)

Which of the following represents compound (X)?

(A) 3-Chloro-2-ethylpentane.

(B) 1-Chloro-2-ethylbutane.

(C) 2-Chloro-2-ethylpropane.

(D) 2-Chloro-2-ethylpentane.

---

14 (X , Y) are two isomers of hydrocarbon derivatives with the general formula ($C_nH_{2n+2}O$), each with a different functional group; (X) has a higher boiling point than (Y). (Sample exam 2026)

By which of the following processes can isomer (Y) be obtained from isomer (X)?

(A) Catalytic hydration.

(B) Complete oxidation.

(C) Heating with conc. sulphuric acid at 180°C

(D) Heating with conc. sulphuric acid at 140°C

15 From the following scheme: (Sample exam 2026)

A → (alkaline hydrolysis / Δ) → B → (oxidation) → C

Which of the following does not represent compounds (A , B , C)?

(A) (A): 1-chloropropane, (B): isopropyl alcohol, (C): propanoic.

(B) (A): ethyl chloride, (B): ethyl alcohol, (C): acetic acid.

(C) (A): 2-chloropropane, (B): isopropyl alcohol, (C): acetone.

(D) (A): 1-chloropropane, (B): primary propyl alcohol, (C): propanoic.

---

16 From the following scheme: (Sample exam 2026)

C_nH_{2n} → process (1) → $C_nH_{2n+2}O$

C_nH_{2n} → process (2) → $C_nH_{2n+2}O_2$

Which of the following represents processes (1) and (2) and the product of each?

(A) (1): oxidation producing a monohydric alcohol.

(B) (2): oxidation producing a dihydric alcohol.

(C) (1): catalytic hydration producing a dihydric alcohol.

(D) (2): catalytic hydration producing a monohydric alcohol.

---

17 From the following scheme: (Sample exam 2026)

C_3H_5Cl (X) → hydrogenation → Y → basic hydrolysis → Z

Which of the following gives the number of isomers of each of (X), (Y) and (Z)?

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

(B) (X): 4 , (Y): 2 , (Z): 2

(C) (X): 3 , (Y): 2 , (Z): 2

(D) (X): 4 , (Y): 3 , (Z): 2

---

18 (X): a primary alcohol that has only one other alcohol isomer. (Sample exam 2026)

(Y): a hydrocarbon produced by the dehydration of compound (X).

(Z): an isomer of compound (Y).

Which of the following describes the properties of compound (Z)?

(A) More stable than normal propane.

(B) Burns faster than cyclobutane.

(C) Burns more slowly than normal hexane.

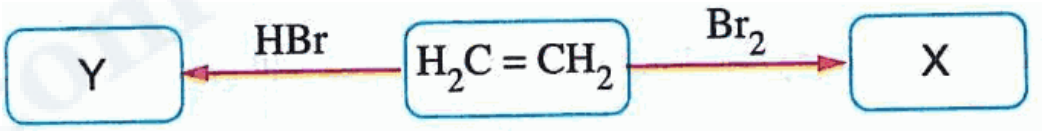
(D) Less active than cyclopentane.

---

19 From the following scheme: (Sample exam 2026)

When excess KOH solution is added with heating to each of (X) and (Y).

Which of the following represents the compound produced in the two cases?



(A) In case (X): a secondary alcohol used in thermometers is produced.

(B) In case (Y): a secondary alcohol used as a mouth and teeth antiseptic is produced.

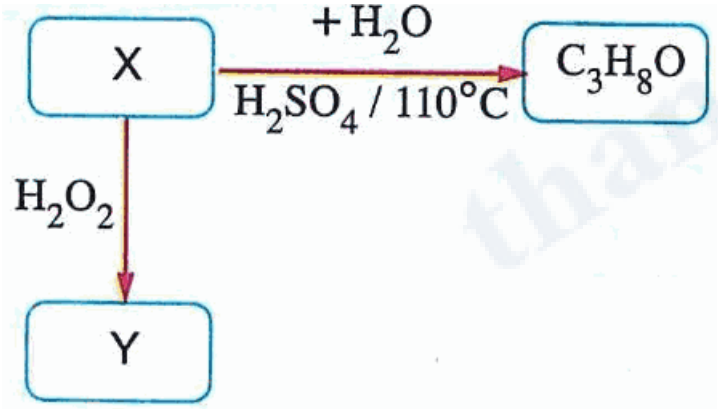
(C) In case (X): a primary alcohol that is the monomer of PEG is produced

(D) In case (Y): a primary alcohol used in pen inks is produced.

---

20 The following reaction was carried out under suitable conditions: (Sample exam 2026)

Which of the following is correct?



(A) Both C_3H_8O and (Y) contain a secondary carbinol group.

(B) Both C_3H_8O and (Y) contain a primary carbinol group.

(C) The carbinol group in C_3H_8O is primary, while in (Y) it is secondary.

(D) The carbinol group in C_3H_8O is secondary, while in (Y) it is tertiary.

---

21 Which of the following is the number of isomers of the formula C_4H_8O that can be oxidized? (1st session 2025)

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

---

22 From the following scheme: (1st session 2025)

(A) → basic hydrolysis → (B) → complete oxidation → (C)

The general formula of compound (C) is $C_nH_{2n}O$

Which of the following represents compounds A, B and C?

(A) (A): chloroethane , (B): ethanol , (C): acetaldehyde.

(B) (A): 1-bromobutane , (B): butanol , (C): butanoic acid.

(C) (A): isopropyl chloride , (B): 2-propanol , (C): propanal.

(D) (A): 2-chloropropane , (B): 2-propanol , (C): propanone.

---

23 Which of the following is the final product of the following processes: (1st session 2025)

dehydration of 3-methyl-1-butanol in the presence of a catalyst, then catalytic hydration of the product?

(A) A ketone.

(B) A secondary alcohol.

(C) A primary alcohol.

(D) A tertiary alcohol.

---

24 The following table gives the general formulas of four organic compounds (A , B , C , D): (1st session 2025)

(A): $C_nH_{2n+2}O_2$, (B): $C_nH_{2n}O$, (C): $C_nH_{2n+2}O_3$, (D): C_nH_nO

Which of the following choices is correct?

(A) Formula (A) is of a compound used as a fuel for cars.

(B) Formula (C) is of a compound used in the textile industry.

(C) Formula (B) is of a compound used in cosmetics.

(D) Formula (D) is of a compound used in preserving food.

---

25 Which of the following choices represents the processes needed to obtain, from 3-bromopropene, a substance added to textiles to make them soft and flexible? (2nd session 2024)

(A) Hydrogenation then basic hydrolysis.

(B) Addition of HBr then basic hydrolysis.

(C) Oxidation by H_2O_2 then basic hydrolysis.

(D) Halogenation then hydrogenation.

---

26 The molecular formulas of three hydrocarbon derivatives (X), (Y) and (Z) are: (2nd session 2024)

(X): $C_3H_8O_3$, (Y): $C_2H_6O_2$, (Z): C_3H_8O

Which of the following choices is correct?

