Chemistry · Organic Chemistry

Carboxylic Acids

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Multiple choice questions — 114 questions

1 All of the following are strong acids, except .....

(A) HCl (B) HNO_3 (C) H_2SO_4 (D) HCOOH

2 Which of the following acid solutions of equal concentration (0.01 M) has a pH of 3.37?

(A) H_2SO_4 (B) HCl (C) CH_3COOH (D) HNO_3

3 Which of the following is the functional group of organic acids?

(A) –OH (B) –COOH (–C(=O)–OH)

(C) –CO– (–C(=O)–) (D) –CHO (–C(=O)–H)

4 Which of the following are organic compounds that contain a carbonyl group attached to a hydroxyl group?

(A) Ketones. (B) Esters. (C) Organic acids. (D) Alcohols.

5 Which of the following compounds contains a carboxyl group?

(A) Propanone. (B) Picric acid. (C) Propanol. (D) Propanoic acid.

6 Which of the following is an organic compound in which the carboxyl group is attached directly to a C_6H_5– group?

(A) An aromatic alcohol. (B) A phenol.

(C) An aromatic acid. (D) An aliphatic acid.

7 Which of the following formulas represents an aliphatic acid?

(A) R–OH (B) Ar–COOH (C) Ar–CHO (D) R–COOH

8 What is the general formula of saturated monobasic aliphatic carboxylic acids?

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

9 Which of the following is a dibasic acid?

(A) Oxalic acid. (B) Formic acid. (C) Benzoic acid. (D) Acetic acid.

10 The two carboxyl groups in phthalic acid are in positions .....

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

11 Phthalic acid is considered .....

(A) dibasic aliphatic. (B) monobasic aromatic.
(C) dibasic aromatic. (D) monobasic aliphatic.

12 A compound has the molecular formula $C_7H_6O_3$.
Which of the following choices is correct?

(A) It contains 3 –OH groups (B) It is an aliphatic compound.
(C) It contains two functional groups. (D) It is catechol.

13 What is the number of (C = C) bonds in one molecule of the organic acid whose chemical formula is $C_{17}H_{29}COOH$?

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

14 The chemical formula of the acid extracted from palm oil is .....

(A) $CH_3(CH_2)_{14}COOH$ (B) $CH_3(CH_2)_{16}COOH$
(C) $CH_3(CH_2)_7CH = CH(CH_2)_7CH_3$ (D) $CH_3(CH_2)_{10}COOH$

15 Which of the following is the common name of the compound $CH_3(CH_2)_{14}COOH$?

(A) Hexadecanoic acid. (B) Palmitic acid.
(C) Butyric acid. (D) Decanoic acid.

16 What is the alkane corresponding to the organic acid whose source is butter?

(A) Ethane. (B) Propane. (C) Butane. (D) Pentane.

17 What is the IUPAC name of the compound $H_2CCHCOOH$?

(A) Propanoic acid. (B) Phthalic acid. (C) Propenoic acid. (D) Butanoic acid.

18 What is the IUPAC name of this compound: $CH_3CH(CH_3)COOH$?

(A) 3-Methylpropanoic acid. (B) 2-Methylpropanoic acid.
(C) Isobutyric acid. (D) Butyric acid.

19 What is the IUPAC name of the compound: $CH_3CHClCH_2COOH$?

(A) 2-Chlorobutanoic acid.
(B) 3-Chlorobutanoic acid.
(C) 2-Chloro-3-propanoic acid.
(D) 2-Chloro-1-propanoic acid.

20 What is the IUPAC name of the carboxylic acid that has no methylene group and whose molecular formula is $C_5H_{10}O_2$?

(A) 2-Ethylpropanoic acid.
(B) 3,3-Dimethylpropanoic acid.
(C) 2,2-Dimethylpropanoic acid.
(D) 2-Methylbutanoic acid.

21 What is the IUPAC name of the opposite compound: $CH_3CHCH_3CHC_6H_5CH_2COOH$?

(A) 4-Methyl-3-phenylpentanoic acid.
(B) 3-Phenylhexanoic acid.
(C) 4-Methyl-3-vinylpentanoic acid.
(D) 3-Vinylhexanoic acid.

22 What is the number of carboxylic acid isomers with the molecular formula $C_4H_8O_2$?

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

23 Acetic acid can be obtained from each of the following, except .....

(A) Oxidation of the product of catalytic hydration of ethyne.
(B) Exposing ethanol to air in the presence of vinegar bacteria.
(C) Passing $H_2S(g)$ over a solution of lead (II) ethanoate.
(D) Treating ethene with $KMnO_4$ solution in an alkaline medium.

24 From the following scheme:

$C_nH_{2n-2} \rightarrow$ process $(1) \rightarrow C_nH_{2n}O \rightarrow$ process $(2) \rightarrow C_nH_{2n}O_2$

Which of the following is correct?

(A) Process (1): catalytic hydration, $C_nH_{2n}O$: propanal, process (2): oxidation, $C_nH_{2n}O_2$: propanoic acid
(B) Process (1): oxidation, $C_nH_{2n}O$: propanal, process (2): reduction, $C_nH_{2n}O_2$: propanoic acid
(C) Process (1): catalytic hydration, $C_nH_{2n}O$: ethanal, process (2): oxidation, $C_nH_{2n}O_2$: ethanoic acid
(D) Process (1): oxidation, $C_nH_{2n}O$: ethanal, process (2): reduction, $C_nH_{2n}O_2$: ethanoic acid

25 From the following scheme:

$CH_3CH(CH_3)CH_2CH_2OH$ (1) → oxidation → (2) → oxidation → (3)

Which of the following gives the functional group of compound (1), the functional group of compound (2) and the IUPAC name of compound (3)?

(A) (1): $-CH_2OH$, (2): carbonyl, (3): 2-methylbutanal

(B) (1): >CHOH, (2): formyl, (3): 2-methylbutanoic acid

(C) (1): >CHOH, (2): carboxyl, (3): 3-methylbutanal

(D) (1): $-CH_2OH$, (2): formyl, (3): 3-methylbutanoic acid

---

26 All of the following describe properties of aliphatic acids, except .....

(A) $C_3H_6O_2$: a colourless liquid with a pungent smell, soluble in water

(B) $C_5H_{10}O_2$: a colourless oily liquid with an unpleasant smell

(C) CH_2O_2: a toxic colourless gas with a pungent smell

(D) $C_{11}H_{22}O_2$: white solid crystals, insoluble in water

---

27 The boiling point of ethanol is lower than the boiling point of .....

(A) propane. (B) ethanoic acid. (C) diethyl ether. (D) ethene.

---

28 The molecules of each of the following compounds are linked together by hydrogen bonds, except .....

(A) CH_3COOH (B) $C_2H_4(OH)_2$ (C) CH_3CH_2OH (D) CH_3OCH_3

---

29 The number of hydrogen bonds is the greatest between molecules of .....

(A) ethanoic acid. (B) diethyl ether. (C) ethanal. (D) ethanol.

---

30 Which organic compound forms the greatest number of hydrogen bonds between its molecules in one mole of it?

(A) CH_2OH-CH_2OH (B) CH_2OH-CH_3 (C) COOH–COOH (D) $COOH-CH_2OH$

---

31 Which of the following gives the correct order of the compounds according to the number of hydrogen bonds each molecule forms when dissolved in water?

(A) Glycerol < ethanol < sorbitol < ethanoic acid.

(B) Ethanoic acid < glycerol < ethanol < sorbitol.

(C) Ethanoic acid < sorbitol < ethanol < glycerol.

(D) Ethanol < ethanoic acid < glycerol < sorbitol.

---

32 Three hydrocarbon derivatives:

(A): is not affected by $KMnO_4$ solution acidified with H_2SO_4

(B): every 2 molecules of it form two hydrogen bonds between them.

(C): does not react with sodium hydroxide solution.

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

(A) (A): ethylene glycol, (B): 2-methyl-2-propanol, (C): ethanoic acid

(B) (A): 2-methyl-2-propanol, (B): ethanoic acid, (C): ethylene glycol

(C) (A): ethanoic acid, (B): 2-methyl-2-propanol, (C): ethylene glycol

(D) (A): 2-methyl-2-propanol, (B): ethylene glycol, (C): ethanoic acid

---

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

(A) CH_3CH_2OH (B) $C_2H_4(OH)_2$ (C) CH_3COOH (D) CH_3OCH_3

---

34 Which of the following represents the order of boiling points?

(A) Butanol > butanal > butanoic acid.

(B) Butanoic acid > butanol > butanal.

(C) Butanol > butanoic acid > butanal.

(D) Butanoic acid > butanal > butanol.

---

35 Which of the following gives the correct order of the pOH values of the following compounds of equal concentration?

(A) $CH_3COOH < H_2CO_3 < HNO_3 < H_2SO_4$

(B) $H_2CO_3 < CH_3COOH < H_2SO_4 < HNO_3$

(C) $HNO_3 < H_2SO_4 < CH_3COOH < H_2CO_3$

(D) $H_2CO_3 < CH_3COOH < HNO_3 < H_2SO_4$

---

36 Each of the following compounds dissolves in water, except .....

(A) Ethene. (B) Ethanol. (C) Glycerol. (D) Ethanoic acid.

37 Which substance is the most soluble in water?

(A) C_4H_{10} (B) C_4H_9Br (C) C_3H_7COOH (D) C_6H_5OH

38 Which of the following gives the solubility of the three compounds shown in the following table - each separately - in 100 g H_2O (at 25°C)?

(A) CH_3COOH: 100 g, C_7H_{14}: 8.2 g, C_6H_5OH: 0.003 g

(B) CH_3COOH: 100 g, C_7H_{14}: 0.003 g, C_6H_5OH: 8.2 g

(C) CH_3COOH: 8.2 g, C_7H_{14}: 0.003 g, C_6H_5OH: 100 g

(D) CH_3COOH: 0.003 g, C_7H_{14}: 8.2 g, C_6H_5OH: 100 g

39 What is the similarity between butane and butanoic acid?

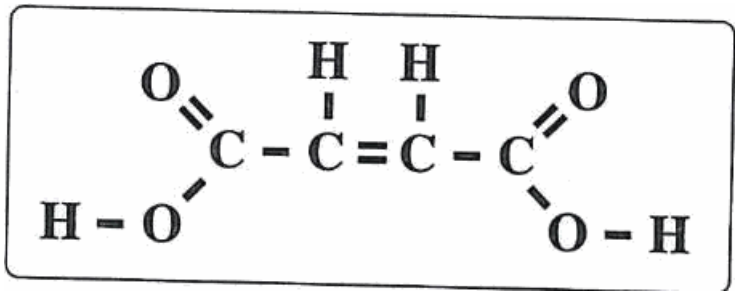
(A) When 1 mol of each of them burns completely, the same number of moles of H_2O is produced

(B) They are used as monomers in condensation polymerization.

(C) They have the same effect on litmus indicator.

(D) When 1 mol of each of them burns completely, the same number of moles of CO_2 is produced

40 The opposite figure shows the structural formula of an organic compound.
All of the following are correct for this compound, except that it .....



(A) decolourizes bromine water.

(B) is a dibasic acid.

(C) takes part in addition polymerization reactions.

(D) its aqueous solution reacts with copper.

41 Which of the following compounds becomes more soluble in water when NaOH is added to it?

(A) An aromatic hydrocarbon.
(B) An alkane.
(C) A carboxylic acid.
(D) An ether.

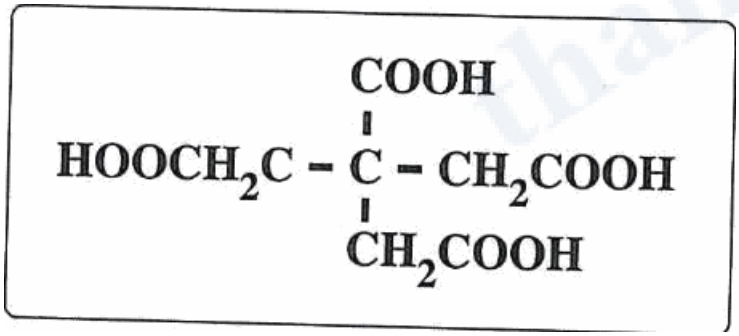
42 1 mol of hydrogen gas is produced when excess sodium reacts with 1 mol of .....

(A) $CH_3CH_2CH_2CH_2OH$
(B) $(CH_3)_3COH$
(C) $CH_3CH_2CH_2COOH$
(D) $CH_3CH(OH)COOH$

43 A gas is given off when sodium reacts with each compound of the following pairs separately, except .....

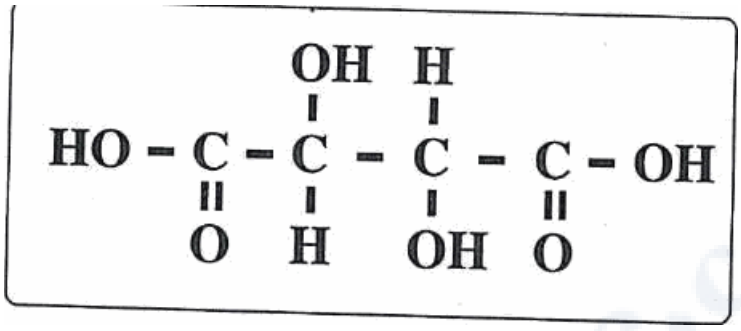
(A) Picric acid and benzoic acid.
(B) Oxalic acid and ethanol.
(C) Butanoic acid and phenol.
(D) Carbolic acid and ethanal.

44 What is the number of moles of hydrogen gas given off when excess sodium metal is added to one mole of the opposite compound?



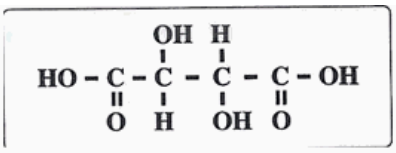
(A) 1 mol
(B) 2 mol
(C) 3 mol
(D) 4 mol

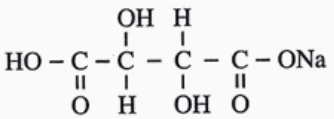
45 What is the number of moles of sodium hydroxide that can react with one mole of the opposite compound?

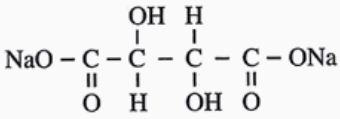


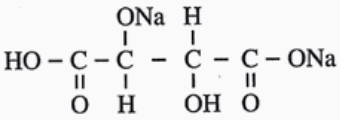
(A) 2 mol
(B) 3 mol
(C) 4 mol
(D) 6 mol

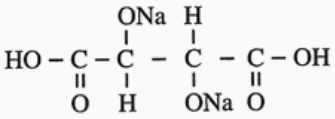
46 The opposite figure shows the structural formula of an organic compound.
What is the structural formula of the compound produced when 1 mol of the opposite compound reacts with excess sodium hydroxide solution?



(B) 

(A) 

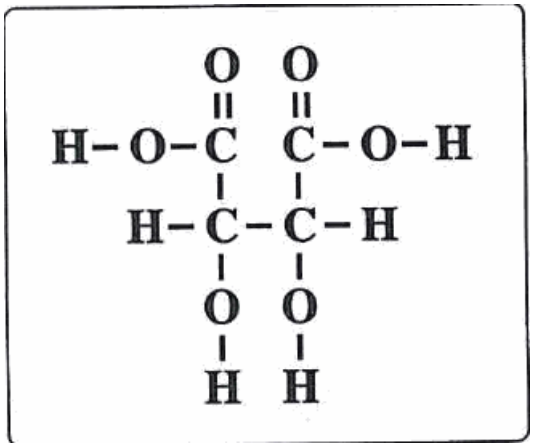
(D) 

(C) 

47 Which of the following compounds reacts with both dilute hydrochloric acid and dilute sodium hydroxide solution?

(A) 2-Propanol.
(B) Pyrogallol.
(C) 3-Hydroxypropanoic acid.
(D) Chloropropane.

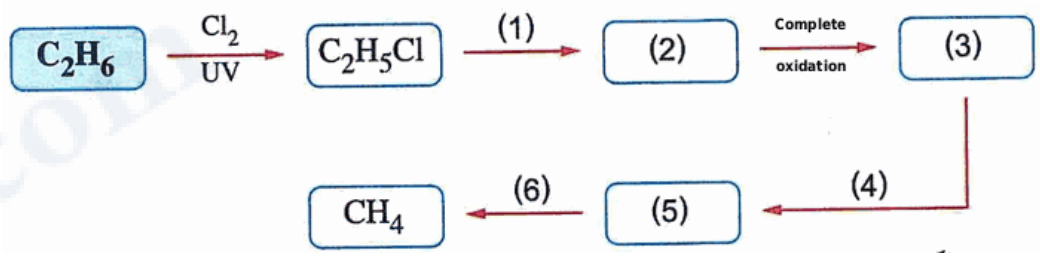
48 The opposite figure represents the structural formula of an organic acid.
Which of the following represents the possible products of the reaction of this acid with potassium hydroxide?



(A) $C_4H_5O_6K$ ✗, $C_4H_4O_6K_2$ ✓, $C_4H_3O_6K_3$ ✗, $C_4H_2O_6K_4$ ✗
(B) $C_4H_5O_6K$ ✓, $C_4H_4O_6K_2$ ✓, $C_4H_3O_6K_3$ ✗, $C_4H_2O_6K_4$ ✗
(C) $C_4H_5O_6K$ ✗, $C_4H_4O_6K_2$ ✗, $C_4H_3O_6K_3$ ✓, $C_4H_2O_6K_4$ ✓
(D) $C_4H_5O_6K$ ✓, $C_4H_4O_6K_2$ ✓, $C_4H_3O_6K_3$ ✓, $C_4H_2O_6K_4$ ✓

49 From the following scheme:

Which of the following is correct?