(A) Compound (X) is a trihydric alcohol and its boiling point is lower than (Y) and (Z).

(B) When compound (Z) is oxidized it gives a ketone, and the boiling point of compound (Y) is lower than (X).

(C) Compound (Y) has a lower boiling point than compound (Z) and higher than compound (X).

(D) Compound (X) reacts with fatty acids and forms soap.

---

27 On the alkaline hydrolysis of the compound C_3H_7Br that has no methylene group, the product is ..... (Trial exam / June 2021)

(A) a secondary alcohol only.

(B) a primary alcohol only.

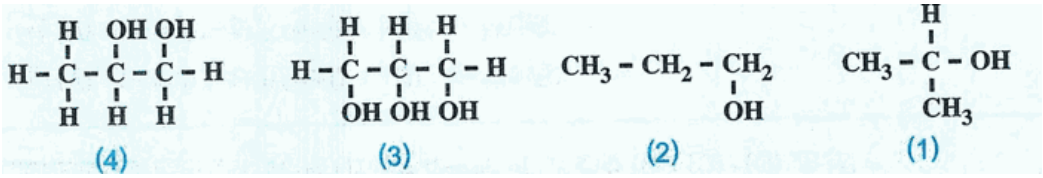
(C) a primary or secondary alcohol.

(D) a primary or tertiary alcohol.

---

28 Four organic compounds have the following formulas: (1st session 2024)

Which of the following choices gives the incorrect name according to the IUPAC system?



(A) Compound (4): 1,2-dihydroxypropane.

(B) Compound (2): 1-propanol.

(C) Compound (3): 1,2,3-trihydroxypropane.

(D) Compound (1): isopropanol.

---

29 On the basic hydrolysis of C_3H_7Br with heating, it can give ..... (1st session 2021)

(A) a primary alcohol only.

(B) a secondary alcohol only.

(C) a primary alcohol or a tertiary alcohol.

(D) a primary alcohol or a secondary alcohol.

---

30 The following table gives the molecular formulas of three organic compounds: (1st session 2024)

(X): $C_2H_6O_2$, (Y): $C_3H_8O_3$, (Z): C_2H_6O

Which of the following choices is correct?

(A) (Y): an alcohol used to sterilize the mouth and teeth.

(B) (X): an alcohol used in car radiators in cold areas.

(C) (Z): an acid used in making artificial silk.

(D) (Y): an acid used in preserving food.

---

31 Three alcohols (X), (Y) and (Z) have the following formulas: (1st session 2024)

(X): $C_2H_5COH(CH_3)_2$, (Y): $C_2H_5CHOHCH_3$, (Z): $(CH_3)_2CHCH_2OH$

Which of the following choices is correct?

(A) (X) is oxidized giving a carboxylic acid, and its boiling point is lower than (Z).

(B) (Y) dissolves in water and is oxidized to a carboxylic acid.

(C) (X) has a higher boiling point than (Y) and is not oxidized under ordinary conditions.

(D) (Z) dissolves in water and is oxidized to a ketone.

---

32 On the alkaline hydrolysis of a primary alkyl halide, compound (A) is formed, and of a secondary alkyl halide, compound (B) is formed; compounds (A) and (B) are ..... (2nd session 2021)

(A) (A): 2-butanol , (B): isobutyl alcohol.

(B) (A): 1-butanol , (B): 2-methyl-2-propanol.

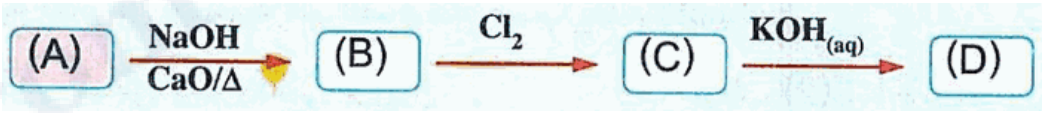
(C) (A): 2-methyl-2-propanol , (B): 1-butanol.

(D) (A): 2-methyl-1-propanol , (B): 2-butanol.

---

33 The following reactions take place under suitable conditions to obtain compounds (B), (C) and (D) as follows: (2nd session 2022)

Compounds (A), (C) and (D) are .....



(A) (A): sodium butanoate , (C): 1-chloropropane , (D): primary alcohol.

(B) (A): sodium butanoate , (C): 1-chloropropane , (D): secondary alcohol.

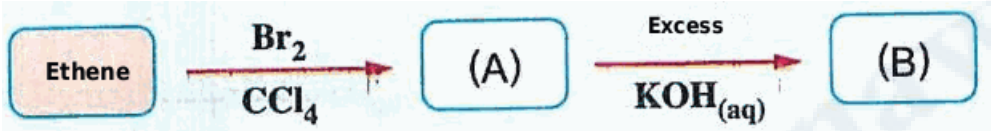
(C) (A): sodium propanoate , (C): 1-chloropropane , (D): primary alcohol.

(D) (A): sodium propanoate , (C): 2-chloropropane , (D): secondary alcohol.

---

34 Using the opposite scheme: (2nd session 2022)

Which of the following is correct?



(A) (A): bromoethane , (B): ethanol.

(B) (A): 1,1-dibromoethane , (B): ethylene glycol.

(C) (A): 1,2-dibromoethane , (B): ethylene glycol.

(D) (A): bromoethane , (B): ethanal.

---

35 Which of the products of the following reactions does not decolourize alkaline potassium permanganate solution? (Trial exam / March 2023)

(A) The product of adding 1 mol of H_2 to 1 mol of propyne.

(B) The product of adding 1 mol of HBr to 1 mol of 2-methyl-2-butene.

(C) The product of the dehydration of 1-butanol.

(D) The product of the dehydration of 2-methyl-2-propanol.

---

36 You have two compounds (A) and (B): compound (A) is an open-chain alkane of molecular mass 58, and compound (B) is a saturated monohydric alcohol of molecular mass 60; compounds (A) and (B) are ..... (1st session 2021)

[C = 12 , O = 16 , H = 1]

(A) (A) a gas , (B) lower in boiling point than (A).

(B) (A) a liquid , (B) higher in boiling point than (A).

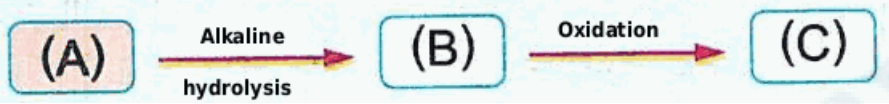
(C) (A) a gas , (B) higher in boiling point than (A).

(D) (A) a liquid , (B) lower in boiling point than (A).

---

37 Using the opposite scheme: (Trial exam / June 2021)

Where one mole of compound (B) contains 12 moles of atoms, compounds (A), (B) and (C) are .....



(A) (A): 2-bromopropane , (B): isopropyl alcohol , (C): acetone.