(A) (1): KOH(aq), (3): CH_3COOH, (6): CaO

(B) (2): C_2H_5OH, (4): NaOH(aq), (5): CH_3COOH

(C) (1): KOH(aq), (2): C_2H_5OH, (6): (CaO + NaOH)

(D) (3): CH_3COOH, (4): NaOH(aq), (5): CH_3ONa

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50 Ethanoic acid is converted into methyl chloride by the sequence of processes .....

(A) neutralization → dry distillation → addition.

(B) reduction → hydrogenation → dry distillation.

(C) neutralization → dry distillation → substitution.

(D) esterification → hydrolysis → neutralization.

---

51 The opposite table compares three different organic compounds.

Reaction with Na: (X) ✓, (Y) ✓, (Z) ✓

Reaction with Na_2CO_3: (X) ✓, (Y) ✗, (Z) ✗

Reaction with HCl: (X) ✗, (Y) ✓, (Z) ✗

Which of the following gives the type of each of these compounds?

(A) (X): alcohol, (Y): phenol, (Z): carboxylic acid.

(B) (X): phenol, (Y): carboxylic acid, (Z): alcohol.

(C) (X): carboxylic acid, (Y): phenol, (Z): alcohol.

(D) (X): carboxylic acid, (Y): alcohol, (Z): phenol.

---

52 The substances (1) to (4) shown in the following scheme are arranged in ascending order of their boiling points:

Which of the following is correct?



(A) Compounds (1), (4) form hydrogen bonds with water.

(B) Compounds (2), (3) react by addition.

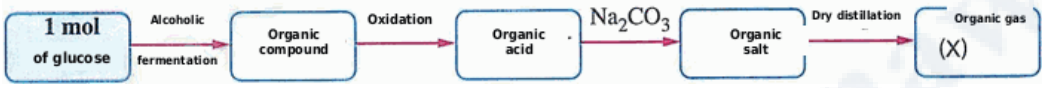
(C) Compounds (1), (3) exist in the gaseous state (at 25°C).

(D) Compounds (2), (4) react by substitution.

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53 From the following scheme:

When the reactions are balanced, the ratio between the volume of gas (X) and the total volume of CO_2 gas produced (at STP) is .....



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

---

54 All the reactions of acetic acid that show its acidic property have in common .....

(A) the evolution of hydrogen gas.

(B) the formation of water.

(C) the formation of the acid's salt.

(D) the evolution of carbon dioxide gas.

---

55 Magnesium acetate solution is formed when acetic acid reacts with each of the following, except .....

(A) magnesium.

(B) magnesium hydroxide.

(C) magnesium bicarbonate.

(D) magnesium sulphate.

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56 Ethanol and ethanoic acid have in common .....

(A) the molar mass.

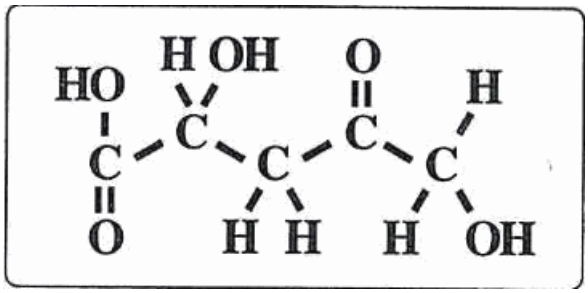
(B) the reaction with sodium bicarbonate.

(C) the number of hydrogen atoms.

(D) the reaction with sodium.

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57 1 mol of the opposite compound reacts with 3 mol of .....

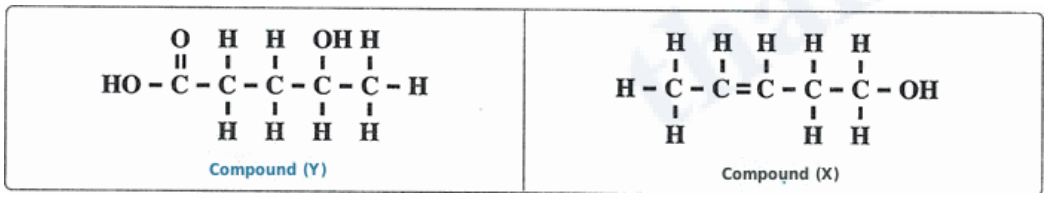


(A) potassium.
(B) sodium carbonate.
(C) sodium bicarbonate.
(D) potassium hydroxide.

58 The compound that reacts with calcium carbonate forming the compound $(C_3H_7COO)_2Ca$ is .....

(A) propanol.
(B) butanol.
(C) butanoic acid.
(D) hexanoic acid.

59 Two compounds (X), (Y) have the following structural formulas:
Which reagent can be used to distinguish between them?

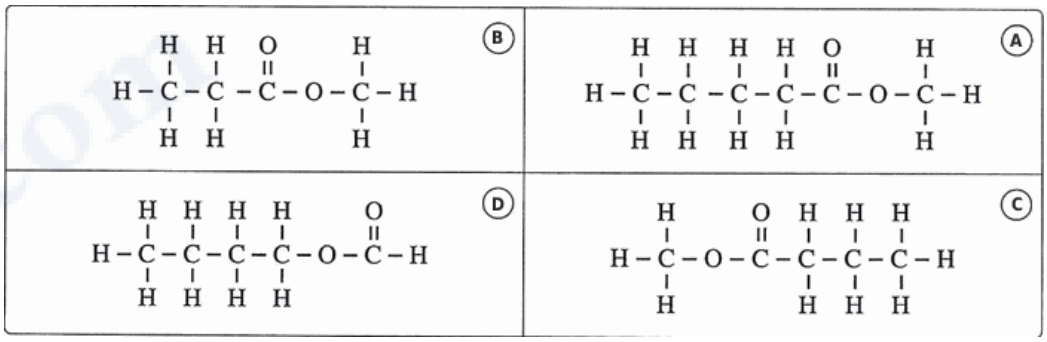


(A) Copper metal.
(B) Chlorine gas in the presence of ultraviolet rays.
(C) Sodium bicarbonate solution.
(D) Potassium metal.

60 $CH_3CH(OH)COOH$ can be converted into $CH_3CH(OH)COONa$ by using excess .....

(A) Na or Na_2CO_3 only.
(B) Na_2CO_3 or NaOH only.
(C) Na or NaOH only.
(D) Na or Na_2CO_3 or NaOH

61 What is the structural formula of the ester produced from the reaction of methanol with butanoic acid?



62 Each of the following describes the opposite acid, except .....

$HOOC–CH=CH–COOH$

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

(A) It decolourizes bromine water.

(B) Its molar mass is 116 g/mol

(C) It reacts with sodium carbonate.

(D) 1 mol of it reacts completely with only 1 mol of ethanol.

63 Which of the following describes ethanoic acid and hydrochloric acid of the same concentration?

(A) They have the same pH value ✗, both react with carbonate salts ✓, both react with ethanol ✗

(B) They have the same pH value ✓, both react with carbonate salts ✗, both react with ethanol ✓

(C) They have the same pH value ✓, both react with carbonate salts ✓, both react with ethanol ✗

(D) They have the same pH value ✗, both react with carbonate salts ✓, both react with ethanol ✓

64 The ester shown in the opposite figure is produced from the reaction of .....

$CH_3CH_2CH_2–COO–CH_2CH_2CH_3$

(A) 1-butanol with butanoic acid.

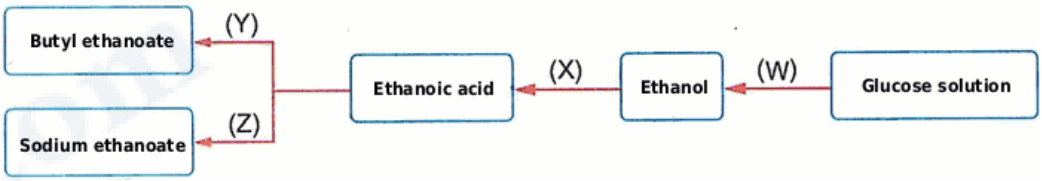
(B) 1-butanol with propanoic acid.

(C) 1-propanol with butanoic acid.

(D) 1-propanol with propanoic acid.

65 The following scheme represents different chemical processes:

What are the processes represented by the letters (W), (X), (Y), (Z)?



(A) (W): reduction, (X): oxidation, (Y): esterification, (Z): esterification

(B) (W): alcoholic fermentation, (X): oxidation, (Y): esterification, (Z): neutralization

(C) (W): alcoholic fermentation, (X): oxidation, (Y): reduction, (Z): esterification

(D) (W): oxidation, (X): reduction, (Y): neutralization, (Z): esterification

---

66 Which of the following compounds oxidizes H_2 gas to H_2O under suitable reaction conditions?

(A) CH_3CHO (B) C_2H_5COOH (C) CH_3COCH_3 (D) C_2H_5OH

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67 Which of the following compounds can be reduced to an aldehyde under suitable conditions?

(A) Butanone. (B) 1-Butanol. (C) Butanoic acid. (D) 2-Butanol.

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68 The acid $C_{18}H_{32}O_2$ is one of the unsaturated monobasic acids found in sunflower oil.

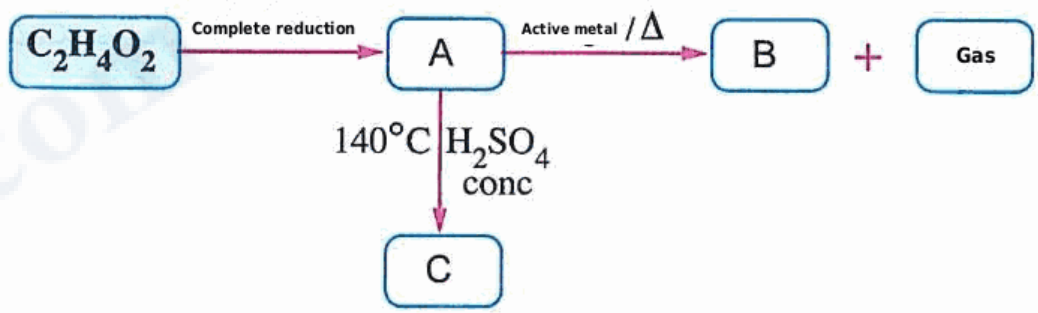
What is the number of moles of hydrogen needed to convert 3 mol of this acid into a saturated acid?

(A) 3 mol (B) 6 mol (C) 9 mol (D) 18 mol

---

69 From the opposite scheme:

Each of the following is correct, except .....



(A) (A): reacts with HCl, (B): a white solid, (C): does not react with active metals

(B) (A): can be prepared by a biological method, (B): is hydrolysed forming (A), (C): follows the general formula $C_nH_{2n+2}O$

(C) (A): dissolves in water, (B): an ionic compound, (C): an isomer of the compound $(CH_3)_3COH$

(D) (A): reacts with NaOH, (B): its solution is alkaline, (C): its boiling point is -29.5°C

---

70 The organic compound that can be detected by sodium bicarbonate can also be detected by testing with .....

(A) phenolphthalein.

(B) bromine water.

(C) ethanol.

(D) sodium chloride solution.

---

71 The following compounds are used to distinguish between ethanol and ethanoic acid, except .....

(A) Acidified potassium permanganate solution.

(B) Phenolphthalein.

(C) Sodium bicarbonate solution.

(D) Litmus indicator.

---

72 1-Propanol and 2-propanol can be distinguished by .....

(A) adding NaOH to each of them, then hydrolysis.

(B) adding Na to each of them, then esterification.

(C) adding hot chromic acid to each of them, then Na_2CO_3

(D) adding acidified potassium permanganate solution to each of them, then HCl

---

73 The most stable vanadium oxide is used in the oxidation of .....

(A) benzene to benzoic acid.
(B) ethanol to ethanoic acid.
(C) toluene to benzoic acid.
(D) isopropanol to acetone.

74 The catalyst used in making superconducting magnets is used as a(n) .....

(A) reducing agent in the reaction of acetic acid with hydrogen.
(B) dehydrating agent in converting ethanol into ethene.
(C) catalyst in converting toluene into benzoic acid.
(D) catalyst in the reaction of phenol with hydrochloric acid.

75 Benzoic acid can be obtained from benzene by .....

(A) alkylation, then oxidation.
(B) nitration, then sulphonation.
(C) chlorination, then sulphonation.
(D) reduction, then catalytic reforming.

76 Compound (X) is used in making one type of network (thermosetting) plastic.
What is the correct order of the processes used to convert compound (X) into an organic compound with the molecular formula $C_7H_6O_2$?

(A) Oxidation - alkylation - reduction.
(B) Reduction - alkylation - oxidation.
(C) Reduction - oxidation - alkylation.
(D) Oxidation - reduction - alkylation.

77 The following statements may describe toluene:
(1): When an H atom in the (C_6H_5-) group is replaced by a Cl atom, the resulting molecular formula has 3 isomers.
(2): It can be nitrated forming an explosive substance.
(3): It can be oxidized forming benzoic acid.
Which of the following choices is correct?

(A) (1) ✓, (2) ✓, (3) ✗
(B) (1) ✗, (2) ✓, (3) ✓
(C) (1) ✗, (2) ✗, (3) ✓
(D) (1) ✓, (2) ✓, (3) ✓

78 Phenol is more acidic than .....

(A) CH_3COOH (B) C_6H_5COOH (C) C_2H_5OH (D) HCl

79 Which of the following compounds is the most acidic?

(A) C_2H_5OH (B) C_6H_5OH (C) CH_3COOH (D) C_6H_5COOH

---

80 Given the Ka values of the following acids (at 25°C):

C_6H_5COOH: 6.5×10^{-5}, $C_2H_2O_4$: 5.9×10^{-2}, CH_3COOH: 1.8×10^{-5}, HCOOH: 1.8×10^{-4}

What is the correct order of the strength of these acids?

(A) Benzoic acid < acetic acid < formic acid < oxalic acid.

(B) Acetic acid < benzoic acid < formic acid < oxalic acid.

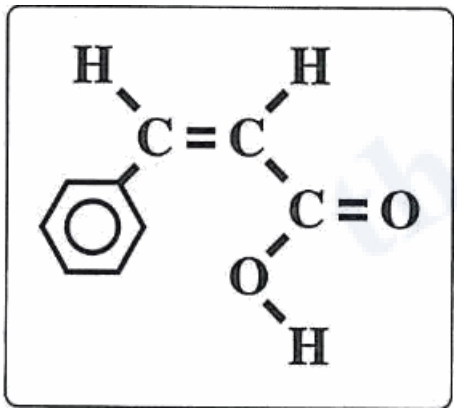
(C) Benzoic acid < oxalic acid < formic acid < acetic acid.

(D) Acetic acid < formic acid < oxalic acid < benzoic acid.

---

81 The opposite structural formula is of one of the acids in the flavour of cinnamon oil.

Which of the following represents the substances that can react with this acid?



(A) CH_3CH_3 in the presence of a catalyst ✓, $Br_2(l) + CCl_4$ ✓, CH_3OH in the presence of conc. H_2SO_4 ✓

(B) CH_3CH_3 in the presence of a catalyst ✓, $Br_2(l) + CCl_4$ ✗, CH_3OH in the presence of conc. H_2SO_4 ✓

(C) CH_3CH_3 in the presence of a catalyst ✗, $Br_2(l) + CCl_4$ ✓, CH_3OH in the presence of conc. H_2SO_4 ✓

(D) CH_3CH_3 in the presence of a catalyst ✗, $Br_2(l) + CCl_4$ ✓, CH_3OH in the presence of conc. H_2SO_4 ✗

---

82 The following equations are correct, except .....

(A) $C_6H_5COOH + NaOH \rightarrow C_6H_5COONa + H_2O$

(B) $C_6H_5OH + NaOH \rightarrow C_6H_5ONa + H_2O$

(C) $2C_6H_5COOH + CaCO_3 \rightarrow (C_6H_5COO)_2Ca + CO_2 + H_2O$

(D) $2C_6H_5OH + Na_2CO_3 \rightarrow 2C_6H_5ONa + CO_2 + H_2O$

83 (X) reacts with (Y) of the carboxyl group of benzoic acid to form compound (Z).
Which of the following is correct?

(A) (X): NaCl, (Y): –H, (Z): sodium benzoate.

(B) (X): NaOH + CaO, (Y): –OH, (Z): benzene.

(C) (X): HCl, (Y): –OH, (Z): benzene.

(D) (X): $NaHCO_3$, (Y): –H, (Z): sodium benzoate.

84 The opposite table shows the Ka values of ethanol, phenol and benzoic acid «not in order».
(1): 1.3×10^{-10}, (2): 1.3×10^{-16}, (3): 6.5×10^{-5}
Which of the following is correct for the two compounds?

(A) (1), (3) react with sodium bicarbonate.

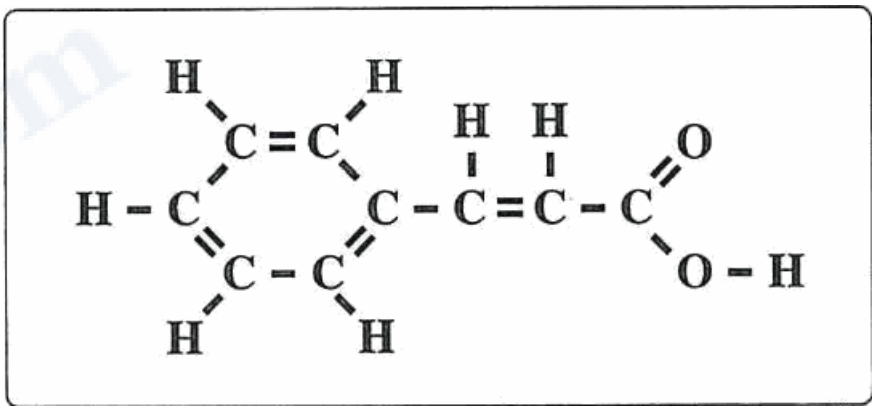
(B) (1), (2) react with sodium hydroxide.

(C) (2), (3) react with sodium.

(D) (1), (2) react with hydrochloric acid.

85 From the opposite structural formula:

Which of the following describes the properties of this compound?



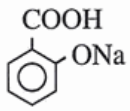
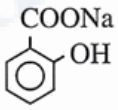
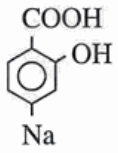
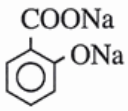
(A) One mole of it reacts with 5 mol of hydrogen to become a saturated acid.

(B) It reacts with bromine dissolved in CCl_4

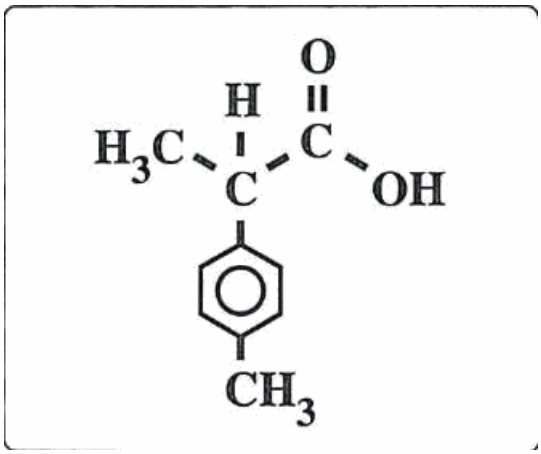
(C) It reacts with acetic acid forming an ester.

(D) One mole of it reacts with 8 mol of hydrogen atoms to become a saturated alcohol.

86 What is the final product of the reaction of salicylic acid with excess sodium hydroxide?

B 	A 
D 	C 

87 The opposite figure represents the structural formula of an organic compound.
All of the following are correct for this compound, except that it .....



(A) reacts with Mg forming H_2 gas
(B) reacts with Na_2CO_3 forming CO_2 gas
(C) reacts with hydrogen in the presence of a catalyst.
(D) reacts with 1-propanol forming a salt and water.

---

88 The following table gives the molecular formulas of four organic compounds.
(W): C_6H_5Cl, (X): C_6H_6O, (Y): $C_7H_6O_2$, (Z): $C_6H_6O_2$
Which compounds react with sodium hydroxide under suitable conditions?

(A) (W) ✓, (X) ✗, (Y) ✓, (Z) ✗
(B) (W) ✗, (X) ✓, (Y) ✗, (Z) ✓
(C) (W) ✗, (X) ✗, (Y) ✓, (Z) ✓
(D) (W) ✓, (X) ✓, (Y) ✓, (Z) ✓

---

89 The following scheme shows the steps of converting benzene into meta-bromobenzoic acid:
Which of the following is correct?



(A) (1): CH_3Cl / $AlCl_3$, (2): C_6H_5Cl
(B) (2): $C_6H_5CH_3$, (3): conc. H_2SO_4
(C) (3): O_2, (4): C_6H_5COOH
(D) (4): C_6H_5COOH, (5): HBr

---

90 Which of the following represents the steps of converting benzene into meta-chlorobenzoic acid?

(A) Substitution → chlorination → oxidation.

(B) Alkylation → oxidation → addition.

(C) Alkylation → oxidation → substitution.

(D) Substitution → alkylation → chlorination.

---

91 Preparing benzene from toluene involves the processes .....

(A) neutralization → oxidation → dry distillation.

(B) oxidation → neutralization → dry distillation.

(C) dry distillation → neutralization → oxidation.

(D) oxidation → dry distillation → neutralization.

---

92 Converting heptane into aromatic benzene goes through four successive chemical processes. Which of the following is correct?

(A) Process (1): catalytic thermal cracking, products of process (2): toluene, inorganic reactant in process (3): sodium, process (4): fractional distillation

(B) Process (1): fractional distillation, products of process (2): toluene, inorganic reactant in process (3): sodium, process (4): catalytic thermal cracking

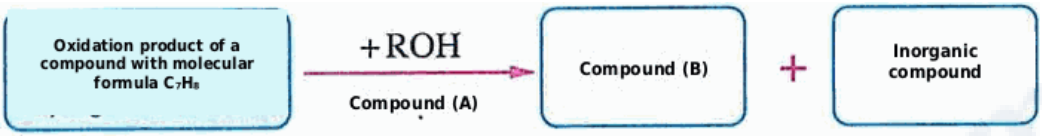
(C) Process (1): catalytic reforming, products of process (2): monobasic acid + water, inorganic reactant in process (3): sodium hydroxide, process (4): dry distillation

(D) Process (1): catalytic reforming, products of process (2): dibasic acid + water, inorganic reactant in process (3): sodium hydroxide, process (4): dry distillation

---

93 From the following scheme:

The substances (A), (B) are .....



(A) (A): conc. H_2SO_4, (B): an ester.

(B) (A): conc. H_2SO_4, (B): an ether.

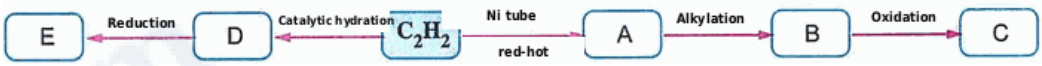
(C) (A): dry HCl, (B): an ester.

(D) (A): dry HCl, (B): an ether.

---

94 From the following scheme:

What is the product of the reaction of the two organic compounds (C), (E)?



(A) An aliphatic ether and hydrogen.
(B) An aromatic ether and hydrogen.
(C) An aliphatic ester and water.
(D) An aromatic ester and water.

95 Carbolic acid and benzoic acid can be distinguished by using .....

(A) NaOH (B) $NaHCO_3$ (C) HCl (D) K

96 Ant stings inject the body with ..... acid.

(A) formic (B) acetic (C) carbonic (D) hydrochloric

97 Each of the following describes the pure organic compound that freezes at 16°C, except .....

(A) It is used in preparing artificial silk.
(B) The product of its complete reduction is a secondary alcohol.
(C) It reacts with sodium hydroxide.
(D) It is the second member of a homologous series.

98 Benzoic acid is an aromatic acid; its melting point is 122°C and its boiling point is 249°C

Which of the following represents one of the physical properties of benzoic acid?

(A) A liquid sparingly soluble in water.
(B) A solid that dissolves with difficulty in water.
(C) A solid that dissolves quickly in water.
(D) A liquid easily absorbed by the body.

99 What is the order of the chemical processes carried out on a saturated hydrocarbon whose atoms are linked by 22 sigma bonds in the molecule, to prepare a salt that prevents the growth of fungi on food?

(A) Substitution - catalytic reforming - neutralization.

(B) Catalytic reforming - oxidation - neutralization.

(C) Substitution - reaction with NaOH - oxidation.

(D) Catalytic reforming - substitution - oxidation.

---

100 What is the maximum number of moles of sodium hydroxide needed to react with one mole of citric acid?

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

---

101 Which of the following describes the properties of the opposite compound?

$HOOCCH_2C(OH)COOHCH_2COOH$

(A) It dissolves in acetone and does not dissolve in water.

(B) The pH value of its solution is less than (7).

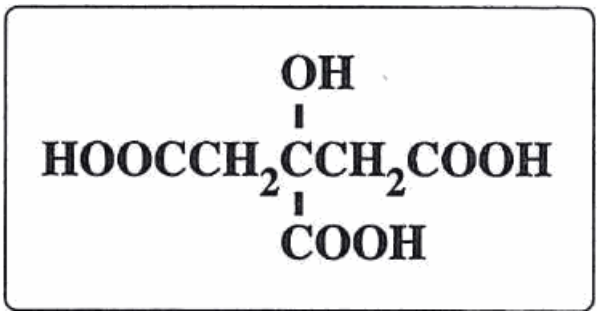
(C) One mole of it is neutralized by one mole of Na_2CO_3

(D) One mole of it reacts with 4 mol of NaOH

---

102 The opposite structural formula represents one of the hydrocarbon derivatives.

Each of the following describes 1 mol of this compound, except .....



(A) It reacts with 4 mol of NaOH (B) It dissolves in water.

(C) It is tribasic. (D) It is found in lemons and oranges.

---

103 What is the importance of adding the compound $C_6H_8O_7$ to preserved foods, and what is the number of moles of NaOH needed to titrate a solution containing 19.2 g of it?
[$C_6H_8O_7$ = 192 g/mol]

(A) Keeping their colour and lowering their pH value / 0.3 mol
(B) Keeping their taste and raising their pH value / 0.4 mol
(C) Preventing the growth of bacteria and lowering their pOH value / 0.3 mol
(D) Preventing the growth of bacteria and raising their pOH value / 0.4 mol

---

104 Two experiments were carried out separately, each using 1 mol of citric acid, where in each experiment the following was added to it:
In experiment (1): excess of the primary reagent of the $S_2O_3^{2-}$ anion in the presence of a suitable catalyst.
In experiment (2): excess of the confirmatory reagent of the Al^{3+} cation.
What is the number of moles of H_2O produced in the two experiments, respectively?

(A) Experiment (1): 1 mol, experiment (2): 4 mol
(B) Experiment (1): 1 mol, experiment (2): 3 mol
(C) Experiment (1): zero, experiment (2): 3 mol
(D) Experiment (1): zero, experiment (2): 4 mol

---

105 The percentage of carbon in lactic acid is calculated from the relation .....
[C = 12 , H = 1 , O = 16]

(A) (36 / 90) × 100%
(B) (24 / 60) × 100%
(C) (48 / 90) × 100%
(D) (72 / 192) × 100%

---

106 Which acid reacts with both dilute hydrochloric acid and sodium hydroxide solution?

(A) Picric acid.
(B) Pentanoic acid.
(C) Lactic acid.
(D) Carbolic acid.

---

107 What is the number of moles of NaOH needed to react with 2 mol of the acid produced in the body as a result of strenuous effort?

(A) 1 mol
(B) 2 mol
(C) 4 mol
(D) 6 mol

---

108 Salicylic acid is similar to lactic acid in each of the following, except .....

(A) the reaction with potassium.

(B) reduction under suitable conditions.

(C) the reaction with potassium bicarbonate.

(D) esterification in the presence of conc. H_2SO_4

109 Salicylic acid and lactic acid are both .....

(A) aliphatic acids.

(B) aromatic acids.

(C) contain the same number of oxygen atoms.

(D) of the same homologous series.

110 Three organic compounds:

(A): its deficiency in the body causes swelling of the joints and bleeding of the gums.

(B): preparations made from it are used to remove skin warts.

(C): is used as a raw material in preparing artificial silk.

Which of the following is correct?

(A) (A): found in green pepper, (B): reacts as an acid or a phenol, (C): is reduced to a primary alcohol

(B) (A): found in green pepper, (B): reacts as an acid or a phenol, (C): is reduced to a secondary alcohol

(C) (A): reacts with NaOH, (B): reacts with Na_2CO_3, (C): does not react with Na

(D) (A): reacts with $NaHCO_3$, (B): does not react with Na, (C): reacts with $NaHCO_3$

111 Each of the following describes aminoethanoic acid, except that it .....

(A) is an alpha-amino acid.

(B) reacts with bases.

(C) is known as glycine.

(D) is sparingly soluble in water.

112 Which of the following are natural polymers?

(A) Teflon only.

(B) Protein only.

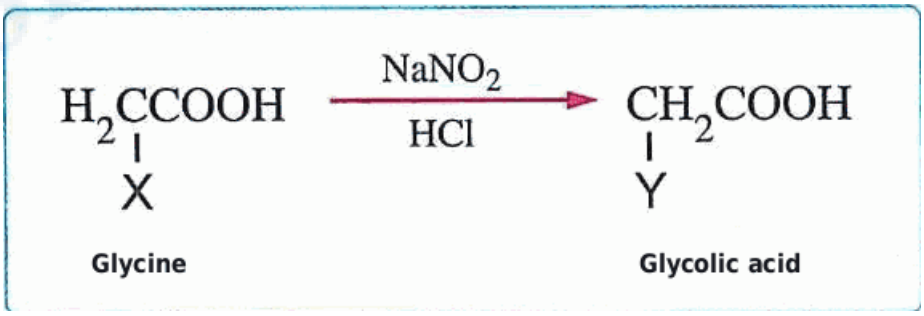
(C) Teflon and Bakelite.

(D) Protein and Bakelite.

113 What are the basic units that make up protein?

(A) Amino acids. (B) Fatty acids. (C) Glucose. (D) Glycerol.

114 What do (X), (Y) represent in the two opposite compounds?



(A) (X): –OH, (Y): $-NH_2$

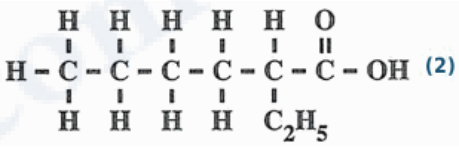
(B) (X): $-NH_2$, (Y): –OH

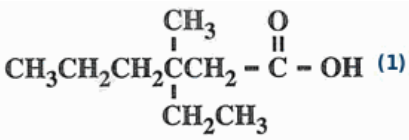
(C) (X): –Cl, (Y): –OH

(D) (X): –OH, (Y): –CN

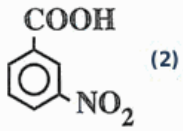
Essay questions — 12 questions

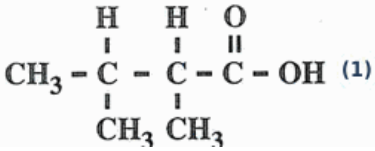
1 Write the names of the following compounds according to the IUPAC system:

 (2)

 (1)

2 Write the IUPAC name of each of the following:

 (2)

 (1)

3 Draw the structural formula of each of:

(1) para-nitrobenzoic acid.

(2) A dicarboxylic acid whose number of carbon atoms equals the number of carboxyl groups.

4 The organic acid (X) is sparingly soluble in water, and its sodium salt is used as a food preservative:

(1) Express the ionization constant Ka of this acid by a mathematical formula.

(2) Write the chemical equation for the dry distillation of the sodium salt of acid (X) with soda lime.

5 Four colourless liquids (A), (B), (C), (D) are the following compounds, not in order:
ethanol, ethanoic acid, pentane, hexene.

The experiments shown in the following table were carried out on them:

Solubility in water: (A) insoluble, (B) soluble, (C) soluble, (D) insoluble

Adding red bromine water: (A) the colour disappears, (B) no reaction, (C) no reaction, (D) no reaction

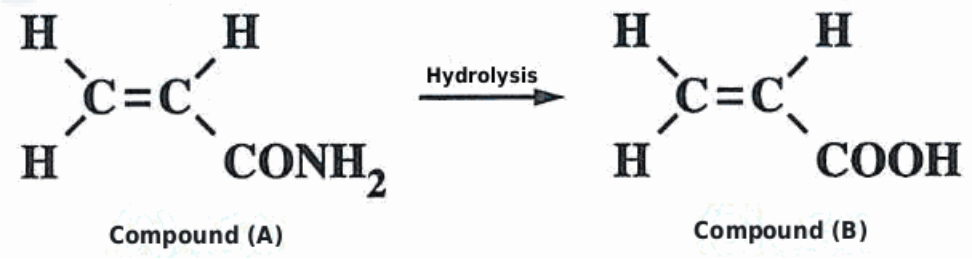
Adding sodium carbonate powder: (A) no reaction, (B) a gas is given off, (C) no reaction, (D) no reaction

Identify the liquids (A), (B), (C), (D).

6 Compound (B) is produced from the hydrolysis of compound (A), according to the following equation:

(1) Which homologous series does compound (A) follow?

(2) What is observed when drops of bromine water are added to compound (B)? Explain, and draw the structural formula of the compound produced.



7 The oxide of the transition metal (M) is used as a pigment in the ceramics industry.

Write a balanced symbolic equation in which this oxide is used in:

(1) One of the steps of preparing a mineral acid.

(2) Preparing an organic acid.

8 Calculate the volume of gas given off (at STP) from the reaction of 17 g of sodium bicarbonate with excess acetic acid.

[$NaHCO_3$ = 84 g/mol]

9 From the following scheme:

$C_2H_5OH \rightarrow 2[O], KMnO_4 / H^+ \rightarrow (X) \rightarrow + NaOH \rightarrow (Y)$

Write the chemical formula of each of:

(1) Compound (X).

(2) The aliphatic hydrocarbon that can be obtained from compound (Y).

10 Solutions of the following substances have equal concentrations:

ethanol, sodium ethoxide, acetic acid, hydrochloric acid.

Arrange these substances in descending order of pH value, with explanation.

11 The following substances have equal concentrations:

phenol, acetic acid, ethanol, benzoic acid.

Arrange these substances in descending order of their strength as acids, with explanation.

12 The following substances have equal concentrations:

ethanol, diethyl ether, ethanoic acid.

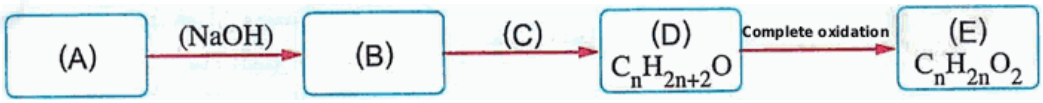
Arrange these substances in ascending order of their boiling points, with explanation.

Past exam questions — 87 questions

1 From the following scheme: (Sample exam 2026)

Given that the organic acid (A) causes muscle cramps when it increases in the body.

Which of the following gives the correct names of (D) and (E) and the name of process (C)?



(A) (D): propanol, (E): propanoic acid, (C): dry distillation.

(B) (D): ethanol, (E): ethanoic acid, (C): dehydration.

(C) (D): ethanol, (E): ethanoic acid, (C): dry distillation.

(D) (D): propanol, (E): propanoic acid, (C): dehydration.