(B) (A): 2-bromopropane , (B): propyl alcohol , (C): propanoic acid.

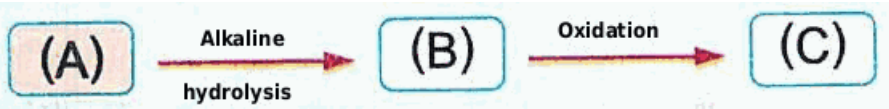
(C) (A): ethyl chloride , (B): ethyl alcohol , (C): acetic acid.

(D) (A): ethyl chloride , (B): ethyl alcohol , (C): acetaldehyde.

---

38 Using the opposite scheme: (1st session 2021)

Where one mole of compound (C) contains 5 moles of atoms, compounds (A), (B) and (C) are .....



(A) (A): methyl chloride , (B): methanol , (C): formic acid.

(B) (A): ethyl chloride , (B): ethanol , (C): acetic acid.

(C) (A): methyl chloride , (B): methanol , (C): formaldehyde.

(D) (A): ethyl chloride , (B): ethanol , (C): acetaldehyde.

---

39 Two compounds (A) and (B) are hydrocarbon derivatives; compound (A) is formed by the reduction of compound (B) (2nd session 2021)

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

(A) (A): CH_3COCH_3 , (B): $(CH_3)_2CHOH$

(B) (A): CH_3COOH , (B): CH_3CHO

(C) (A): $(CH_3)_2CHOH$, (B): CH_3COCH_3

(D) (A): CH_3COOH , (B): CH_3CH_2CHO

---

40 An alcohol can be obtained from ethyne under suitable conditions by ..... (2nd session 2022)

(A) hydration then oxidation.

(B) polymerization then nitration.

(C) polymerization then alkylation.

(D) hydration then reduction.

---

41 The correct IUPAC name of the compound with the molecular formula $C_4H_{10}O$ is ..... (2nd session 2023)

(A) 2-methyl-2-propanol.

(B) butanone.

(C) butanal.

(D) 2-methylpropanal.

---

42 Three organic compounds that are hydrocarbon derivatives: (1st session 2023)

Compound (A): cannot be oxidized.

Compound (B): does not form hydrogen bonds between its molecules.

Compound (C): does not react by addition.

So compounds (A), (B) and (C) are .....

(A) (A): $C(CH_3)_3OH$, (B): $CH_3–O–CH_3$, (C): $C_3H_5(OH)_3$

(B) (A): C_3H_7COOH , (B): C_2H_5OH , (C): C_6H_5OH

(C) (A): $C_2H_5COCH_3$, (B): CH_3COOCH_3 , (C): C_6H_5OH

(D) (A): $CH_3CHOHCH_3$, (B): $CH_3–O–CH_3$, (C): $C_3H_5(OH)_3$

---

43 Which of the following steps are correct to obtain, from 3-chloropropene, a compound used to dilate the arteries? (1st session 2024)

(A) Basic hydrolysis then addition of HCl then nitration.

(B) Halogenation by substitution then basic hydrolysis then nitration.

(C) Halogenation by addition then basic hydrolysis then nitration.

(D) Addition of HCl then basic hydrolysis then nitration.

---

44 The formula $C_3H_8O_2$ represents several organic compounds. (1st session 2024)
Which of the following choices represents these compounds?

(A) Isopropyl alcohol – ethyl methyl ether – propanol.

(B) 1,2-Dihydroxypropane and 1,3-dihydroxypropane.

(C) Methyl ethanoate – ethyl methanoate – propanoic acid.

(D) Propanoic acid – propanone – propanal.

---

45 (A), (B) and (C) are three organic compounds. When acidified potassium dichromate solution was added to each of them separately, it was found that (A) and (C) change the colour of acidified potassium dichromate, while (B) does not. Which of the following choices is correct? (Trial exam / March 2023)

(A) (A): $C_2H_5COCH_3$, (C): C_4H_9OH

(B) (B): C_3H_7CHO , (A): $C_2H_5COCH_3$

(C) (A): C_3H_7COOH , (C): C_3H_7OH

(D) (A): C_3H_7CHO , (B): $C(CH_3)_3OH$

---

46 (A), (B) and (C) are three hydrocarbons characterized by the following: (Trial exam / March 2023)
(A): an organic solvent. (B): a gas used in the Midrex furnace is prepared from it. (C): prepared by the dehydration of tertiary alcohols.
So compounds (A), (B) and (C) are .....

(A) (A): alcohol , (B): ethane , (C): diethyl ether.

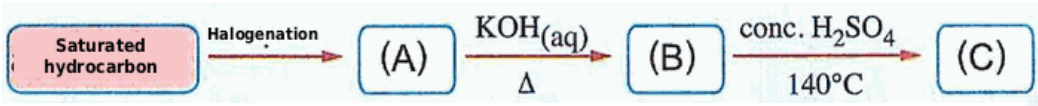
(B) (A): benzene , (B): methane , (C): branched alkene.

(C) (A): branched alkene , (B): ethane , (C): unbranched alkene.

(D) (A): benzene , (B): methane , (C): branched alkane.

---

47 From the following scheme: (2nd session 2023)
Compounds (B) and (C) are .....



(A) (B): an acid , (C): an unsaturated hydrocarbon.

(B) (B): an aldehyde , (C): a saturated hydrocarbon.

(C) (B): an alcohol , (C): an ether.

(D) (B): a ketone , (C): an ether.

---

48 From the following scheme: (Sample exam 2026)

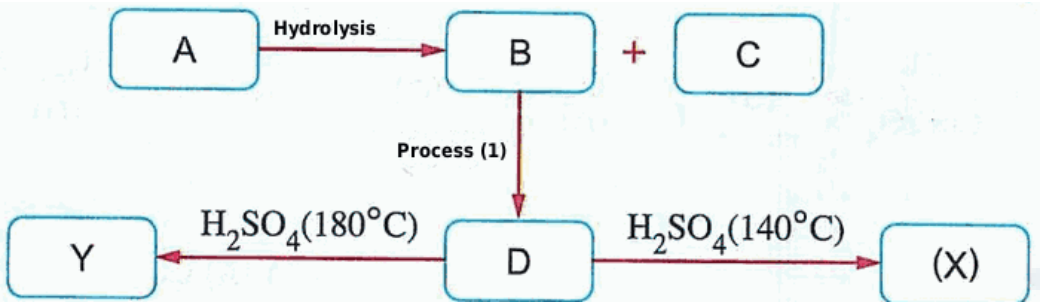
Given that (C , B) are isomers:

(1) Write the chemical formulas of (X , C).

(2) State the name of process number (1).

(3) Write the IUPAC name of the compound that gives an organic sodium salt in one process.