---

2 Which of the following gives the correct order of the chemical processes needed to prepare a substance used in printing inks from the compound produced by the catalytic hydration of the simplest alkyne? (Sample exam 2026)

(A) Reduction – esterification – hydrolysis in an acidic medium – thermal cracking.

(B) Oxidation – dry distillation – neutralization – passing steam.

(C) Reduction – dehydration – hydrogenation – halogenation.

(D) Oxidation – neutralization – dry distillation – thermal cracking.

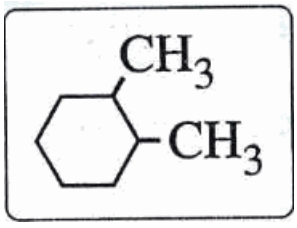
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3 The following processes were carried out on the organic substance (X) in order: (Sample exam 2026)

(complete oxidation - neutralization - dry distillation - catalytic reforming - complete hydrogenation),

and the compound in the opposite figure was one of the products.

Which of the following compounds can be substance (X)?



(A) 3,4-Dimethyl-1-heptanol.

(B) 2,3-Dimethyl-1-hexanol.

(C) 3,4-Dimethyl-1-hexanol.

(D) 3,5-Dimethyl-1-heptanol.

---

4 Which of the following choices gives the correct order of the chemical processes needed to obtain an organic substance used as a food preservative that prevents the growth of fungi? (Sample exam 2026)

(A) Trimerization of acetylene – halogenation in the presence of a catalyst – alkaline hydrolysis – reduction.

(B) Catalytic reforming of hexane – alkylation – oxidation – neutralization.

(C) Reduction of phenol – alkylation – oxidation – reduction.

(D) Fractional distillation of coal tar – halogenation in the presence of a catalyst – alkaline hydrolysis – alkylation.

---

5 Which of the following gives the correct order of the processes needed to obtain the simplest aromatic carboxylic acid from the simplest aliphatic hydrocarbon? (Sample exam 2026)

(A) Halogenation – alkaline hydrolysis – complete oxidation.

(B) Strong heating and sudden cooling – polymerization – alkylation – nitration.

(C) Strong heating and sudden cooling – polymerization – alkylation – oxidation.

(D) Alkaline hydrolysis – halogenation – complete oxidation.

---

6 Three hydrocarbon derivatives: (Sample exam 2026)

The first compound: reacts with dilute hydrochloric acid and does not react with sodium hydroxide solution.

The second compound: reacts with both the first compound and sodium hydroxide solution under suitable conditions.

The third compound: reacts with sodium hydroxide solution and does not react with hydrochloric acid.

Each of the following is correct, except .....

(A) The general formula of the first compound: $C_nH_{2n+2}O$

(B) The general formula of the second compound: $C_nH_{2n}O_2$

(C) Iron (III) chloride is used to detect the third compound.

(D) The third compound is prepared by oxidation of the first compound.

---

7 (A) and (B) are two organic compounds; the molecular formula of the alcohol (A) is C_2H_6O and of compound (B) is $C_7H_6O_3$, (Sample exam 2026)

Compounds (A), (B) have in common that both .....

(A) are used in medical fields.
(B) react with sodium hydroxide.
(C) are used in making Dacron fibres.
(D) react with hydrochloric acid.

8 All the following substances decolourize potassium permanganate solution in an acidic medium, except ..... (Sample exam 2026)

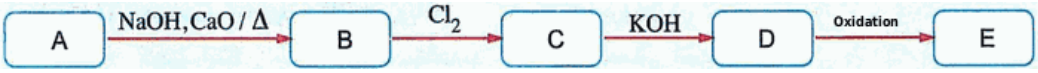
(A) Hydroxycyclohexane.
(B) Isobutyl alcohol.
(C) 2-Bromo-2-propanol.
(D) 2-Hydroxypropanoic acid.

9 Which of the following represents the processes needed to obtain the simplest hydrocarbon from the simplest alkyne? (Sample exam 2026)

(A) Catalytic hydration – complete oxidation – reduction – dry distillation.
(B) Catalytic hydration – reduction – complete oxidation – dry distillation.
(C) Oxidation (Baeyer) – complete oxidation – neutralization – dry distillation.
(D) Catalytic hydration – complete oxidation – neutralization – dry distillation.

10 The following scheme shows the steps that the organic compound (A) goes through to obtain the organic compound (E): (Sample exam 2026)

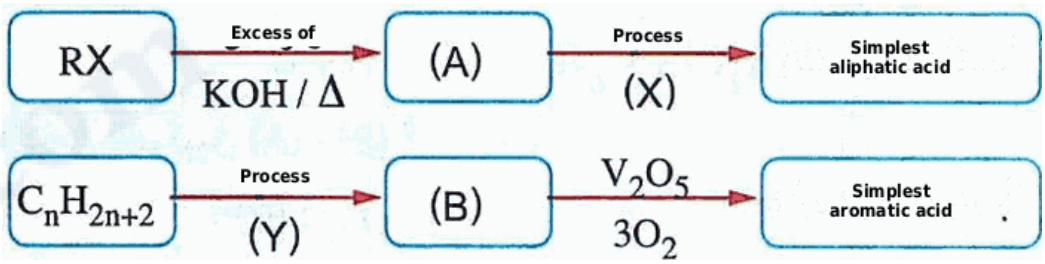
Which of the following represents the substances (A), (C), (E)?



(A) (A): sodium butanoate, (C): 2-chloropropane, (E): propanal
(B) (A): sodium pentanoate, (C): 1-chlorobutane, (E): butanoic acid
(C) (A): sodium butanoate, (C): 1-chloropropane, (E): propanone
(D) (A): sodium pentanoate, (C): 2-chlorobutane, (E): butanoic acid

11 From the following schemes: (Sample exam 2026)

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



(A) Process (X): acid hydrolysis, process (Y): alkaline hydrolysis.

(B) Process (X): complete oxidation, process (Y): catalytic reforming.

(C) Process (X): partial oxidation, process (Y): ester formation.

(D) Process (X): alkaline hydrolysis, process (Y): acid hydrolysis.

---

12 Three organic acids: (Sample exam 2026)

(A): contains an alcoholic group that can be oxidized.

(B): contains an alcoholic group that cannot be oxidized.

(C): does not contain any alcoholic groups.

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

(A) (A): $C_3H_6O_3$, (B): $C_6H_8O_7$, (C): C_6H_6O

(B) (A): $C_6H_8O_7$, (B): C_6H_6O, (C): $C_6H_3O_7N_3$

(C) (A): C_6H_6O, (B): $C_6H_8O_7$, (C): $C_3H_6O_3$

(D) (A): $C_3H_6O_3$, (B): $C_7H_6O_3$, (C): C_6H_6O

---

13 From the following scheme: (Sample exam 2026)

(A) → reduction → (B) → dehydration → (C) → oxidation → (D)

Given that (C) is an unsaturated aliphatic hydrocarbon,

which of the following is correct for the compounds (A), (B), (C), (D)?

(A) (A): propanoic acid, (B): propanol, (C): propene.

(B) (A): ethyl alcohol, (B): acetaldehyde, (D): acetic acid.

(C) (A): propanoic acid, (C): propyne, (D): propanol.

(D) (A): ethyl alcohol, (B): acetic acid, (D): acetaldehyde.

---

14 Which of the following represents a method for preparing 2-methylpropane? (Sample exam 2026)

(A) Neutralization of 2-methylpropanoic acid, then dry distillation.

(B) Dehydration of 1-propanol, then hydrogenation.

(C) Neutralization of 3-methylbutanoic acid, then dry distillation.

(D) Dehydration of 1-butanol, then hydrogenation.

---

15 Which of the following gives the correct order of the processes needed to obtain aromatic benzene from a compound with the formula $C_6H_{13}COOH$? (Sample exam 2026)

(A) Reduction – dehydration – oxidation.

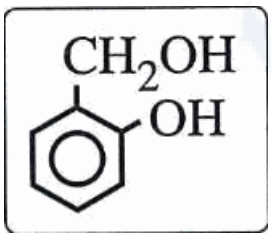
(B) Neutralization – dry distillation – hydrogenation.

(C) Reduction – dehydration – catalytic reforming.

(D) Neutralization – dry distillation – catalytic reforming.

---

16 Which of the following is a use of the product of the complete oxidation of the opposite compound? (Sample exam 2026)



(A) Preparing Dacron fabric.

(B) Preparing medical drugs.

(C) Preparing Bakelite.

(D) Preparing explosives.

---

17 (X), (Y) are organic carboxylic acids: (Sample exam 2026)

(X): an aromatic acid, one mole of which reacts with 2 mol of caustic soda.

(Y): an aliphatic acid, one mole of which reacts with 3 mol of caustic soda, then 1 mol of sodium.

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

(A) (Y): lactic acid, secreted by the body during effort.

(B) (Y): citric acid, used to preserve frozen fruits.

(C) (X): terephthalic acid, used in making artificial silk.

(D) (X): salicylic acid, used in making Dacron fibres.

18 (A) and (B) are organic acids: (Sample exam 2026)

(A): does not respond to the acidity test.

(B): is used in preparing a compound used to treat headaches.

Which of the following represents the two acids (A) and (B)?

(A) (A) is acetic acid, while (B) is salicylic acid.

(B) (A) is an acid not reduced by hydrogen and copper (II) chromite, while (B) is salicylic acid.

(C) (A) is acetic acid, while (B) is benzoic acid.

(D) (A) is carbolic acid, while (B) is an acid that can be prepared by oxidation of para-methyltoluene.

---

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

(X): an aliphatic compound that is oxidized to a compound used in producing polyester.

(Y): an aromatic compound whose sodium salt is used to prevent the growth of fungi.

Which of the following statements is correct?

(A) Compound (X) follows the formula $C_nH_{2n+2}O_2$ and does not contain a carboxyl group.

(B) Compound (Y) does not follow the formula $C_nH_{2n}O_2$ and contains a carboxyl group.

(C) Compound (X) follows the formula $C_nH_{2n+2}O_2$ and contains a carboxyl group.

(D) Compound (Y) follows the formula $C_nH_{2n}O_2$ and contains a carboxyl group.

---

20 An organic compound has the molecular formula $C_5H_{10}O_2$ and has a functional group made of two groups. (Sample exam 2026)

Which of the following can be the IUPAC name of this compound?

(A) 2,2-Dimethylbutanoic acid.

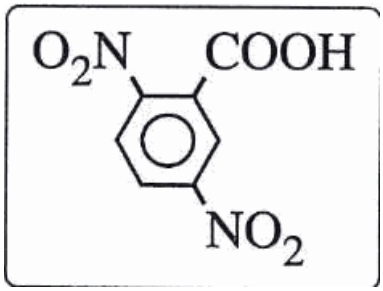
(B) Methyl butanoate.

(C) Ethyl propanoate.

(D) 2,2-Dimethylpropanoic acid.

---

21 Which of the following is the IUPAC name of the compound shown? (Sample exam 2026)



(A) 3,6-Dinitrobenzoic acid.
(B) 2,5-Dinitrobenzoic acid.
(C) Ortho and meta-dinitrobenzoic acid.
(D) 3,5-Dinitrobenzoic acid.

---

22 From the following scheme: (Sample exam 2026)

C_2H_4 → ($KMnO_4$ in an alkaline medium) → X → ($KMnO_4$ in an acidic medium) → Y

Which of the following is correct?

(A) (X): used in making insecticides, (Y): a dibasic acid.
(B) (X): used in car radiators, (Y): decolourizes acidified $KMnO_4$.
(C) (X): used in making polymers, (Y): is $C_2H_2O_4$
(D) (X): used in treating burns, (Y): is $C_2H_2O_4$

---

23 By carrying out the following reactions in order on an organic acid (with a pungent smell, freezing point 16°C): (Sample exam 2026)

(neutralization - dry distillation - heating then rapid cooling - trimerization)

Which of the following represents the final product of these processes?

(A) A branched aromatic hydrocarbon.
(B) An unsaturated aliphatic hydrocarbon.
(C) An unbranched aromatic hydrocarbon.
(D) A saturated aliphatic hydrocarbon.

---

24 Which of the following represents the correct order of the processes needed to obtain the compound with the formula C_6H_5COOH from a compound with the formula $C_7H_{15}COOH$? (Sample exam 2026)

(A) Catalytic reforming – dry distillation – oxidation – neutralization.
(B) Neutralization – dry distillation – oxidation – catalytic reforming.
(C) Catalytic thermal cracking – catalytic reforming – neutralization.
(D) Neutralization – dry distillation – catalytic reforming – oxidation.

---

25 Three organic compounds: (Sample exam 2026)

(A): an aliphatic organic compound with the general formula $C_nH_{2n+2}O_2$

(B): an aromatic acid containing two different functional groups.

(C): a liquid organic compound used in making artificial ghee and the basis for making a compound with the general formula $C_nH_{2n+2}O_3$

Which of the following is correct for compounds (A), (B), (C)?

(A) Compound (A) causes effervescence when sodium bicarbonate is added to it.

(B) Compound (B) changes the colour of potassium dichromate from orange to green.

(C) Compound (C) decolourizes potassium permanganate in an alkaline medium.

(D) Compound (A) gives a violet colour with iron (III) chloride solution.

---

26 Compounds (A, B) are hydrocarbon derivatives, where: (Sample exam 2026)

(A): is produced by chlorinating the compound produced from the dry distillation of sodium acetate, replacing three hydrogen atoms.

(B): is produced by removing water from 2-chloroethanol at 180°C

Which of the following represents (A) or (B)?

(A) (A): an alkane derivative used in dry cleaning.

(B) (B): an alkane derivative used as a raw material in making floor insulators.

(C) (A): an alkene derivative that was used as an anaesthetic.

(D) (B): an alkene derivative used as a raw material in making water hoses.

---

27 Three organic compounds (A, B, C): (Sample exam 2026)

(A): C_2H_4O, (B): C_2H_6O, (C): C_2H_4

Which of the following is correct?

(A) Oxidation of each of (A), (C) gives an acid used in making dyes.

(B) Oxidation of each of (A), (B) gives an acid used in making insecticides.

(C) (B) is not oxidized and is produced from the reduction of (A).

(D) Reduction of (A) and oxidation of (C) give the same product.

---

28 The following table gives the molecular formulas of three organic compounds: (Sample exam 2026)

(A): $C_3H_8O_3$, (B): $C_3H_8O_2$, (C): $C_2H_4O_2$

Which of the following gives the correct order of compounds (A, B, C) by boiling point?

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

29 (X, Y) are carboxylic acids with the following molecular formulas: (Sample exam 2026)

Acid (X): $C_7H_6O_3$, acid (Y): $C_3H_6O_3$

Which of the following gives the number of moles of each substance in the table needed when it reacts with one mole of (X, Y) separately?

(A) NaOH with (X): 1, NaOH with (Y): 1, Na with (X): 1, Na with (Y): 1

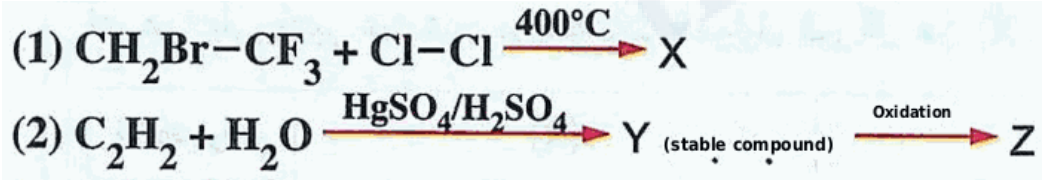
(B) NaOH with (X): 2, NaOH with (Y): 1, Na with (X): 2, Na with (Y): 2

(C) NaOH with (X): 1, NaOH with (Y): 2, Na with (X): 2, Na with (Y): 2

(D) NaOH with (X): 2, NaOH with (Y): 2, Na with (X): 2, Na with (Y): 2

30 From the following reactions: (Sample exam 2026)

Which of the following represents the two compounds (X, Z)?



(A) (X): a hydrocarbon used as a safe anaesthetic.

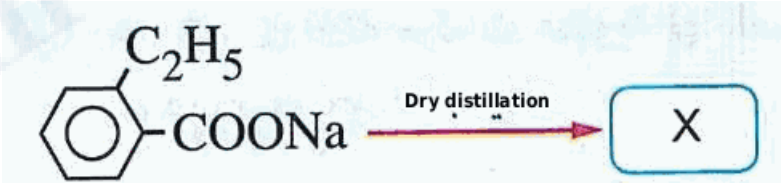
(B) (Z): an acid used to preserve fruits and vegetables.

(C) (X): a hydrocarbon derivative used as a safe anaesthetic.

(D) (Z): an alcohol used in insecticides.

31 From the opposite scheme: (Sample exam 2026)

Which of the following represents the product of chlorinating compound (X) in the presence of $FeCl_3$?



(A) Meta-chloroethylbenzene only.

(B) Para-chloroethylbenzene only.

(C) A mixture of ortho- and para-chloroethylbenzene.

(D) A mixture of ortho- and para-chloromethylbenzene.

---

32 When excess NaOH solution is added to dicarboxylic acids (X, Y): (Sample exam 2026)

In the case of acid (X), a salt with the formula NaOOC–COONa is formed

In the case of acid (Y), a salt with the formula $C_6H_4(COONa)_2$ is formed

Which of the following represents the two acids (X, Y)?

(A) (X): oxalic acid, (Y): phthalic acid.

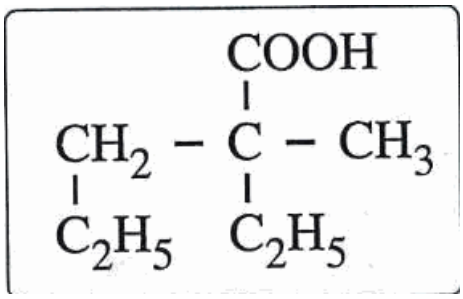
(B) (X): oxalic acid, (Y): benzoic acid.

(C) (X): phthalic acid, (Y): ethanoic acid.