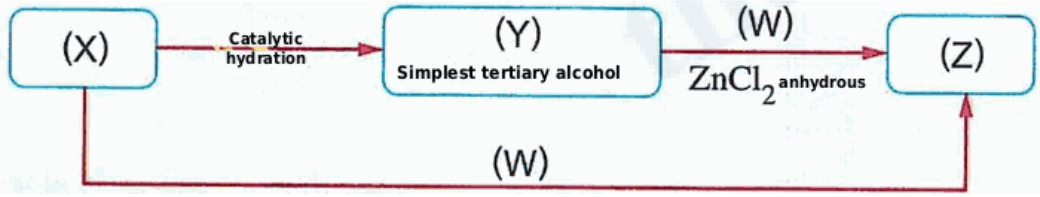
(4) Write the structural formula of an alcohol isomer of compound (X) that is not oxidized by ordinary oxidizing agents.



49 From the following scheme: (Sample exam 2026)

(1) Write the IUPAC name of each of (X , Z).

(2) Write the structural formulas of the saturated isomers of compound (X).



50 From the following scheme: (2nd session 2024)

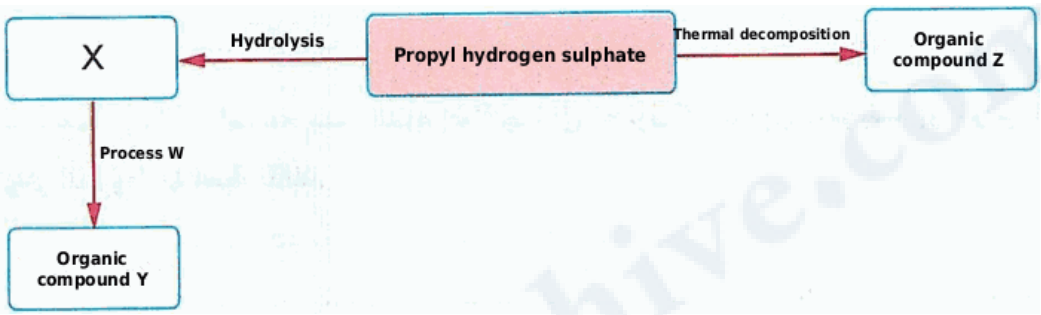
Given that (X), (Y) and (Z) are organic compounds, deduce each of the following:

(1) The IUPAC name of the compound produced by adding HBr to compound (Z).

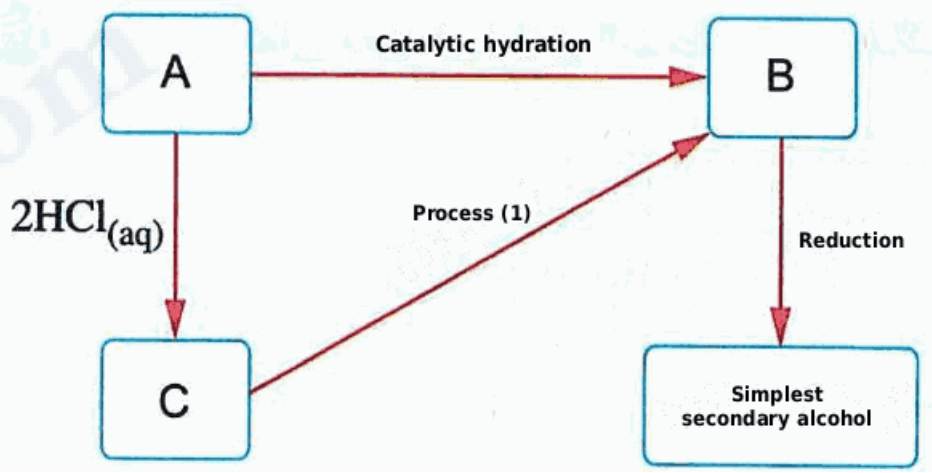
(2) The structural formula of the compound produced by the catalytic hydration of compound (Z).

(3) The name of process (W), given that compound (Y) effervesces with sodium carbonate.

(4) The molecular formula of compound (Y).



51 Study the opposite scheme, then state the names of compounds (A), (B) and (C) according to the IUPAC system and the name of process (1). (1st session 2025)

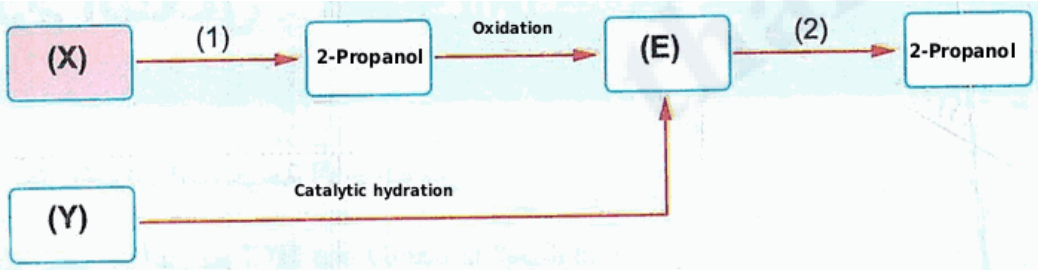


52 From the following scheme: (1st session 2024)

Deduce each of:

(1) The IUPAC name of hydrocarbons (X) and (Y).

(2) The names of processes (1) and (2).



Answer key and solutions

Multiple choice questions

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

1 **Answer (A)**

$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6$ (glucose) + $C_6H_{12}O_6$ (fructose)

2 **Answer (C)**

Pentane C_5H_{12} and cyclopentane C_5H_{10} do not have the same molecular formula.

3 **Answer (B)**

Yeast ferments the sugar: $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

4 **Answer (D)**

(1) Alcoholic fermentation of glucose gives dilute ethanol.

(2) Distillation raises its concentration.

5 **Answer (A)**

Glucose → alcoholic fermentation, ethene → catalytic hydration, ethanal → reduction.

6 **Answer (D)**

Hydration of propene follows Markovnikov's rule, so it gives 2-propanol.

7 **Answer (C)**

$CH_3CH=CH_2 + H_2O \rightarrow CH_3CH(OH)CH_3$ (isopropyl alcohol)

8 **Answer (C)**

Hydration of 2-methyl-1-butene: OH goes to the carbon atom with fewer hydrogens (number 2), so 2-methyl-2-butanol is formed.

9 **Answer (B)**

According to Markovnikov's rule, OH bonds to carbon atom number 2.

The product is 2-methyl-2-butanol.

10 **Answer (D)**

(X) is propene C_3H_6: unsaturated, can be hydrogenated, and its molecule has 9 atoms.

The molecule has 3 carbon atoms, not 3 moles.

11 **Answer (C)**

The monomer is $CH_3–CH=CH–C_2H_5$ (2-pentene); its hydration gives 2-pentanol or 3-pentanol.

Both are secondary alcohols of formula $C_5H_{12}O$

12 **Answer (C)**

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

Ethanol is heated with conc. H_2SO_4 at 180°C to give ethylene.

13 **Answer (D)**

The reaction of ethene with hydrogen peroxide gives ethylene glycol, not ethanol.

14 **Answer (B)**

(A) Addition of HBr to ethene gives bromoethane.