(D) (X): oxalic acid, (Y): salicylic acid.

---

33 Which of the following represents the correct IUPAC name of the compound in the opposite figure? (Sample exam 2026)



(A) 2,3-Diethyl-2-methylpropanoic acid.

(B) 2-Methyl-2-ethylpentanoic acid.

(C) 2-Methyl-2-propylpropanoic acid.

(D) 2-Ethyl-2-methylpentanoic acid.

---

34 (M) is an organic compound that can be obtained by the following steps in order: (Sample exam 2026)

(1): neutralizing acid (X) with caustic soda, then strongly heating the product in the presence of soda lime to prepare gas (Y).

(2): chlorinating gas (Y) at (400°C) to obtain (Z).

(3): reacting (Z) with the simplest aromatic hydrocarbon to obtain (W).

(4): oxidizing (W) in the presence of V_2O_5 to obtain (M).

Which of the following represents the organic compounds (X, Y, Z, W, M)?

(A) (X) propanoic acid, (Y) ethane, (Z) chloroethane, (W) ethylbenzene, (M) benzoic acid

(B) (X) acetic acid, (Y) methane, (Z) chloromethane, (W) toluene, (M) benzaldehyde

(C) (X) acetic acid, (Y) methane, (Z) chloromethane, (W) toluene, (M) benzoic acid

(D) (X) acetic acid, (Y) methane, (Z) dichloromethane, (W) phenol, (M) salicylic acid

---

35 Which of the following gives the number of isomers of the formula $C_4H_8O_2$ that can be reduced to compounds with the general formula $C_nH_{2n+2}O$? (Sample exam 2026)

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

---

36 Acid (A): aromatic, used in making aspirin and produced by oxidizing substance (X). (Sample exam 2026)

Acid (B): aliphatic, used in making plastics and produced by oxidizing substance (Y).

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

(A) (X): ethanol, (Y): toluene.

(B) (X): salicylic acid, (Y): formic acid.

(C) (X): para-methylphenol, (Y): ethanol.

(D) (X): ortho-methylphenol, (Y): methanol.

---

37 (A, B, C) are three organic compounds: (Sample exam 2026)

(A): an aliphatic hydroxy acid that is oxidized to an acid containing a carboxyl group and a ketone group.

(B): an aliphatic hydroxy acid that does not decolourize acidified potassium permanganate.

(C): an aromatic hydroxy acid that can be detected by iron (III) chloride solution.

Which of the following gives the correct molecular formulas of the three compounds (A, B, C)?

(A) (A): $C_3H_6O_3$, (B): $C_6H_8O_7$, (C): $C_7H_6O_3$

(B) (A): $C_2H_4O_2$, (B): $C_3H_6O_3$, (C): C_6H_6O

(C) (A): $C_3H_6O_3$, (B): $C_2H_2O_4$, (C): $C_7H_6O_2$

(D) (A): $C_6H_8O_7$, (B): $C_3H_6O_3$, (C): $C_7H_6O_3$

---

38 (X, Y) are two salts of organic acids with the following chemical formulas: (Sample exam 2026)

(X): $(HCOO)_2Ca$, (Y): CaC_2O_4

Which of the following choices gives the number of moles of the organic acid and the base needed to prepare one mole of each of the two salts (X, Y)?

(A) (X): 1 mol of oxalic acid and 2 mol of calcium hydroxide, (Y): 1 mol of formic acid and 1 mol of calcium hydroxide.

(B) (X): 2 mol of formic acid and 2 mol of calcium hydroxide, (Y): 1 mol of oxalic acid and 1 mol of calcium hydroxide.

(C) (X): 2 mol of oxalic acid and 2 mol of calcium hydroxide, (Y): 1 mol of formic acid and 1 mol of calcium hydroxide.

(D) (X): 2 mol of formic acid and 1 mol of calcium hydroxide, (Y): 1 mol of oxalic acid and 1 mol of calcium hydroxide.

---

39 Which of the following gives the correct order of the steps needed to obtain a compound with the general formula $C_7H_6O_2$ from one of the products of the fractional distillation of coal tar? (Sample exam 2026)

(A) Alkylation → oxidation → esterification.

(B) Reduction → alkylation → oxidation.

(C) Halogenation → alkaline hydrolysis → reaction with acetic acid.

(D) Oxidation → esterification → alkaline hydrolysis.

---

40 Compounds (A) and (B) are prepared by nitration, where: (Sample exam 2026)

Compound (A): is prepared by nitrating an aromatic hydrocarbon.

Compound (B): is prepared by nitrating an aromatic hydrocarbon derivative.

Which of the following represents compounds (A) and (B)?

(A) (A): meta-nitrotoluene, (B): meta-nitrobenzoic acid.

(B) (A): 4-nitrotoluene, (B): 3-nitrobenzoic acid.

(C) (A): ortho-nitrotoluene, (B): 2-nitrobenzoic acid.

(D) (A): 2-nitrotoluene, (B): para-nitrobenzoic acid.

---

41 Three organic compounds (X, Y, Z) have the molecular formulas: (Sample exam 2026)

(X): C_2F_4, (Y): $C_2H_4O_2$, (Z): CCl_2F_2

Which of the following correctly describes each compound?

(A) (X) an alkene derivative: used as a raw material for lining cooking pans, (Y) an aliphatic acid: used in making artificial silk, (Z) an alkane derivative: used as a refrigerant

(B) (X) an alkane derivative: used in surgical threads, (Y) an aromatic acid: used as a food preservative, (Z) an alkene derivative: used as a cleaner for devices

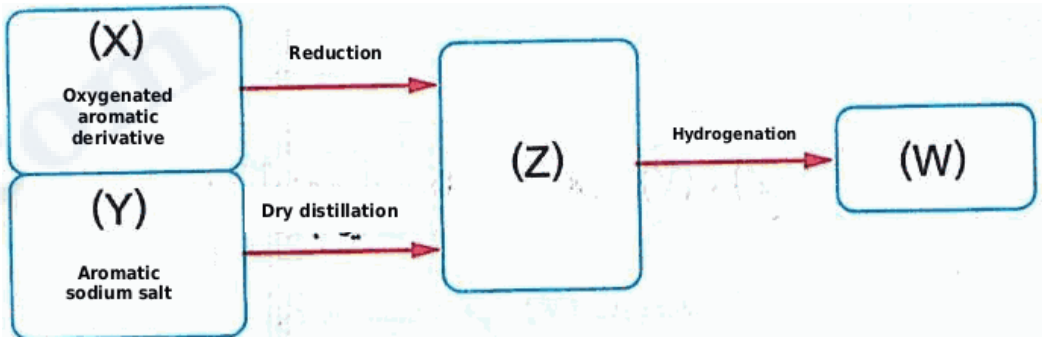
(C) (X) an alkane derivative: used as a raw material for lining cooking pans, (Y) an aliphatic ester: used as a flavouring and fragrance, (Z) an alkane derivative: used as a propellant for liquids

(D) (X) an alkene derivative: used in making plastics, (Y) an aliphatic acid: used in making explosives, (Z) an alkene derivative: used as an insecticide

---

42 From the following scheme: (Sample exam 2026)

Which of the following is correct?



(A) (Y): sodium ortho-methylbenzoate, (X): ortho-methylphenol, (W): cyclohexane.

(B) (Y): sodium para-methylbenzoate, (Z): methylbenzene, (W): cyclohexane.

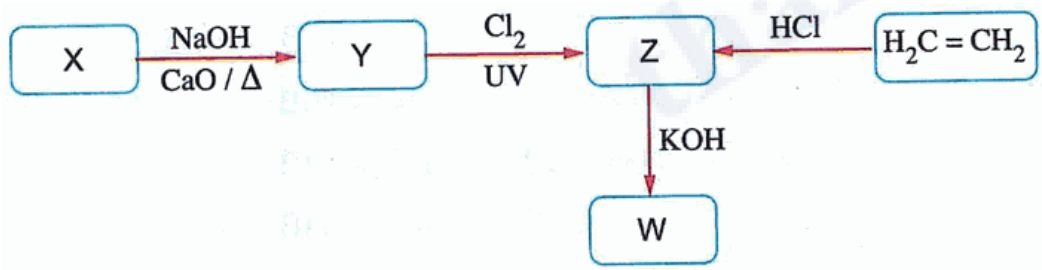
(C) (X): para-methylphenol, (Z): methylbenzene, (W): methylcyclohexane.

(D) (X): phenol, (Y): sodium ortho-methylbenzoate, (W): methylcyclohexane.

---

43 From the following scheme: (Sample exam 2026)

Which of the following is correct?



(A) (X): sodium ethanoate, (W): a secondary alcohol.

(B) (X): sodium propanoate, (W): a primary alcohol.

(C) (X): sodium ethanoate, (W): a primary alcohol.

(D) (X): sodium propanoate, (W): a secondary alcohol.

---

44 You have the following organic compounds: (Sample exam 2026)

(X): C_7H_8, (Y): C_6H_6O, (Z): $C_7H_6O_2$, (L): $C_6H_{14}O_6$

The compounds that react with NaOH are .....

(A) (X), (Y) only.

(B) (Z), (Y) only.

(C) (L), (Y) only.

(D) (L), (Z), (Y) only.

---

45 Which of the following represents the compound produced by the dry distillation of the organic compound $CH_3CH(OH)CH_2COONa$ in the presence of soda lime? (1st session 2025)

(A) 2-Propanol. (B) 1-Butanol. (C) 2-Butanol. (D) 1-Propanol.

---

46 Which of the following choices represents the process needed to obtain an aromatic compound with the formula $C_7H_6O_3$ under suitable conditions? (1st session 2025)

(A) Oxidation of toluene.

(B) Reaction of benzoic acid with caustic soda.

(C) Oxidation of 2-methylphenol.

(D) Reaction of phenol with formic acid.

---

47 The molecular formulas of three organic compounds (X), (Y), (Z) are: (2nd session 2024)

(X): $C_8H_6O_4$, (Y): $C_2H_6O_2$, (Z): $C_2H_4O_2$

Which of the following choices is correct?

(A) (X): an aromatic acid used in making polyester, (Y): a dihydric alcohol, (Z): an aliphatic acid used in making insecticides.

(B) (X): an aliphatic acid used in making vinegar, (Y): an aromatic alcohol used in making polyester, (Z): a dihydric alcohol.

(C) (X): a dihydric alcohol used in making polyester, (Y): an aliphatic acid used in making vinegar, (Z): an aromatic acid.

(D) (X): an ester, (Y): a monohydric alcohol used in making printing ink, (Z): an aliphatic acid used in making vinegar.

---

48 Which of the following choices gives the correct order of the processes needed to convert methane into an organic acid whose salt is used to prevent the growth of fungi? (2nd session 2024)

(A) Halogenation – adding a base with heating – oxidation.

(B) Strong heating then sudden cooling – catalytic hydration – reduction.

(C) Strong heating then sudden cooling – polymerization – halogenation.

(D) Strong heating then sudden cooling – polymerization – alkylation – oxidation.

---

49 The chemical formulas of three carboxylic acids are: (2nd session 2024)

(X): $C_7H_6O_2$, (Y): $C_nH_{2n}O_2$, (Z): $C_7H_6O_3$

Which of the following choices is incorrect?

(A) Acid (Y) is stronger than acid (X).

(B) Acid (X) is sparingly soluble in water.

(C) Acid (Y) is more stable than carbonic acid and liberates it from its salts.

(D) One mole of (Z) reacts with 2 mol of potassium hydroxide.

---

50 Oxidation of the compound $CH_3–CH(CH_3)–CH(CH_3)–CHO$ gives ..... (1st session 2021)

(A) 2,3-dimethylpropanoic acid.

(B) 2,3-dimethylbutanoic acid.

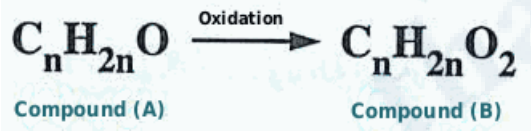
(C) 2,3-diethylbutanoic acid.

(D) 2,4-diethylpropanoic acid.

---

51 From the opposite reaction scheme (which takes place under suitable conditions): (1st session 2022)

compound (B) is .....



(A) an aromatic acid. (B) an ester. (C) a ketone. (D) an aliphatic acid.

---

52 The following table shows the observations when three organic compounds (A), (B), (C) react with three different solutions: (2nd session 2022)

(A) + $KMnO_4$ / H_2SO_4: the violet colour disappears.

(B) + Br_2 / CCl_4: a white precipitate forms.

(C) + $NaHCO_3$: effervescence and CO_2 gas is given off

Which of the following choices is correct?

(A) (A): propanol, (B): carbolic acid.

(B) (A): carbolic acid, (B): propanol.

(C) (B): carbolic acid, (C): propanol.

(D) (A): phenol, (C): propanoic acid.

---

53 The following table shows three solutions of the same concentration: (1st session 2022)

(A): terephthalic acid, (B): hydroiodic acid, (C): ethanoic acid.

The correct order of these solutions by hydrogen ion concentration is .....

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

---

54 (A), (B) are the molecular formulas of two organic acids: (Trial exam / March 2023)

(A): $C_2H_4O_2$, (B): $C_2H_2O_4$

Which of the following choices is correct?

(A) The boiling point of (B) is higher than that of (A).

(B) Reduction of compound (A) gives the simplest alcohol.

(C) Reduction of compound (B) gives a compound used in thermometers.

(D) The solubility of compound (A) in water is higher than that of compound (B).

---

55 When 2-methylpropanoic acid reacts with sodium metal, then the salt produced is heated with soda lime, the product is ..... (Trial exam / March 2023)

(A) 2-methylpropane.

(B) butane.

(C) 2-methylbutane.

(D) propane.

---

56 Lactic acid reacts with sodium; the products of the reaction are ..... (Trial exam / June 2021)

(A) $CH_3–CH(OH)–COONa$ + water

(B) $CH_3–CH(ONa)–COONa$ + hydrogen

(C) $CH_3–CH(ONa)–COONa$ + water

(D) $CH_3–C(Na)(OH)–COOH$ + hydrogen

---

57 The molecular formulas of the following carboxylic acids are: (1st session 2024)

(X): $C_7H_6O_3$, (Y): $C_3H_6O_3$, (Z): $C_8H_6O_4$

Which of the following choices is correct?

(A) (X): an aromatic acid, one mole of which reacts with 2 mol of KOH, (Y): an aliphatic acid that reacts with HCl, (Z): an aromatic acid that does not react with HCl

(B) (X): an aromatic acid that reacts with $FeCl_3$, (Y): an aromatic acid, one mole of which reacts with 2 mol of NaOH, (Z): an aromatic acid, 1 mol of which reacts with 2 mol of KOH

(C) (X): an aliphatic acid that reacts with HCl, (Y): an aliphatic acid insoluble in water, (Z): an aromatic acid, 1 mol of which reacts with 2 mol of KOH

(D) (X): an aromatic acid, one mole of which reacts with 2 mol of KOH, (Y): an aliphatic acid, one mole of which reacts with one mole of KOH, (Z): an aliphatic acid that reacts with HCl

---

58 Three organic compounds (A), (B), (C) are arranged by boiling point as follows: (C) > (B) > (A) (1st session 2024)

Which of the following choices is correct for these compounds?

(A) (B): ethanoic acid, (C): glycerol.
(B) (B): propane, (A): propanol.
(C) (C): ethylene glycol, (B): glycerol.
(D) (A): pentane, (C): butene.

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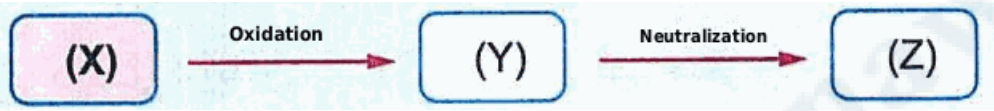
59 When oxalic acid reacts with excess sodium hydroxide, the products of the reaction are ..... (2nd session 2021)

(A) water + HOOC–COONa
(B) water + NaOOC–COONa
(C) hydrogen + NaOOC–COONa
(D) hydrogen + NaOOC–COOH

---

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

Which of the following is correct?



(A) (X): toluene, (Z): methyl chloride.
(B) (X): toluene, (Z): benzoic acid.
(C) (Z): sodium benzoate, (Y): benzoic acid.
(D) (X): methane, (Y): sodium acetate.

---

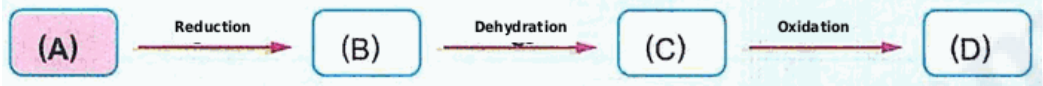
61 You have the two organic compounds $C_6H_6O_2$, $C_8H_6O_4$; both react with ..... (Trial exam / March 2023)

(A) NaOH
(B) Na_2CO_3
(C) C_2H_5OH
(D) HCl

---

62 Study the following scheme: (2nd session 2022)

Given that (C) is an unsaturated aliphatic hydrocarbon, which of the following choices is correct?



(A) (A): propanoic acid, (B): propanol, (C): propene.
(B) (A): ethyl alcohol, (B): acetaldehyde, (D): acetic acid.
(C) (A): propanoic acid, (C): propyne, (D): propanol.
(D) (A): ethyl alcohol, (B): acetic acid, (D): acetaldehyde.

63 The following general formulas are of some hydrocarbon derivatives: (1st session 2023)

(A): $C_nH_{2n}O_2$, (B): $C_nH_{2n+2}O_2$

Which of the following is correct?

(A) (A): a dihydric alcohol, (B): a carboxylic acid.

(B) (A): a carboxylic acid, (B): a dihydric alcohol.

(C) (A): an ester, (B): a carboxylic acid.

(D) (A): an ester, (B): a monohydric alcohol.