(B) Substitution of Br by an OH group gives ethanol.

15 **Answer (B)**

$CH_3CHCl_2 + 2KOH \rightarrow CH_3CH(OH)_2 + 2KCl$

The compound $CH_3CH(OH)_2$ is unstable, so it loses a water molecule and acetaldehyde is formed.

16 **Answer (B)**

(X) is HCl (addition according to Markovnikov's rule gives 2-chloropentane).

Hydrolysis gives 2-pentanol $CH_3(CH_2)_2CHOHCH_3$

17 **Answer (C)**

(1) Halogenation of ethane at 400°C, (2) aqueous KOH gives ethanol (X).

(3) Dehydration of ethanol with conc. H_2SO_4 at 180°C gives ethene.

18 **Answer (B)**

$(CH_3)_2C=CHCH_3 + HX \rightarrow (CH_3)_2CX–CH_2CH_3$

Hydrolysis gives $(CH_3)_2C(OH)CH_2CH_3$: 2-methyl-2-butanol.

19 **Answer (B)**

Molar mass of sucrose $C_{12}H_{22}O_{11}$ = 342 g

Number of moles = 3.4 ÷ 342 ≈ 0.00994 mol

Number of H atoms = $0.00994 \times 22 \times 6.02 \times 10^{23} \approx 1.3 \times 10^{23}$ atom

20 **Answer (D)**

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

Number of moles of glucose = 10.3 ÷ 180 ≈ 0.0572 mol

Volume of CO_2 = 2 × 0.0572 × 22.4 ≈ 2.56 L

21 **Answer (A)**

Mass of maltose = 2 × 180 − 18 = 342 g/mol

Its formula is $C_{12}H_{22}O_{11}$ like sucrose, so they are isomers.

22 **Answer (A)**

The hydroxyl group in alcohols is a polar, non-ionized group (it does not carry a full charge).

23 **Answer (D)**

Ethanol forms hydrogen bonds with water, so it dissolves in it; hydrocarbons do not dissolve.

24 **Answer (A)**

There are covalent bonds inside the molecules and hydrogen bonds between water and glycerol molecules.

There are no ionic bonds.

25 **Answer (D)**

Alcohols are higher than ethers and alkanes (hydrogen bonds), and the boiling point rises as the mass increases.

So 1-propanol has the highest boiling point.

26 **Answer (C)**

The mass of methanol (32) is less than propane (44), but its molecules are bonded by hydrogen bonds, so its boiling point is higher.

27 **Answer (D)**

The boiling point of methanol is 64.7°C and of ethane −88.6°C

28 **Answer (B)**

Propane (no hydrogen bonds) is the lowest.

1-Propanol is higher than ethanol because its mass is greater.

29 **Answer (C)**

1-Pentanol is a primary alcohol, 3-methyl-2-butanol is secondary, 2-methyl-2-butanol is tertiary.

So the order is: 1-pentanol then 3-methyl-2-butanol then 2-methyl-2-butanol.

30 **Answer (D)**

Ethanol does not form hydrogen bonds with benzene (benzene has no OH group).

31 **Answer (B)**

The figure shows hydrogen bonds between ethylene glycol molecules (each molecule has two OH groups).

This is the reason for its high boiling point.

32 **Answer (B)**

1-Propanol is a light liquid, miscible with water, with a boiling point of 97°C

33 **Answer (D)**

Equation (1) is the combustion of ethanol, which is not a hydrocarbon.

(2) and (3) are the combustion of ethene and methane.

34 **Answer (C)**

(1) C_2H_4 (28) → C_2H_5OH (46): increased.

(2) C_2H_5OH (46) → CO_2 (44): decreased.

(3) $C_6H_{12}O_6$ (180) → C_2H_5OH (46): decreased.

35 **Answer (A)**

$2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$

Moles of methanol = 40 ÷ 32 = 1.25 mol

Moles of O_2 = 1.25 × 3 ÷ 2 = 1.875 ≈ 1.88 mol

36 **Answer (C)**

Heat per 1 g = molar heat of combustion ÷ molar mass

CH_4: 880 ÷ 16 = 55 kJ , C_3H_8: 2200 ÷ 44 = 50 kJ

C_4H_8: 2716 ÷ 56 = 48.5 kJ , C_2H_5OH: 1380 ÷ 46 = 30 kJ

37 **Answer (C)**

HNO_3 and HCl are strong acids, and methanol has a very weak acidic character (it reacts with sodium).

Ethane is a saturated hydrocarbon with no acidic character, so it is the weakest.

38 **Answer (C)**

$2C_2H_5OH + 2Na \rightarrow 2C_2H_5ONa + H_2$

Sodium ethoxide is an ionic compound.

39 **Answer (C)**

It reacts with sodium and does not react with NaOH, so it is an alcohol.

3-Pentanol and 1-propanol are both alcohols.

40 **Answer (A)**

(1) is correct, and (3) is correct because hydrolysis gives NaOH.

(2) is wrong because alcohols do not react with sodium hydroxide.

41 **Answer (C)**

$2CH_3OH + 2Na \rightarrow 2CH_3ONa + H_2$

Moles of Na = 2.3 ÷ 23 = 0.1 mol , moles of H_2 = 0.05 mol

42 **Answer (C)**

(A) Sodium ethoxide is hydrolysed to NaOH (the third group reagent), so its solution turns litmus blue.

(B) Ethyl hydrogen sulphate is hydrolysed to H_2SO_4 (the fifth group reagent) and decomposes on heating to ethene.

43 **Answer (C)**

Esterification takes place in the presence of conc. sulphuric acid (excluding (B) and (D)).

The RCO part of the acid combines with the R`O part of the alcohol, forming RCOOR` + H_2O

44 **Answer (B)**

$C_2H_5ONa + H_2O \rightarrow C_2H_5OH + NaOH$

$C_2H_5OH + CH_3COOH \rightarrow CH_3COOC_2H_5 + H_2O$ (ester)

45 **Answer (D)**

The compound has 4 OH groups; its mass $C(CH_2OH)_4$ = 136 is greater than glycerol (92).

One mole of it reacts with sodium forming 4 ÷ 2 = 2 mol of H_2

46 **Answer (B)**

Hydration of 2-butene gives 2-butanol $CH_3CH(OH)CH_2CH_3$

Its reaction with acetic acid gives $CH_3COOCH(CH_3)CH_2CH_3$

47 **Answer (A)**

(X) is the oxidation of ethanol to acetic acid.

(Y) and (Z) are esterification reactions.

48 **Answer (B)**

$CH_3CH_2CH_2OH + HBr \rightarrow CH_3CH_2CH_2Br + H_2O$

49 **Answer (A)**

The product 1-halopropane $CH_3CH_2CH_2X$ has one methyl group.

50 **Answer (B)**

The product 2-halobutane $CH_3CHXCH_2CH_3$: two methyl groups and one methylene group.

51 **Answer (D)**

$C_2H_5OH + HBr \rightarrow C_2H_5Br + H_2O$ (substitution of OH by Br)

52 **Answer (A)**

(X) is CH_3Br; it does not form hydrogen bonds, so its boiling point is lower than methanol.

53 **Answer (D)**

$(CH_3)_3COH + HCl \rightarrow (CH_3)_3CCl + H_2O$

The name: 2-chloro-2-methylpropane.

54 **Answer (B)**

(1) Addition of HBr to propene gives 2-bromopropane (A).

(2) and (3) are substitution of Br by OH and the reverse.

55 **Answer (C)**

Primary alcohol → aldehyde → carboxylic acid, secondary alcohol → ketone, tertiary alcohol is not oxidized.

56 **Answer (C)**

The compound has a CH_2OH group, so it is a primary alcohol, and its complete oxidation gives a carboxylic acid.

57 **Answer (C)**

The acid $C_nH_{2n+1}COOH$: $14n + 46 = 88$

$n = 3$, the acid is C_3H_7COOH

The alcohol that is oxidized to it: $CH_3CH_2CH_2CH_2OH$

58 **Answer (D)**

(X) is propene; adding HX then hydrolysis gives 2-propanol.

Its oxidation by chromic acid gives acetone (carbonyl group C=O).

59 **Answer (A)**

Reduction of a ketone gives a secondary alcohol: acetone gives isopropyl alcohol.

60 **Answer (A)**

$CH_3CH_2COCH_3$ is a ketone, and its reduction gives a secondary alcohol (2-butanol).

61 **Answer (D)**

$CH_2=CH-CO-CH=CH_2$ + excess H_2: the double bonds are saturated and the carbonyl group is reduced.

The product is $CH_3CH_2CH(OH)CH_2CH_3$: 3-pentanol.

62 **Answer (B)**

$CH_3CH(CH_3)OH$ (2-propanol) is a secondary alcohol; it is oxidized to a ketone, not to an acid.

63 **Answer (A)**

(X) is ethanol, (Y) acetic acid, (Z) ethyl acetate (an ester).

64 **Answer (C)**

The acid produced by oxidizing the alcohol has the same number of carbon atoms.

$C_2H_5COOC_3H_7$: the acid C_2H_5COOH and the alcohol C_3H_7OH (3 carbon atoms each).

65 **Answer (C)**

Hydrolysis of sucrose → alcoholic fermentation → oxidation of ethanol to acetic acid.

66 **Answer (A)**

The nitrate ion and the carboxyl group are in their highest oxidation state, so they are not oxidized.

67 **Answer (C)**

Oxidation of 2-butanol $CH_3CH(OH)CH_2CH_3$ gives $CH_3COCH_2CH_3$ (ethyl methyl ketone).

68 **Answer (A)**

(1) is correct: 1-phenyl-2-pentanol.

The compound is a secondary alcohol; it is oxidized to a ketone, not an aldehyde, and does not easily form an acid.

69 **Answer (B)**

$C_nH_{2n+2}O \rightarrow C_nH_{2n}O$ by losing only 2H and the reaction stops, so it is a secondary alcohol giving a ketone.

70 **Answer (B)**

The colour change of potassium dichromate from orange to green is used to detect whether drivers have drunk alcohol.

71 **Answer (B)**

Hot chromic acid oxidizes a primary alcohol to a carboxylic acid.

72 **Answer (D)**

$CH_3CHOHCH_3$ is a secondary alcohol that is oxidized to acetone.

73 **Answer (C)**

The compound $(CH_3CH_2)_2CHOH$ is a secondary alcohol that is oxidized, so the colour of the dichromate changes from orange to green.

74 **Answer (B)**

2-Methyl-2-pentanol is a tertiary alcohol that is not oxidized, so it does not decolourize the permanganate.

75 **Answer (D)**

The monomer is 2-methylpropene, and its hydration gives tertiary butyl alcohol, which is not oxidized by ordinary oxidizing agents.

76 **Answer (D)**

(1) 1-Propanol is a light liquid miscible with water.
(2) 2-Propanol is prepared by hydration of propene.
(3) Ethyl methyl ether does not react with sodium.

77 **Answer (B)**

Isomers of $C_4H_{10}O$: 4 alcohols and 3 ethers.
The four alcohols dissolve in water and form an alkoxide (A = 4 , B = 4).
Only the primary and secondary alcohols (3) are oxidized by permanganate (C = 3).

78 **Answer (B)**

(B) is a solvent with a carbonyl group: acetone C_3H_6O
It comes from 2-propanol produced from propene C_3H_6

79 **Answer (A)**

$2ROH \rightarrow ROR + H_2O$ (dehydration)

80 **Answer (C)**

$2C_2H_5OH \rightarrow C_2H_5OC_2H_5 + H_2O$ (conc. H_2SO_4 at 140°C)

81 **Answer (C)**

RX + R`ONa → ROR` + NaX (ether)

82 **Answer (C)**

There is no compound called 2-propene; dehydration of 2-propanol gives propene.

83 **Answer (C)**

(A) 2-methylpropene, (B) 2-chloro-2-methylpropane, (C) tertiary butyl alcohol.

The tertiary alcohol is not affected by acidified potassium dichromate.

84 **Answer (D)**

Diethyl ether is formed from ethanol (A), and its reaction with sodium gives sodium ethoxide (B).

85 **Answer (D)**

$C_4H_9ONa + C_2H_5I \rightarrow C_4H_9OC_2H_5$ (X) + NaI

$C_4H_9ONa + H_2O \rightarrow C_4H_9OH$ (Y) + NaOH

Dibutyl ether is prepared from butanol.

86 **Answer (C)**

$C_4H_{10}O$ has 3 ether isomers that do not react with sodium.

87 **Answer (C)**

Denatured alcohol is a mixture of ethanol and methanol; both are alcohols, so they do not react together to form an ester.

88 **Answer (A)**

The mixture of ethanol and methanol (denatured alcohol) is used as a household fuel and in some chemical industries.

89 **Answer (B)**

Ethanol is a good solvent and an antiseptic.

90 **Answer (B)**

Gasoline is mixed with ethanol to produce a fuel for cars.

91 **Answer (B)**

Ethylene glycol is a viscous liquid.

92 **Answer (D)**

(A) is ethene and (B) is ethylene glycol, which dissolves in water because it forms hydrogen bonds.