---

64 Which of the following processes are carried out on a monobasic carboxylic acid to convert it into a neutral compound with the same number of oxygen and carbon atoms? (1st session 2023)

(A) Complete reduction – dehydration – oxidation.

(B) Neutralization – dry distillation – halogenation.

(C) Complete reduction – dehydration – catalytic hydration.

(D) Esterification – basic hydrolysis – dry distillation.

---

65 (X), (Y), (Z) are three compounds: (1st session 2023)

(X): an organic compound with the fewest carbon atoms, used in making insecticides.

(Y): an inorganic compound used as an insecticide.

(Z): an organic compound used as a raw material in making artificial silk.

Which of the following choices is correct?

(A) (X): acetic acid, (Y): manganese sulphate, (Z): gammexane.

(B) (X): formic acid, (Y): copper sulphate, (Z): acetic acid.

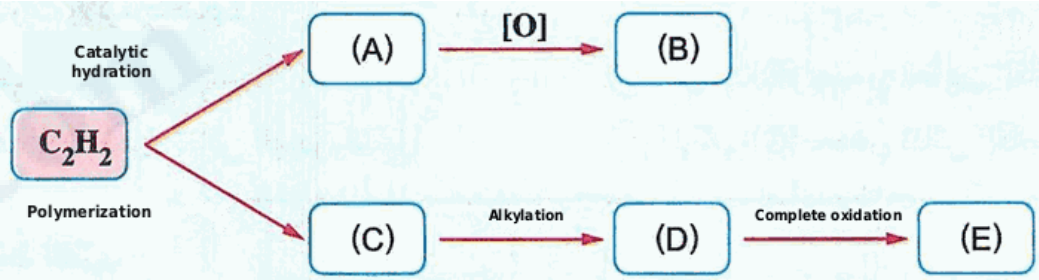
(C) (X): gammexane, (Y): copper sulphate, (Z): acetic acid.

(D) (X): formic acid, (Y): manganese sulphate, (Z): gammexane.

---

66 From the following scheme: (Trial exam / March 2023)

Which of the following is correct?



(A) (B): sparingly soluble in water, (E): used in making insecticides.

(B) (B): used in making silk, (E): its salt is used as a food preservative.

(C) (B): prevents the growth of bacteria, (E): used in cosmetics.

(D) (B): used in making insecticides, (E): prevents the growth of fungi.

---

67 The dry distillation of the sodium salt of citric acid with soda lime produces ..... (1st session 2023)

(A) propanal. (B) propane. (C) 1-propanol. (D) 2-propanol.

---

68 From the following scheme: (2nd session 2023)

Which of the following choices is correct?



(A) Compound (B) is a symmetrical alkene.

(B) Compound (C) is a monobasic acid.

(C) Compound (A) is a dihydric alcohol.

(D) Compound (C) is a dibasic acid.

---

69 (A), (B), (C) are three hydrocarbon derivatives, and the following table shows the results of adding some reagents: (2nd session 2023)

$Na_2CO_3(s)$: (A) no reaction, (B) CO_2 gas is given off, (C) CO_2 gas is given off

Acidified $K_2Cr_2O_7(aq)$: (A) the colour changes, (B) no change, (C) no change

$FeCl_3(aq)$: (A) no change, (B) no change, (C) the colour changes

Which of the following choices is correct?

(A) (A): $C_7H_6O_3$, (B): $C_2H_4O_2$, (C): C_2H_5OH

(B) (A): $C_2H_4O_2$, (B): C_2H_5OH, (C): $C_7H_6O_3$

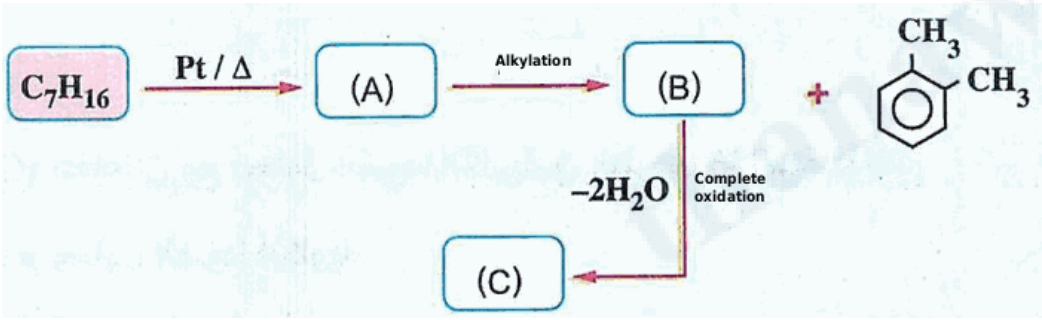
(C) (A): C_2H_5OH, (B): $C_7H_6O_3$, (C): $C_2H_4O_2$

(D) (A): C_2H_5OH, (B): $C_2H_4O_2$, (C): $C_7H_6O_3$

---

70 From the following scheme: (1st session 2023)

Which of the following choices is correct?



(A) (A): used in preparing benzoic acid, (C): a raw material for preparing Bakelite.

(B) (A): used in preparing explosives, (C): a raw material for making artificial heart valves.

(C) (A): an aromatic acid, (C): a raw material for preparing Dacron fabric.

(D) (A): an aliphatic hydrocarbon, (C): an aromatic carboxylic acid.

---

71 Compounds (A), (B) are aromatic organic compounds; the molecular formula of compound (A) is C_6H_6O and of compound (B) is $C_7H_6O_3$ (Trial exam / June 2021)

Both compounds (A), (B) react with .....

(A) sodium hydroxide.

(B) sodium carbonate.

(C) ethyl alcohol.

(D) hydrochloric acid.

---

72 Compounds (A), (B) are organic compounds that have in common that each of them reacts with NaOH (1st session 2021)
Which of the following is correct?

(A) The molecular formula of compound (A) is C_6H_6O, and of compound (B) is C_2H_6O

(B) Compound (A) is methyl alcohol, compound (B) is acetic acid.

(C) Compound (A) is isopropyl alcohol, compound (B) is phenol.

(D) The molecular formula of compound (A) is C_6H_6O, and of compound (B) is $C_7H_6O_3$

---

73 The correct order of the steps to obtain an alkane from an alkyne is ..... (Trial exam / May 2021)

(A) Oxidation – dry distillation – neutralization with NaOH – catalytic hydration.

(B) Dry distillation – neutralization with NaOH – catalytic hydration – oxidation.

(C) Catalytic hydration – oxidation – neutralization with NaOH – dry distillation.

(D) Neutralization with NaOH – dry distillation – catalytic hydration – oxidation.

---

74 The processes that lead to obtaining acetic acid from sodium acetate under suitable conditions are ..... (1st session 2022)

(A) Strong heating then rapid cooling – combustion – catalytic hydration – reduction.

(B) Dry distillation – strong heating then rapid cooling – catalytic hydration – oxidation.

(C) Dry distillation – catalytic hydration – reduction.

(D) Strong heating – catalytic hydration – oxidation.

---

75 The correct order of the processes needed to obtain ethanoic acid from the simplest aliphatic compound ..... (2nd session 2022)

(A) Heating then rapid cooling – catalytic hydration – reduction.

(B) Halogenation – hydrolysis – oxidation.

(C) Heating then rapid cooling – catalytic hydration – oxidation.

(D) Halogenation – hydrolysis – combustion.

---

76 Benzoic acid can be obtained starting from a saturated aliphatic compound by ..... (Trial exam / June 2021)

(A) reforming, then oxidation.

(B) polymerization, then oxidation.

(C) polymerization, then hydrogenation.

(D) oxidation, then halogenation.

77 From the opposite scheme: (1st session 2021)
compound (C) is .....



(A) $C_6H_6O_2$ (B) $C_7H_6O_2$ (C) $C_7H_6O_3$ (D) $C_6H_8O_3$

78 Meta-chlorobenzoic acid can be obtained from ethyne by the following processes ..... (2nd session 2021)

(A) polymerization, then oxidation, then halogenation, then alkylation.
(B) polymerization, then alkylation, then oxidation, then halogenation.
(C) alkylation, then polymerization, then halogenation, then oxidation.
(D) oxidation, then polymerization, then halogenation, then alkylation.

79 To obtain the simplest aromatic compound from the aromatic compound with the formula C_7H_8 (1st session 2021)
the correct order of the processes needed is .....

(A) neutralization, oxidation, dry distillation.
(B) oxidation, dry distillation, neutralization.
(C) neutralization, dry distillation, oxidation.
(D) oxidation, neutralization, dry distillation.

80 To obtain a monobasic aromatic organic acid from an aromatic compound. (2nd session 2021)
the steps needed, in order, are .....

(A) reduction, then alkylation, then oxidation.
(B) nitration, then alkylation, then reduction.
(C) reduction, then halogenation, then hydrolysis.
(D) nitration, then halogenation, then oxidation.

81 Which of the following compounds forms 2,2-dimethylpropane by its dry distillation? (2nd session 2023)

(A) Sodium pentanoate.
(B) Sodium hexanoate.
(C) Sodium 3,3-dimethylbutanoate.
(D) Sodium 2,2-dimethylpropanoate.

82 The compounds (A), (B), (C) are: (2nd session 2023)

(A): $C_2H_4O_2$, (B): $C_3H_5(OH)_3$, (C): $C_2H_2O_4$

The order of the compounds by the number of hydrogen bonds between every two molecules of each is .....

(A) A < C < B (B) C < B < A (C) B < A < C (D) A < B < C

83 (A), (B) are two organic compounds with the general formulas: (2nd session 2023)

(A): C_nH_{2n}, (B): C_nH_{2n-2}

When each of them separately undergoes catalytic hydration, then complete oxidation, we obtain a compound with the general formula .....

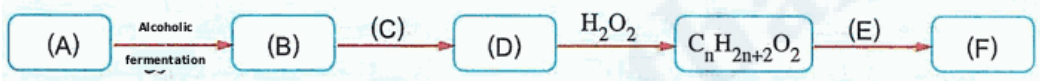
(A) $C_nH_{2n}O_2$ (B) $C_nH_{2n}O$ (C) $C_nH_{2n+2}O_2$ (D) $C_nH_{2n+2}O$

84 Study the following scheme: (Sample exam 2026)

Given that (F) is a dibasic carboxylic acid:

(1) Write the name of each of the organic compounds (A) and (D).

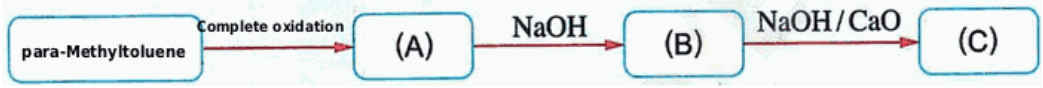
(2) State the name of the processes (C) and (E).



85 Study the following scheme, then answer the following questions: (Sample exam 2026)

(1) Write the structural formulas of compounds (A), (B), (C).

(2) Write one use of compound (A).

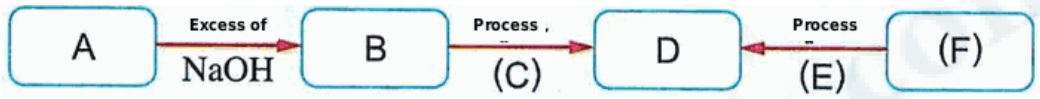


86 From the following scheme: (Sample exam 2026)

Given that the organic compound (A) is used as a preservative for frozen fruits, and the organic compound (F) is produced from the catalytic hydration of propyne:

(1) Write the structural formulas of compounds (B) and (D).

(2) Write the name of each of the chemical processes (C) and (E).

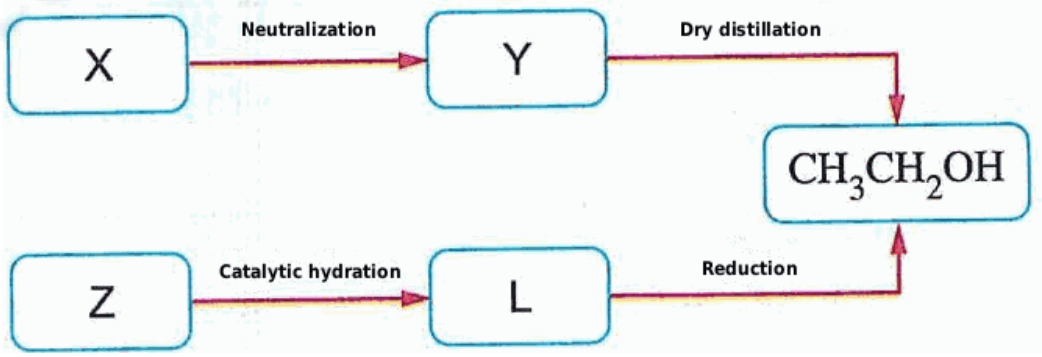


87 The following scheme represents some reactions of organic compounds: (Sample exam 2026)

(1) State the IUPAC name of the isomer of the compound produced by adding excess HBr to compound (Z).

(2) State the IUPAC name of the product of reducing compound (X).

(3) Write the structural formulas of compounds (Y) and (L).



Answer key and solutions

Multiple choice questions

1 D	2 C	3 B	4 C	5 D	6 C	7 D	8 D	9 A	10 A
11 C	12 C	13 C	14 A	15 B	16 C	17 C	18 B	19 B	20 C
21 A	22 B	23 D	24 C	25 D	26 C	27 B	28 D	29 A	30 C
31 D	32 B	33 B	34 B	35 D	36 A	37 C	38 B	39 D	40 D
41 C	42 D	43 D	44 B	45 A	46 A	47 C	48 B	49 C	50 C
51 D	52 D	53 D	54 C	55 D	56 D	57 A	58 C	59 C	60 B
61 C	62 D	63 D	64 C	65 B	66 B	67 C	68 B	69 D	70 C
71 B	72 C	73 C	74 C	75 A	76 B	77 D	78 C	79 D	80 B
81 C	82 D	83 D	84 C	85 B	86 C	87 D	88 D	89 C	90 C
91 B	92 C	93 C	94 D	95 B	96 A	97 B	98 B	99 B	100 C
101 B	102 A	103 A	104 B	105 A	106 C	107 B	108 D	109 C	110 A
111 D	112 B	113 A	114 B						

1 **Answer (D)**

HCOOH (formic acid) is a weak organic acid; the others are strong mineral acids.

2 **Answer (C)**

pH = 3.37 for a 0.01 M solution means that $[H^+]$ is much less than the acid concentration. So the acid is weakly ionized, which is CH_3COOH (the other acids are strong and completely ionized).

3 **Answer (B)**

The functional group of organic acids is the carboxyl group –COOH

4 **Answer (C)**

Carboxyl group = a carbonyl group (C=O) attached to a hydroxyl group (OH); it is found in organic acids.

5 **Answer (D)**

Propanoic acid CH_3CH_2COOH contains a carboxyl group.

Picric acid is a phenol, propanone is a ketone and propanol is an alcohol.

6 **Answer (C)**

Attaching –COOH directly to the benzene ring (C_6H_5-) gives an aromatic acid such as benzoic acid.

7 **Answer (D)**

R is an alkyl group, so the aliphatic acid is R–COOH (Ar is an aromatic aryl group).

8 **Answer (D)**

A saturated monobasic aliphatic acid = an alkyl group C_nH_{2n+1} attached to a –COOH group

9 **Answer (A)**

Oxalic acid $(COOH)_2$ has two carboxyl groups, so it is dibasic.

10 **Answer (A)**

Phthalic acid: the two carboxyl groups are on two neighbouring carbon atoms of the ring (positions 1, 2).

11 **Answer (C)**

Phthalic acid has two carboxyl groups attached to a benzene ring, so it is dibasic aromatic.

12 **Answer (C)**

$C_7H_6O_3$ is salicylic acid (aromatic).

It contains two functional groups: –COOH and the phenolic –OH.

13 **Answer (C)**

The saturated alkyl group with 17 carbon atoms is $C_{17}H_{35}$

Hydrogen atoms missing = 35 − 29 = 6

Each C=C bond removes two hydrogen atoms, so the number of bonds = 6 ÷ 2 = 3

14 **Answer (A)**

Palmitic acid, extracted from palm oil, has the formula $CH_3(CH_2)_{14}COOH$

15 **Answer (B)**

$CH_3(CH_2)_{14}COOH$ is palmitic acid (its common name).

16 **Answer (C)**

The acid found in butter is butyric acid C_3H_7COOH (4 carbon atoms).

Its corresponding alkane is butane.

17 **Answer (C)**

$H_2C{=}CH{-}COOH$: a chain of 3 carbon atoms with a double bond, so it is propenoic acid.

18 **Answer (B)**

The longest chain containing the carboxyl carbon has 3 atoms, and the methyl group is on carbon atom number 2

Name: 2-methylpropanoic acid.

19 **Answer (B)**

Numbering starts from the carbon of the –COOH group, so the chlorine atom is on carbon atom number 3

Name: 3-chlorobutanoic acid.

20 **Answer (C)**

The acid that has no $-CH_2-$ group is $(CH_3)_3C{-}COOH$

Name: 2,2-dimethylpropanoic acid.

21 **Answer (A)**

$CH_3{-}CH(CH_3){-}CH(C_6H_5){-}CH_2{-}COOH$

Numbering from the –COOH carbon: the phenyl group is on carbon 3 and the methyl group on carbon 4

Name: 4-methyl-3-phenylpentanoic acid.

22 **Answer (B)**

The $C_4H_8O_2$ acids are: butanoic acid $CH_3CH_2CH_2COOH$ and 2-methylpropanoic acid $CH_3CH(CH_3)COOH$

Their number is 2

23 **Answer (D)**

Oxidation of ethene with $KMnO_4$ solution in an alkaline medium gives ethylene glycol, not acetic acid.