93 **Answer (A)**

(X) is TNT: $C_7H_5N_3O_6$

One mole gives $(12 + 5 + 3) \div 2 = 10$ mol of gases

Volume = $10 \times 22.4 = 224$ L

Essay questions

1 **Model answer**

(1) $CH_3Cl + KOH(aq) \rightarrow CH_3OH + KCl$ (on heating)

(2) $CH_3Cl + 3F_2 \rightarrow CF_3Cl + 3HF$ (in the presence of ultraviolet rays UV)

2 **Model answer**

2-Bromo-2-methylbutane is hydrolysed by heating with KOH(aq):

$(CH_3)_2CBr–C_2H_5 + KOH(aq) \rightarrow (CH_3)_2C(OH)–C_2H_5 + KBr$

3 **Model answer**

$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ (by yeast / zymase enzyme)

$C_2H_5OH + HCl \rightarrow C_2H_5Cl + H_2O$ (in the presence of $ZnCl_2$)

4 **Model answer**

$C_2H_5ONa + H_2O \rightarrow C_2H_5OH + NaOH$

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

5 **Model answer**

$CH_3CHBrCH_3 + KOH(aq) \rightarrow CH_3CH(OH)CH_3 + KBr$ (on heating)

$CH_3CH(OH)CH_3 + [O] \rightarrow CH_3COCH_3 + H_2O$

6 **Model answer**

$C_2H_5Br + KOH(aq) \rightarrow C_2H_5OH + KBr$ (on heating)

$2C_2H_5OH \rightarrow C_2H_5OC_2H_5 + H_2O$ (conc. H_2SO_4 at 140°C)

7 **Model answer**

$CH_3CH_2CH_2OH \rightarrow CH_3CH=CH_2 + H_2O$ (conc. H_2SO_4 at 180°C)

$CH_3CH=CH_2 + H_2O \rightarrow CH_3CH(OH)CH_3$ (H_2SO_4 at 110°C)

8 **Model answer**

(1) Ethyl methyl ether $CH_3OC_2H_5$

(2) $CH_3–O–CH_2CH_2CH_3$, $C_2H_5–O–C_2H_5$, $CH_3–O–CH(CH_3)_2$

9 **Model answer**

(1) Compound M is ethene, which does not dissolve in water, while compound N is ethanol, which dissolves in water.

(2) Compound M reacts with HX by addition, while compound N reacts with HX by substitution.

10 **Model answer**

(1) 3,4-Dimethyl-3-hexene.

(2) Type of alcohol: tertiary alcohol.

Observation: the violet colour of the permanganate does not disappear.

Explanation: because tertiary alcohols are not oxidized by ordinary oxidizing agents.

11 **Model answer**

(1) Propene $CH_3–CH=CH_2$

(2) 2-Methylpropene $(CH_3)_2C=CH_2$

12 **Model answer**

(1) $2CH_3(CH_2)_2OH \rightarrow CH_3(CH_2)_2–O–(CH_2)_2CH_3 + H_2O$ (conc. H_2SO_4 at 140°C)

(2) $C_3H_7OH \rightarrow C_3H_6 + H_2O$ (conc. H_2SO_4 at 180°C)

13 **Model answer**

(1) (a) Compound (1): propene $CH_3–CH=CH_2$, (b) isomer (3): ethyl methyl ether $CH_3CH_2–O–CH_3$

(2) (a) Compound (2): 2-propanol , (b) compound (4): propyl ethanoate.

14 **Model answer**

Isomer (1): $CH_3CH_2C(CH_3)=CH_2$ (2-methyl-1-butene)

Isomer (2): $CH_3CH(CH_3)CH=CH_2$ (3-methyl-1-butene)

Isomer (3): $CH_3C(CH_3)=CHCH_3$ (2-methyl-2-butene)

The tertiary alcohol is produced by the hydration of isomers (1) and (3).

15 **Model answer**

(1) (a) CH_3CHO , (b) $C_2H_5OC_2H_5$

(2) (a) $CH_3COOC_2H_5$, (b) C_2H_5OH

16 **Model answer**

(1) (a) Compound (A): $CH_3CH_2CH_2CH_2OH$, (b) compound (B): $(CH_3)_3C-OH$

(2) By adding $KMnO_4$ solution acidified with H_2SO_4:

Compound (A) decolourizes the violet permanganate, while compound (B) does not change its colour.

Past exam questions

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

1 **Answer (C)**

Cane sugar → (hydrolysis) glucose → (alcoholic fermentation) ethanol.

Ethanol → (dehydration at 180°C) ethylene → ($+H_2O_2$) ethylene glycol, the antifreeze.

2 **Answer (D)**

(A) 2-methyl-1-propanol (primary) is oxidized to 2-methylpropanoic acid.

(B) 2-methyl-2-propanol (tertiary) is not oxidized.

(C) 1-butanol (primary) is oxidized to butanoic acid.

3 **Answer (B)**

2,2-Dimethyl-1-propanol is a primary alcohol, so it is oxidized.

And it does not give 2-methyl-1-butene on dehydration.

(A) and (C) are tertiary alcohols that are not oxidized, and (D) gives 2-methyl-1-butene.

4 **Answer (C)**

The alcohol that is not oxidized is a tertiary alcohol: 2-methyl-2-propanol.

Its dehydration gives 2-methylpropene, and its hydrogenation gives 2-methylpropane (saturated).

5 **Answer (C)**

(X) acetylene → (catalytic hydration) acetaldehyde (Y) → (H_2) ethanol (Z), a primary alcohol.

(W) diethyl ether does not react with sodium, and acetylene adds in two steps.

6 **Answer (B)**

The alcohol is methanol (it is not prepared by catalytic hydration).

Methanol has no isomers.

7 **Answer (B)**

$(CH_3)_2CHCH_2Br + KOH \rightarrow (CH_3)_2CHCH_2OH$

The product is 2-methyl-1-propanol (isobutyl alcohol).

8 **Answer (C)**

(X) → (alkaline hydrolysis) two OH groups form on the same carbon, so it loses water giving propanal → (reduction) 1-propanol.

(Y) → propanone → (reduction) 2-propanol.

9 **Answer (D)**

Primary and secondary alcohols are oxidized by acidified permanganate, but tertiary alcohols are not.

10 **Answer (C)**

(X) 2-methylpropanal (an aldehyde that is oxidized, turning the dichromate green).

(Y) butanone (a ketone that is not oxidized).

11 **Answer (B)**

(X) CH_2O is formaldehyde, (Y) C_2H_6O is ethyl alcohol (monohydric primary).

(Z) $C_2H_6O_2$ is ethylene glycol (dihydric primary alcohol).

12 **Answer (D)**

(X) 1-propanol is oxidized to an acid: 1 methyl group.

(Y) 2-propanol is oxidized to a ketone: 2 methyl groups.

(Z) methoxyethane (an ether): 2 methyl groups.

13 **Answer (B)**

The simplest alcohol with an ethyl branch: 2-ethyl-1-butanol.

It is produced by the alkaline hydrolysis of 1-chloro-2-ethylbutane.

14 **Answer (D)**

(X) is an alcohol and (Y) an ether (its boiling point is lower).

The ether is prepared from the alcohol by heating with conc. H_2SO_4 at 140°C

15 **Answer (A)**

1-Chloropropane gives 1-propanol by alkaline hydrolysis, not isopropyl alcohol.

16 **Answer (B)**

(2) Oxidation of the alkene (Baeyer) gives a dihydric alcohol $C_nH_{2n+2}O_2$

(1) Catalytic hydration gives a monohydric alcohol.