24 **Answer (C)**

C_nH_{2n-2} is an alkyne; its catalytic hydration gives $C_nH_{2n}O$

Ethyne gives ethanal, and its oxidation gives ethanoic acid $C_nH_{2n}O_2$

(Propyne gives acetone, not propanal).

25 **Answer (D)**

Compound (1) is a primary alcohol; its functional group is $-CH_2OH$

Its oxidation gives an aldehyde (2) whose functional group is formyl $-CHO$

Then oxidation of the aldehyde gives 3-methylbutanoic acid (3).

26 **Answer (C)**

CH_2O_2 is formic acid, which is a liquid, not a gas.

27 **Answer (B)**

Ethanoic acid molecules are linked by more hydrogen bonds than ethanol, so its boiling point is higher.

Propane, ether and ethene do not form hydrogen bonds.

28 **Answer (D)**

CH_3OCH_3 (an ether) has no OH group, so its molecules do not form hydrogen bonds.

29 **Answer (A)**

Each ethanoic acid molecule is linked to another molecule by two hydrogen bonds, so the number of bonds is the greatest.

30 **Answer (C)**

Oxalic acid COOH–COOH has two carboxyl groups, so it forms the greatest number of hydrogen bonds.

31 **Answer (D)**

The number of hydrogen bonds increases as the number of polar OH groups increases.
Ethanol (one OH) is the least, then ethanoic acid, then glycerol (3 OH), then sorbitol (6 OH) the greatest.

32 **Answer (B)**

(A) is not affected by acidified $KMnO_4$: a tertiary alcohol (2-methyl-2-propanol).
(B) every two molecules form two hydrogen bonds: ethanoic acid.
(C) does not react with NaOH: ethylene glycol.

33 **Answer (B)**

Ethylene glycol has two OH groups, so it forms many hydrogen bonds and its boiling point (197°C) is the highest.

34 **Answer (B)**

Boiling point: butanoic acid is higher than butanol, and butanol is higher than butanal.
(The acid forms more hydrogen bonds, and the aldehyde does not form hydrogen bonds between its molecules).

35 **Answer (D)**

The stronger the acid, the lower the pH and the higher the pOH
Order: H_2CO_3 (weakest), then CH_3COOH, then HNO_3, then H_2SO_4 (strong dibasic).

36 **Answer (A)**

Ethene is a non-polar hydrocarbon that does not form hydrogen bonds with water, so it does not dissolve in it.

37 **Answer (C)**

C_3H_7COOH has a carboxyl group that forms hydrogen bonds with water, so its solubility is the highest.

38 **Answer (B)**

Acetic acid is completely soluble (100 g), phenol is sparingly soluble (8.2 g), and the hydrocarbon C_7H_{14} is almost insoluble (0.003 g).

39 **Answer (D)**

C_4H_{10} and C_3H_7COOH both have 4 carbon atoms.
So burning 1 mol of each of them produces 4 mol CO_2

40 **Answer (D)**

The compound is a dibasic acid with a C=C bond, so it decolourizes bromine water and undergoes addition polymerization.

But its solution does not react with copper (copper comes after hydrogen in the electrochemical series).

41 **Answer (C)**

A carboxylic acid reacts with NaOH, forming an ionic salt that dissolves in water.

42 **Answer (D)**

$CH_3CH(OH)COOH$ has two active hydrogen atoms (OH and COOH).

So one mole of it gives 1 mol H_2 with sodium, while each of the others gives 0.5 mol

43 **Answer (D)**

Ethanal has no active hydrogen atom, so it does not react with sodium.

44 **Answer (B)**

The compound has 4 –COOH groups; every two groups give 1 mol H_2

Number of moles of H_2 = 4 ÷ 2 = 2 mol

45 **Answer (A)**

The compound (tartaric acid) has only two carboxyl groups that react with NaOH

The two alcoholic OH groups do not react with NaOH, so 2 mol are needed

46 **Answer (A)**

NaOH reacts only with the two –COOH groups and does not react with the two alcoholic OH groups.

Product: NaOOC–CH(OH)–CH(OH)–COONa

47 **Answer (C)**

3-Hydroxypropanoic acid reacts with HCl as an alcohol (OH group), and with NaOH as an acid (COOH group).

48 **Answer (B)**

The acid (tartaric acid) has only two –COOH groups that react with KOH

So it gives the mono-salt $C_4H_5O_6K$ or the di-salt $C_4H_4O_6K_2$

49 **Answer (C)**

(1) KOH(aq) converts C_2H_5Cl into (2) C_2H_5OH

Oxidation of ethanol gives (3) CH_3COOH, and with NaOH (4) it gives (5) CH_3COONa

Dry distillation with soda lime (6) (CaO + NaOH) gives CH_4

50 **Answer (C)**

Neutralization: $CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

Dry distillation: $CH_3COONa + NaOH \rightarrow CH_4 + Na_2CO_3$

Substitution: $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

51 **Answer (D)**

(X) reacts with Na_2CO_3, so it is a carboxylic acid.

(Y) reacts with HCl, so it is an alcohol.

(Z) reacts with Na only, so it is a phenol.

52 **Answer (D)**

(1) alkene, (2) dialkyl halide, (3) diol, (4) acid (effervescence with Na_2CO_3).

The alkyl halide (2) reacts by substitution with KOH(aq), and the acid (4) replaces the hydrogen of its group with Na_2CO_3

53 **Answer (D)**

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

$2C_2H_5OH \rightarrow 2CH_3COOH$, then $2CH_3COOH + Na_2CO_3 \rightarrow 2CH_3COONa + H_2O + CO_2$

$2CH_3COONa \rightarrow 2CH_4$ (by dry distillation)

$CH_4 : CO_2 = 2 : 3$

54 **Answer (C)**

In all the reactions of acetic acid as an acid (with metals, bases and carbonates) the salt of the acid is formed.

55 **Answer (D)**

Magnesium sulphate is a salt of a strong acid (H_2SO_4), so it does not react with the weak acetic acid.

56 **Answer (D)**

Both have an active hydrogen atom, so they react with sodium and H_2 is given off

(Ethanol does not react with sodium bicarbonate).

57 **Answer (A)**

The compound has three active hydrogen atoms (a –COOH group and two OH groups).

So one mole of it reacts with 3 mol of potassium.

58 **Answer (C)**

$(C_3H_7COO)_2Ca$ is a salt of butanoic acid C_3H_7COOH

59 **Answer (C)**

(X) is an unsaturated alcohol, and (Y) is a carboxylic acid (it also has an OH group).

Sodium bicarbonate reacts with (Y) only, and CO_2 effervescence occurs

60 **Answer (B)**

Only the –COOH group must react, not the alcoholic OH group.

Na_2CO_3 and NaOH react with –COOH only, while Na reacts with both groups.

61 **Answer (C)**

Butanoic acid $CH_3CH_2CH_2COOH + CH_3OH \rightarrow CH_3CH_2CH_2COOCH_3 + H_2O$

The ester produced: methyl butanoate, as in (C).

62 **Answer (D)**

The acid (HOOC–CH=CH–COOH) is dibasic, so one mole of it reacts with 2 mol of ethanol.

Its molar mass = $4\times12 + 4\times1 + 4\times16 = 116$ g/mol

63 **Answer (D)**

They have the same concentration, but HCl is strong and CH_3COOH is weak, so their pH values are different.

Both react with carbonates, and both react with ethanol.

64 **Answer (C)**

$CH_3CH_2CH_2COO–$ comes from butanoic acid, and $–CH_2CH_2CH_3$ from 1-propanol.

65 **Answer (B)**

(W) alcoholic fermentation of glucose → ethanol.

(X) oxidation of ethanol → ethanoic acid.

(Y) esterification with butanol → butyl ethanoate, (Z) neutralization with NaOH → sodium ethanoate.

66 **Answer (B)**

Reduction of the acid with hydrogen gives the alcohol and water:

$C_2H_5COOH + 2H_2 \rightarrow C_3H_7OH + H_2O$

67 **Answer (C)**

Reduction of a carboxylic acid gives the aldehyde and then the primary alcohol.

Butanoic acid → butanal.

68 **Answer (B)**

$C_{18}H_{32}O_2 = C_{17}H_{31}COOH$, the saturated group is $C_{17}H_{35}$, 4 H atoms are missing, i.e. two C=C bonds

One mole needs 2 mol H_2, so 3 mol need 6 mol

69 **Answer (D)**

(A) ethanol, (B) sodium ethoxide, (C) diethyl ether.

Ethanol does not react with NaOH, so statement (D) is wrong.

70 **Answer (C)**

An organic acid is detected by sodium bicarbonate, and also by its reaction with ethanol forming an ester with a characteristic smell.

71 **Answer (B)**

Phenolphthalein is colourless in neutral and acidic solutions, so it does not distinguish between them.

72 **Answer (C)**

Chromic acid oxidizes 1-propanol to propanoic acid, and 2-propanol to acetone.

Only propanoic acid reacts with Na_2CO_3 and CO_2 is given off

73 **Answer (C)**

The most stable vanadium oxide is V_2O_5, and it is used as a catalyst in the oxidation of toluene to benzoic acid.

74 **Answer (C)**

Vanadium is used in making superconducting magnets, and its oxide V_2O_5 is a catalyst in converting toluene into benzoic acid.

75 **Answer (A)**

Alkylation of benzene (Friedel-Crafts) gives toluene, and its oxidation gives benzoic acid.

76 **Answer (B)**

(X) is phenol (used in making Bakelite).

Its reduction with zinc gives benzene, then alkylation → toluene, then oxidation → benzoic acid $C_7H_6O_2$

77 **Answer (D)**

(1) Replacing an H of the ring by Cl gives ortho, meta and para: 3 isomers.

(2) Its nitration gives the explosive TNT, (3) its oxidation gives benzoic acid.

78 **Answer (C)**

Phenol is more acidic than ethanol, and less acidic than carboxylic acids and HCl

79 **Answer (D)**

Benzoic acid ($Ka = 6.5 \times 10^{-5}$) is stronger than acetic acid ($Ka = 1.8 \times 10^{-5}$) and than phenol and ethanol.

80 **Answer (B)**

Acid strength increases as Ka increases

Acetic (1.8×10^{-5}), then benzoic (6.5×10^{-5}), then formic (1.8×10^{-4}), then oxalic (5.9×10^{-2}).

81 **Answer (C)**

The acid has a C=C bond, so it reacts with bromine in CCl_4, and the –COOH group reacts with methanol (esterification).

It does not react with ethane.

82 **Answer (D)**

Phenol is a very weak acid that does not react with sodium carbonate and does not liberate CO_2

83 **Answer (D)**

$NaHCO_3$ replaces the hydrogen atom (–H) of the carboxyl group and sodium benzoate is formed.

84 **Answer (C)**

(1) phenol, (2) ethanol, (3) benzoic acid (largest Ka).

Ethanol and benzoic acid both react with sodium.

85 **Answer (B)**

The compound has a C=C bond outside the ring, so it reacts with bromine dissolved in CCl_4 (Complete hydrogenation needs 4 mol H_2, not 5, and it does not react with acetic acid).

86 **Answer (C)**

Excess NaOH reacts with both the –COOH group and the phenolic OH group of salicylic acid. Product: COONa and ONa on the ring, as in (C).

87 **Answer (D)**

The compound is a carboxylic acid; its reaction with 1-propanol is esterification, giving an ester and water, not a salt.

88 **Answer (D)**

C_6H_5Cl reacts with NaOH under suitable conditions (giving phenol).

C_6H_6O is phenol, $C_7H_6O_2$ is benzoic acid, $C_6H_6O_2$ is a dihydric phenol, and all of them react with NaOH

89 **Answer (C)**

Benzene + CH_3Cl / $AlCl_3$ (1) → toluene (2); its oxidation (3) with oxygen → benzoic acid (4) Then bromination (5) → meta-bromobenzoic acid.

90 **Answer (C)**

Alkylation → toluene, oxidation → benzoic acid, substitution (chlorination) → meta-chlorobenzoic acid (the COOH group directs to meta).

91 **Answer (B)**

Oxidation of toluene → benzoic acid, neutralization → sodium benzoate, dry distillation → benzene.

92 **Answer (C)**

(1) catalytic reforming → toluene, (2) oxidation → benzoic acid (monobasic) + water
(3) neutralization with NaOH → sodium benzoate, (4) dry distillation → benzene.

93 **Answer (C)**

C_7H_8 (toluene) is oxidized to benzoic acid.

Benzoic acid + ROH in the presence of dry HCl → ester (B) + water.

94 **Answer (D)**

C_2H_2 → benzene (A) → toluene (B) → benzoic acid (C)

C_2H_2 → ethanal (D) → ethanol (E)

C + E → ethyl benzoate (an aromatic ester) + water.

95 **Answer (B)**

Benzoic acid reacts with $NaHCO_3$ and CO_2 is given off, while carbolic acid (phenol) does not react.

96 **Answer (A)**

An ant sting injects the body with formic acid.

97 **Answer (B)**

The compound is (glacial) acetic acid.

Its complete reduction gives ethanol, which is a primary alcohol, not a secondary one.

98 **Answer (B)**

Its melting point is 122°C, so it is a solid at room temperature, and it is sparingly soluble in water.

99 **Answer (B)**

The number of sigma bonds in the alkane C_nH_{2n+2} = 3n + 1 = 22, n = 7 (heptane).

The salt that prevents fungi is sodium benzoate.

Heptane → (catalytic reforming) toluene → (oxidation) benzoic acid → (neutralization) sodium benzoate.

100 **Answer (C)**

Citric acid has 3 carboxyl groups, so one mole of it reacts with 3 mol NaOH

101 **Answer (B)**

The compound is citric acid, and its solution is acidic with pH less than 7

102 **Answer (A)**

The compound is citric acid, which is tribasic, so one mole of it reacts with 3 mol NaOH, not 4

103 **Answer (A)**

Citric acid is added to foods to keep their colour and lower the pH

Number of moles = 19.2 ÷ 192 = 0.1 mol

It is a tribasic acid, so moles of NaOH = 0.1 × 3 = 0.3 mol

104 **Answer (B)**

(1) The primary reagent of the thiosulphate anion is dilute HCl; it reacts with the alcoholic OH group, producing 1 mol H_2O

(2) The confirmatory reagent of the Al^{3+} cation is NaOH; it reacts with the 3 COOH groups, producing 3 mol H_2O

105 **Answer (A)**

Lactic acid $C_3H_6O_3$ = 90 g/mol and has 3 carbon atoms = 36 g

Percentage = (36 / 90) × 100%

106 **Answer (C)**

Lactic acid has an OH group (reacts with HCl) and a COOH group (reacts with NaOH).

107 **Answer (B)**

The acid produced by strenuous effort is lactic acid (monobasic).

2 mol of it react with 2 mol NaOH

108 **Answer (D)**

109 **Answer (C)**

Salicylic acid $C_7H_6O_3$ and lactic acid $C_3H_6O_3$ both have 3 oxygen atoms.

110 **Answer (A)**

(A) vitamin C (ascorbic acid) is found in green pepper.

(B) salicylic acid reacts as an acid or a phenol.

(C) acetic acid is reduced to ethanol (a primary alcohol).

111 **Answer (D)**

Aminoethanoic acid (glycine) dissolves in water, so it is not sparingly soluble.

112 **Answer (B)**

Protein is a natural polymer, while Teflon and Bakelite are synthetic polymers.

113 **Answer (A)**

Protein is a natural polymer whose basic units are amino acids.

114 **Answer (B)**

Glycine is $H_2N–CH_2–COOH$, so group (X) is $–NH_2$

Its reaction with $NaNO_2$ / HCl converts it into –OH (glycolic acid), so group (Y) is –OH

Essay questions

1 **Model answer**

(1) 3-Ethyl-3-methylhexanoic acid.

(2) 2-Ethylhexanoic acid.

2 **Model answer**

(1) 2,3-Dimethylbutanoic acid.

(2) 3-Nitrobenzoic acid (meta-nitrobenzoic acid).

3 **Model answer**

(1) A benzene ring carrying a –COOH group and, in the para position, an $–NO_2$ group: $p\text{-}NO_2–C_6H_4–COOH$

(2) Oxalic acid: HOOC–COOH

4 **Model answer**

(1) The acid is benzoic acid:

$C_6H_5COOH \rightleftharpoons C_6H_5COO^- + H^+$

$Ka = [C_6H_5COO^-][H^+] / [C_6H_5COOH]$

(2) $C_6H_5COONa + NaOH \rightarrow C_6H_6 + Na_2CO_3$ (by heating in the presence of CaO)

5 **Model answer**

Liquid (A) is the only one that decolourizes bromine water: (A) hexene.

Liquid (B) is the only one that reacts with sodium carbonate: (B) ethanoic acid.

Liquid (C) dissolves in water: (C) ethanol.

So liquid (D): pentane.

6 **Model answer**

(1) The amides series.

(2) Observation: the colour of bromine water disappears.

Explanation: bromine water is consumed in breaking the (C=C) bond.

Structural formula of the compound produced: $CH_2Br–CHBr–COOH$

7 **Model answer**

The oxide is V_2O_5

(1) $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ (in the presence of V_2O_5 at 450°C)

(2) $2C_6H_5CH_3(l) + 3O_2(g) \rightarrow 2C_6H_5COOH(aq) + 2H_2O(v)$ (in the presence of V_2O_5 at 400°C)

8 **Model answer**

$CH_3COOH(aq) + NaHCO_3(s) \rightarrow CH_3COONa(aq) + H_2O(l) + CO_2(g)$

84 g of $NaHCO_3$ give 22.4 L of CO_2

Volume of gas given off = $22.4 \times 17 \div 84 = 4.53$ L

9 **Model answer**

(1) CH_3COOH

(2) CH_4

10 **Model answer**

Descending order of pH: sodium ethoxide, then ethanol, then acetic acid, then hydrochloric acid.

Explanation:

CH_3CH_2ONa dissolves in water forming NaOH, a strong alkali (pH greater than 7).