17 **Answer (B)**

(X) C_3H_5Cl has 4 isomers (3 open-chain + cyclic chloropropane).

(Y) C_3H_7Cl has two isomers, and (Z) propanol has two alcohol isomers.

18 **Answer (B)**

(X) is 1-propanol, (Y) propene, (Z) cyclopropane.

Cyclopropane has small bond angles, so it is less stable, more active and burns faster than cyclobutane.

19 **Answer (C)**

(X) 1,2-dibromoethane with KOH gives ethylene glycol (a primary alcohol, the monomer of PEG).

(Y) bromoethane gives ethanol.

20 **Answer (A)**

(X) is propene; its hydration gives 2-propanol (secondary carbinol).

With H_2O_2 it gives propylene glycol (Y), which has a secondary carbinol group and a primary one.

21 **Answer (A)**

22 **Answer (D)**

Complete oxidation of a secondary alcohol gives a ketone $C_nH_{2n}O$

2-Chloropropane → 2-propanol → propanone.

23 **Answer (B)**

Dehydration gives 3-methyl-1-butene, and catalytic hydration (Markovnikov) gives 3-methyl-2-butanol.

So the product is a secondary alcohol.

24 **Answer (B)**

(C) $C_nH_{2n+2}O_3$ is glycerol, used in the textile industry.

25 **Answer (C)**

The substance added to textiles is glycerol.

CH_2=CH–CH_2Br: oxidation by H_2O_2 adds two OH groups across the double bond.

Then basic hydrolysis replaces Br by an OH group, forming glycerol.

26 **Answer (B)**

(X) glycerol , (Y) ethylene glycol , (Z) propanol.

2-Propanol is oxidized to acetone (a ketone).

The boiling point of the glycol is lower than glycerol because it has fewer OH groups.

27 **Answer (A)**

The compound with no methylene group $(-CH_2-)$ is CH_3–CHBr–CH_3

Its hydrolysis gives 2-propanol (a secondary alcohol).

28 **Answer (D)**

The IUPAC name of compound (1) $CH_3CH(OH)CH_3$ is 2-propanol.

Isopropanol is a common name, not an IUPAC name.

29 **Answer (D)**

C_3H_7Br may be 1-bromopropane or 2-bromopropane.

So by hydrolysis it gives a primary alcohol or a secondary alcohol.

30 **Answer (B)**

(X) $C_2H_6O_2$ is ethylene glycol: used in car radiators in cold areas.

31 **Answer (C)**

(X) is a tertiary alcohol (2-methyl-2-butanol) that is not oxidized by ordinary oxidizing agents.

Its molar mass is greater than (Y), so its boiling point is higher.

32 **Answer (D)**

A primary alkyl halide gives a primary alcohol: 2-methyl-1-propanol.

A secondary alkyl halide gives a secondary alcohol: 2-butanol.

33 **Answer (A)**

Sodium butanoate distilled with soda lime gives propane (B).

Propane + Cl_2 → (C) 1-chloropropane.

Hydrolysis → (D) 1-propanol (a primary alcohol).

34 **Answer (C)**

Ethene + Br_2 → (A) 1,2-dibromoethane.

Hydrolysis with excess KOH(aq) → (B) ethylene glycol.

35 **Answer (B)**

Adding HBr to 2-methyl-2-butene gives a saturated alkyl halide that does not decolourize the permanganate.

The other products are unsaturated alkenes that decolourize it.

36 **Answer (C)**

(A) an alkane of mass 58: C_4H_{10} (butane), a gas.

(B) an alcohol of mass 60: C_3H_7OH; hydrogen bonds make its boiling point higher.

37 **Answer (A)**

Compound (B) has 12 atoms: C_3H_8O

(A) 2-bromopropane → (B) isopropyl alcohol (secondary) → (C) acetone.

38 **Answer (A)**

Compound (C) has 5 atoms: HCOOH, formic acid.

(A) methyl chloride → (B) methanol → (C) formic acid.

39 **Answer (C)**

Reduction of acetone CH_3COCH_3 gives isopropyl alcohol $(CH_3)_2CHOH$

So compound (A) is $(CH_3)_2CHOH$ and (B) is CH_3COCH_3

40 **Answer (D)**

Hydration of ethyne gives acetaldehyde.

Reduction of acetaldehyde gives ethanol.

41 **Answer (A)**

$C_4H_{10}O$ is an alcohol, and 2-methyl-2-propanol is a correct IUPAC name.

Butanone and butanal have the formula C_4H_8O

42 **Answer (A)**

(A) $C(CH_3)_3OH$ is a tertiary alcohol that is not oxidized.

(B) CH_3OCH_3 is an ether that does not form hydrogen bonds between its molecules.

(C) Glycerol is saturated and does not react by addition.

43 **Answer (C)**

The compound that dilates the arteries is nitroglycerin.

Halogenation by addition: $CH_2{=}CH{-}CH_2Cl \rightarrow$ 1,2,3-trichloropropane.

Basic hydrolysis → glycerol, then nitration → nitroglycerin.

44 **Answer (B)**

$C_3H_8O_2$ is a dihydric alcohol.

1,2-Dihydroxypropane and 1,3-dihydroxypropane.

45 **Answer (D)**

(A) and (C) are oxidized (an aldehyde or a primary or secondary alcohol).

(B) is not oxidized: a tertiary alcohol, a ketone or an acid.

(A) C_3H_7CHO is an aldehyde and (B) $C(CH_3)_3OH$ is a tertiary alcohol.

46 **Answer (B)**

(A) Benzene is an organic solvent.

(B) The gas used in the Midrex furnace is prepared from methane.

(C) Dehydration of tertiary alcohols gives a branched alkene.

47 **Answer (C)**

Halogenation → (A) alkyl halide → hydrolysis → (B) alcohol.

Alcohol + conc. H_2SO_4 at 140°C → (C) ether.

48 **Model answer**

(1) (C): $C_6H_{12}O_6$, (X): $C_2H_5{-}O{-}C_2H_5$

(2) Process (1): alcoholic fermentation.

(3) Ethanol.

(4) $(CH_3)_3C{-}OH$ (2-methyl-2-propanol).

49 **Model answer**

(1) (X): 2-methyl-1-propene , (Z): 2-chloro-2-methylpropane.

(2) Cyclobutane (a ring of 4 CH_2 groups).

Methylcyclopropane (a ring of 3 carbon atoms carrying a CH_3 group).

50 **Model answer**

(1) 2-Bromopropane.

(2) $CH_3–CH(OH)–CH_3$

(3) Complete oxidation.

(4) $C_3H_6O_2$

51 **Model answer**

(A): 1-propyne , (B): propanone , (C): 2,2-dichloropropane.

Process (1): alkaline hydrolysis.

52 **Model answer**

(1) (X): propene , (Y): propyne.

(2) (1): catalytic hydration , (2): reduction.