C_2H_5OH: its solution is neutral (pH = 7).

CH_3COOH is a weak acid (pH slightly less than 7).

HCl is a strong acid (pH approaches 0).

11 **Model answer**

Descending order of acid strength: benzoic acid, then acetic acid, then phenol, then ethanol.

Explanation: carboxylic acids are among the most acidic organic substances, and benzoic acid is an aromatic acid with a stronger acidic character than aliphatic acids such as acetic acid, and the weak acidity of phenol is greater than that of ethanol.

12 **Model answer**

Ascending order of boiling point: diethyl ether, then ethanol, then ethanoic acid.

Explanation:

$C_2H_5OC_2H_5$ does not form hydrogen bonds between its molecules.

C_2H_5OH: every two molecules form one hydrogen bond.

CH_3COOH: each molecule forms two hydrogen bonds with the other molecule.

Past exam questions

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

1 **Answer (C)**

(A) is lactic acid; it is neutralized by NaOH giving sodium lactate (B).

Its dry distillation (C) gives ethanol (D) $C_nH_{2n+2}O$

Complete oxidation of ethanol gives ethanoic acid (E) $C_nH_{2n}O_2$

2 **Answer (D)**

Ethyne + H_2O (catalytic hydration) → acetaldehyde → (oxidation) acetic acid → (neutralization) sodium acetate.

Dry distillation → methane → (thermal cracking) carbon black, used in printing inks.

3 **Answer (A)**

The alcohol (C_9) → (oxidation) acid → (neutralization) salt → (dry distillation) C_8 alkane (2,3-dimethylhexane).

Catalytic reforming gives ortho-xylene (two neighbouring methyl groups), and hydrogenation gives 1,2-dimethylcyclohexane.

So the alcohol is 3,4-dimethyl-1-heptanol.

4 **Answer (B)**

The preservative is sodium benzoate.

Hexane → (catalytic reforming) benzene → (alkylation) toluene → (oxidation) benzoic acid → (neutralization) sodium benzoate.

5 **Answer (C)**

Methane → (strong heating and sudden cooling) acetylene → (trimerization) benzene.

Benzene → (alkylation) toluene → (oxidation) benzoic acid.

6 **Answer (D)**

The first is an alcohol, the second a carboxylic acid and the third a phenol.

Phenol is not prepared by oxidation of an alcohol, so statement (D) is wrong.

7 **Answer (A)**

(A) is ethanol and (B) is salicylic acid.

Both are used in medical fields.

8 **Answer (C)**

2-Bromo-2-propanol: the carbon atom attached to OH carries no hydrogen (like a tertiary alcohol), so it is not oxidized.

The others are primary or secondary alcohols that are oxidized.

9 **Answer (D)**

Acetylene → (catalytic hydration) acetaldehyde → (oxidation) acetic acid.

→ (neutralization) sodium acetate → (dry distillation) methane.

10 **Answer (B)**

Sodium pentanoate → (NaOH, CaO) butane → (Cl_2) 1-chlorobutane.

→ (KOH) 1-butanol → (oxidation) butanoic acid.

11 **Answer (B)**

RX → (KOH) methyl alcohol → (complete oxidation) formic acid.

C_nH_{2n+2} → (catalytic reforming) toluene → (V_2O_5) benzoic acid.

12 **Answer (A)**

(A) lactic acid $C_3H_6O_3$ (a secondary alcohol that is oxidized).

(B) citric acid $C_6H_8O_7$ (a tertiary alcohol that is not oxidized).

(C) phenol C_6H_6O has no alcoholic group.

13 **Answer (A)**

Propanoic acid → (reduction) propanol → (dehydration) propene (an unsaturated hydrocarbon).

14 **Answer (C)**

Dry distillation of the acid's salt removes one carbon atom (the carboxyl group).

Sodium 3-methylbutanoate → 2-methylpropane.

15 **Answer (D)**

$C_6H_{13}COOH$ → (neutralization) salt → (dry distillation) hexane → (catalytic reforming) benzene.

16 **Answer (B)**

Complete oxidation of the CH_2OH group gives COOH, so the product is salicylic acid.

It is used in preparing medical drugs (aspirin and oil of wintergreen).

17 **Answer (B)**

(Y) reacts with 3 mol NaOH (three COOH groups) and with 1 extra mol of Na (the OH group): citric acid.

It is used to preserve frozen fruits.

18 **Answer (B)**

(A) carbolic acid (phenol): it does not react with carbonates and is not reduced because it has no carboxyl group.

(B) salicylic acid is used in preparing aspirin.

19 **Answer (B)**

(X) ethylene is oxidized to ethylene glycol (used in producing polyester).

(Y) benzoic acid $C_7H_6O_2$ contains COOH and does not follow $C_nH_{2n}O_2$

20 **Answer (D)**

The group made of two groups is the carboxyl group (carbonyl + hydroxyl).

2,2-Dimethylpropanoic acid has the formula $C_5H_{10}O_2$ ((A) has the formula $C_6H_{12}O_2$).

21 **Answer (B)**

The COOH group is on carbon atom number 1, and the two nitro groups are on atoms 2 and 5

22 **Answer (C)**

(X) ethylene glycol, used in making polymers (Dacron).

(Y) oxalic acid $C_2H_2O_4$

23 **Answer (C)**

The acid is acetic acid → (neutralization and dry distillation) methane → acetylene → (trimerization) benzene.

Benzene is an unbranched aromatic hydrocarbon.

24 **Answer (D)**

$C_7H_{15}COOH$ → (neutralization) salt → (dry distillation) heptane → (reforming) toluene → (oxidation) benzoic acid.

25 **Answer (C)**

(C) is glycerol, an alcohol that is oxidized, so it decolourizes permanganate.

(A) is a glycol that does not react with $NaHCO_3$ and gives no colour with $FeCl_3$, and (B) salicylic acid is not oxidized by dichromate.

26 **Answer (D)**

(A) chloroform $CHCl_3$ from the chlorination of methane (an alkane derivative, formerly used as an anaesthetic).

(B) vinyl chloride CH_2=CHCl (an alkene derivative) is used in making PVC, which is used in water hoses.

27 **Answer (B)**

(A) is acetaldehyde and (B) ethanol, and their oxidation gives acetic acid.

Acetic acid is used in making insecticides.

28 **Answer (D)**

(A) glycerol, (B) propylene glycol, (C) acetic acid.

The more OH groups, the more hydrogen bonds and the higher the boiling point: A > B > C

29 **Answer (B)**

(X) salicylic acid: COOH and a phenolic OH, both react with NaOH and Na: 2, 2

(Y) lactic acid: only COOH reacts with NaOH (1), and COOH and OH react with Na (2).

30 **Answer (C)**

(X) halothane $CF_3CHBrCl$ is a hydrocarbon derivative used as a safe anaesthetic.

31 **Answer (C)**

Dry distillation gives ethylbenzene (the ethyl group directs to the ortho and para positions).

Chlorination gives a mixture of ortho- and para-chloroethylbenzene.

32 **Answer (A)**

(X) oxalic acid $(COOH)_2$, (Y) phthalic acid $C_6H_4(COOH)_2$

33 **Answer (D)**

The longest chain including the carboxyl group has 5 carbon atoms (pentanoic).

Atom 2 carries an ethyl and a methyl group, written alphabetically: 2-ethyl-2-methylpentanoic acid.

34 **Answer (C)**

Acetic acid → methane (Y) → (Cl_2) chloromethane (Z).

With benzene it gives toluene (W), and oxidation gives benzoic acid (M).

35 **Answer (B)**

Acids are reduced to alcohols $C_nH_{2n+2}O$

The acid isomers of $C_4H_8O_2$: butanoic acid and 2-methylpropanoic acid = 2

36 **Answer (D)**

(X) ortho-methylphenol is oxidized to salicylic acid.

(Y) methanol is oxidized to formic acid.

37 **Answer (A)**

(A) lactic acid $C_3H_6O_3$ is oxidized to pyruvic acid.

(B) citric acid $C_6H_8O_7$, (C) salicylic acid $C_7H_6O_3$

38 **Answer (D)**

$2HCOOH + Ca(OH)_2 \rightarrow (HCOO)_2Ca + 2H_2O$

$(COOH)_2 + Ca(OH)_2 \rightarrow CaC_2O_4 + 2H_2O$

39 **Answer (B)**

Phenol → (reduction with zinc) benzene → (alkylation) toluene → (oxidation) benzoic acid $C_7H_6O_2$

40 **Answer (B)**

The methyl group directs to ortho and para: 4-nitrotoluene.

The carboxyl group directs to meta: 3-nitrobenzoic acid.

41 **Answer (A)**

(X) tetrafluoroethylene (an alkene derivative) for lining cooking pans (Teflon).

(Y) acetic acid is used in making artificial silk, (Z) Freon (an alkane derivative) is a refrigerant.

42 **Answer (C)**

(X) para-methylphenol is reduced to toluene (Z), and the salt sodium methylbenzoate also gives toluene by dry distillation.

Hydrogenation of toluene gives methylcyclohexane (W).

43 **Answer (B)**

(Z) is chloroethane (from adding HCl to ethylene), so (Y) is ethane.

(X) is sodium propanoate, and (W) ethanol is a primary alcohol.

44 **Answer (B)**

(Y) phenol and (Z) benzoic acid react with NaOH

(X) toluene and (L), a hexahydroxy alcohol, do not react.

45 **Answer (A)**

Dry distillation removes the COONa group and puts H in its place

$CH_3CH(OH)CH_2COONa \rightarrow CH_3CH(OH)CH_3$ (2-propanol).

46 **Answer (C)**

Oxidation of the methyl group in 2-methylphenol gives salicylic acid $C_7H_6O_3$

47 **Answer (A)**

(X) $C_8H_6O_4$ terephthalic acid: aromatic and used in making polyester (Dacron).

(Y) $C_2H_6O_2$ ethylene glycol: a dihydric alcohol.

(Z) $C_2H_4O_2$ acetic acid: an aliphatic acid used in making insecticides.

48 **Answer (D)**

The required acid is benzoic acid (its salt sodium benzoate prevents the growth of fungi).

Methane, by strong heating then sudden cooling, gives acetylene.

Polymerization of acetylene gives benzene, then alkylation gives toluene, then oxidation gives benzoic acid.

49 **Answer (A)**

(X) is benzoic acid and (Y) an aliphatic acid.

Aromatic acids are stronger than aliphatic acids, so statement (A) is incorrect.

(Z) salicylic acid: one mole of it reacts with 2 mol of KOH (the COOH group and the phenolic OH group).

50 **Answer (B)**

Oxidation of the aldehyde converts CHO into COOH without changing the chain.

$CH_3–CH(CH_3)–CH(CH_3)–COOH$: 2,3-dimethylbutanoic acid.

51 **Answer (D)**

$C_nH_{2n}O$ is an aldehyde; by oxidation it gives $C_nH_{2n}O_2$, an aliphatic acid.

52 **Answer (A)**

(A) propanol is oxidized and decolourizes acidified permanganate.

(B) carbolic acid forms a white precipitate with bromine.

(C) propanoic acid reacts with $NaHCO_3$ and CO_2 is given off

53 **Answer (B)**

Hydroiodic acid is a strong, completely ionized mineral acid.

Terephthalic acid (aromatic) is stronger than ethanoic acid (aliphatic).

B > A > C

54 **Answer (A)**

(A) is acetic acid and (B) oxalic acid $(COOH)_2$

Oxalic acid has two carboxyl groups, so it has more hydrogen bonds and a higher boiling point.

55 **Answer (D)**

Dry distillation of the acid's salt with soda lime removes the COO group

$(CH_3)_2CH–COONa \rightarrow (CH_3)_2CH_2$, i.e. $CH_3–CH_2–CH_3$: propane.

56 **Answer (B)**

Sodium reacts with both the COOH group and the alcoholic OH group.

$CH_3–CH(ONa)–COONa$, and hydrogen is given off.

57 **Answer (A)**

(X) salicylic acid: aromatic, one mole of it reacts with 2 mol of KOH

(Y) lactic acid: aliphatic, its alcoholic OH group reacts with HCl

(Z) terephthalic acid: aromatic and does not react with HCl

58 **Answer (A)**

The boiling point of glycerol (C) is higher than that of ethanoic acid (B).

So the order C > B is correct.

59 **Answer (B)**

Oxalic acid is dibasic; with excess NaOH both groups are neutralized.

$(COOH)_2 + 2NaOH \rightarrow (COONa)_2 + 2H_2O$

60 **Answer (C)**

(X) toluene, by oxidation → (Y) benzoic acid.

Neutralization → (Z) sodium benzoate.

61 **Answer (A)**

$C_8H_6O_4$ is terephthalic acid and $C_6H_6O_2$ is catechol (a phenol).

Both are acidic, so they react with NaOH

62 **Answer (A)**

(C) is an alkene produced by removing water from the alcohol (B).

(A) propanoic acid, by reduction → (B) propanol → (C) propene.

63 **Answer (B)**

$C_nH_{2n}O_2$: a carboxylic acid (or an ester).

$C_nH_{2n+2}O_2$: a dihydric alcohol.

64 **Answer (A)**

Complete reduction converts the acid into an alcohol, and dehydration gives an alkene.

Oxidation of the alkene (with permanganate) gives a neutral dihydric alcohol.

It has the same number of carbon and oxygen atoms (2 O) as the acid.

65 **Answer (B)**

(X) formic acid (one carbon atom) is used in making insecticides.

(Y) copper sulphate is an inorganic pesticide.

(Z) acetic acid is a raw material in making artificial silk.

66 **Answer (B)**

C_2H_2 by hydration → (A) acetaldehyde → by oxidation (B) acetic acid (used in making artificial silk).

C_2H_2 by polymerization → (C) benzene → alkylation (D) toluene → oxidation (E) benzoic acid.

The salt of benzoic acid (sodium benzoate) is a food preservative.

67 **Answer (D)**

Citric acid: $HOOC–CH_2–C(OH)(COOH)–CH_2–COOH$

Dry distillation removes the three COO groups.

Product $CH_3–CH(OH)–CH_3$: 2-propanol.

68 **Answer (D)**

Ethanol by dehydration → (A) ethene.

Ethene + H_2O_2 → (B) ethylene glycol.

Complete oxidation → (C) oxalic acid (dibasic).

69 **Answer (D)**

(A) changes the colour of acidified dichromate and does not react with Na_2CO_3: C_2H_5OH

(B) only gives off CO_2: $C_2H_4O_2$ (acetic acid).

(C) gives off CO_2 and changes colour with $FeCl_3$: $C_7H_6O_3$ (salicylic acid).

70 **Answer (B)**

C_7H_{16} (heptane) by reforming → (A) toluene, used in preparing explosives (TNT).

Alkylation → (B) para-xylene, and complete oxidation → (C) terephthalic acid.

Terephthalic acid is a raw material in making Dacron (artificial heart valves).

71 **Answer (A)**

(A) is phenol and (B) salicylic acid.

Both are acidic, so they react with sodium hydroxide.

72 **Answer (D)**

C_6H_6O phenol and $C_7H_6O_3$ salicylic acid react with NaOH

Alcohols do not react with NaOH

73 **Answer (C)**

Hydration of the alkyne → aldehyde, then oxidation → acid.

Neutralization with NaOH → salt, then dry distillation → alkane.

74 **Answer (B)**

Dry distillation of sodium acetate → methane.

Strong heating then rapid cooling → acetylene.

Catalytic hydration → acetaldehyde, and oxidation → acetic acid.

75 **Answer (C)**

The simplest aliphatic compound is methane; by heating then rapid cooling → acetylene.

Catalytic hydration → acetaldehyde, then oxidation → ethanoic acid.

76 **Answer (A)**

Reforming of heptane gives toluene.

Oxidation of toluene gives benzoic acid.

77 **Answer (B)**

Polymerization of C_2H_2 → (A) benzene, alkylation → (B) toluene.

Oxidation → (C) benzoic acid $C_7H_6O_2$

78 **Answer (B)**

Polymerization of ethyne → benzene, then alkylation → toluene.

Oxidation → benzoic acid, and the COOH group directs to the meta position.

Then halogenation → meta-chlorobenzoic acid.

79 **Answer (D)**

Oxidation of toluene → benzoic acid.

Neutralization → sodium benzoate, then dry distillation → benzene.

80 **Answer (A)**

Reduction of phenol (with zinc dust) → benzene.

Alkylation → toluene, then oxidation → benzoic acid.

81 **Answer (C)**

Dry distillation removes the COO group from the acid's salt.

$(CH_3)_3C–CH_2–COONa$ → $(CH_3)_3C–CH_3$: 2,2-dimethylpropane.

82 **Answer (D)**

Acetic acid (A) has one COOH group.

Glycerol (B) has 3 OH groups, and oxalic acid (C) has two COOH groups

A < B < C

83 **Answer (A)**

Hydration of the alkene gives an alcohol, and its complete oxidation gives an acid $C_nH_{2n}O_2$

Hydration of the alkyne gives an aldehyde (or a ketone), and its oxidation gives an acid $C_nH_{2n}O_2$

84 **Model answer**

(1) (A): glucose, (D): ethene (ethylene).

(2) (C): dehydration, (E): oxidation.

85 **Model answer**

(1) (A): terephthalic acid HOOC–C_6H_4–COOH (para).

(B): sodium terephthalate NaOOC–C_6H_4–COONa

(C): benzene C_6H_6

(2) Making Dacron fabric.

86 **Model answer**

(1) (B): sodium citrate: HO–C(COONa)($CH_2COONa)_2$

(D): CH_3–CH(OH)–CH_3 (2-propanol).

(2) (C): dry distillation, (E): reduction.

87 **Model answer**

(1) 1,2-Dibromoethane.

(2) 1,2-Dihydroxypropane.

(3) (Y): CH_3–CH(OH)–COONa, (L): CH_3–CHO