Chemistry · Organic Chemistry

Esters

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166	3	64
questions	sets	pages

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Multiple choice questions — 85 questions

1 Which of the following has a molecule that contains a C – O bond and a C = O bond?

(A) Ketones. (B) Esters. (C) Alcohols. (D) Ethers.

2 Which of the following compounds is an ester?

(A) $(CH_3)_3COC(CH_3)_3$ (B) $CH_3COOCH_2CH_3$

(C) $(CH_3)_3CCOOH$ (D) CH_3OCH_3

3 The ester whose chemical formula is $CH_3COOC_6H_5$ is called .....

(A) phenyl ethanoate only. (B) methyl benzoate only.

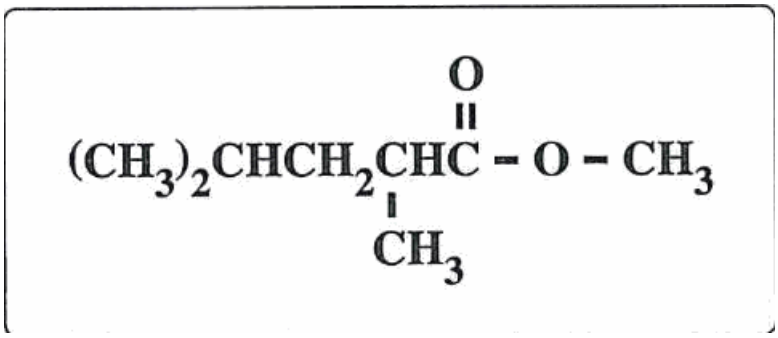
(C) phenyl acetate or methyl benzoate. (D) phenyl ethanoate or phenyl acetate.

4 What is the chemical formula of methyl propanoate?

(A) $CH_3CH_2COOCH_3$ (B) $CH_3COOCH_2CH_3$

(C) $CH_3COOCH_2CH_2CH_3$ (D) $HCOOCH_2CH_2CH_3$

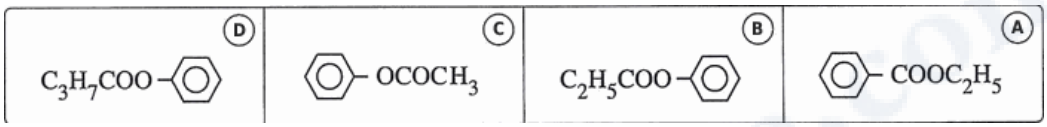
5 What is the IUPAC name of the opposite compound?



(A) Methyl 2,4-dimethylpentanoate. (B) Butyl 2,4-dimethylethanoate.

(C) Methyl 3,5-dimethylpentanoate. (D) Methyl 1,1,3-trimethylpentanoate.

6 Which of the following represents the structural formula of ethyl benzoate?



7 All of the following are isomers of ethyl ethanoate, except .....

(A) butanoic acid.
(B) methyl propanoate.
(C) 2-methylbutanoic acid.
(D) propyl methanoate.

8 What is the molecular isomer of methyl benzoate?

(A) Butanoic acid.
(B) Phenylacetic acid.
(C) Ethyl acetate.
(D) Propyl benzoate.

9 All of the following are isomers of pentyl acetate, except .....

(A) hexyl formate.
(B) heptanoic acid.
(C) butyl propanoate.
(D) propyl propanoate.

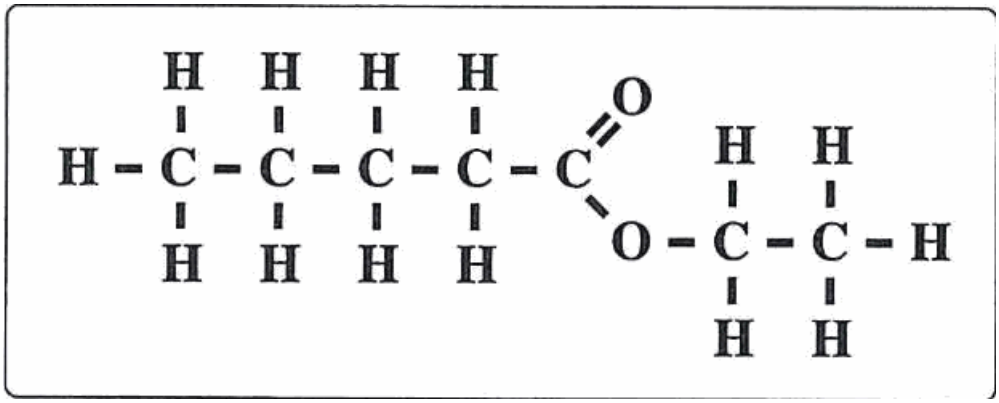
10 An ester has a molar mass of 74 g/mol.

Which of the following expresses the number of its isomers that do not form hydrogen bonds?

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

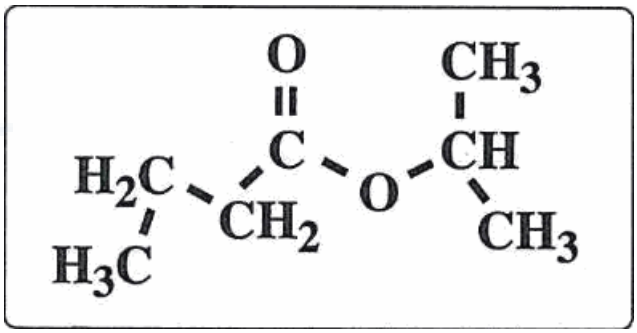
(A) 2
(B) 3
(C) 4
(D) 5

11 The opposite ester is produced by the reaction of .....



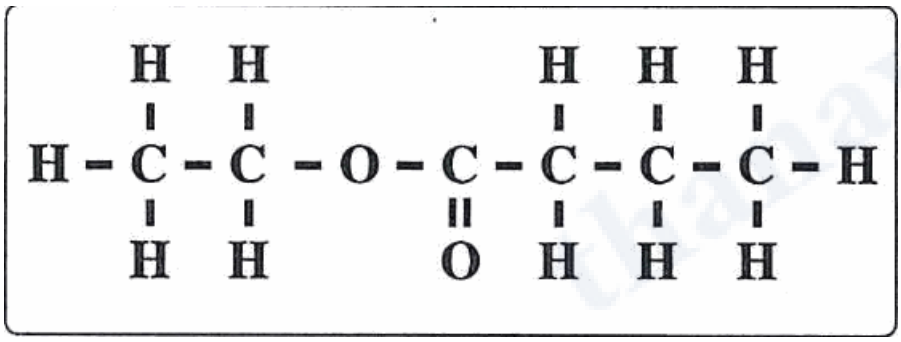
(A) ethene and 1-butanol.
(B) ethane and pentanoic acid.
(C) ethanol and pentanoic acid.
(D) ethanol and butanoic acid.

12 The ester shown in the opposite figure is produced by the reaction of .....



(A) 1-butanol with methylpropanoic acid.
(B) 1-propanol with butanoic acid.
(C) 2-propanol with butanoic acid.
(D) 2-propanol with propanoic acid.

13 The opposite figure shows the structural formula of an ester produced by the reaction of .....

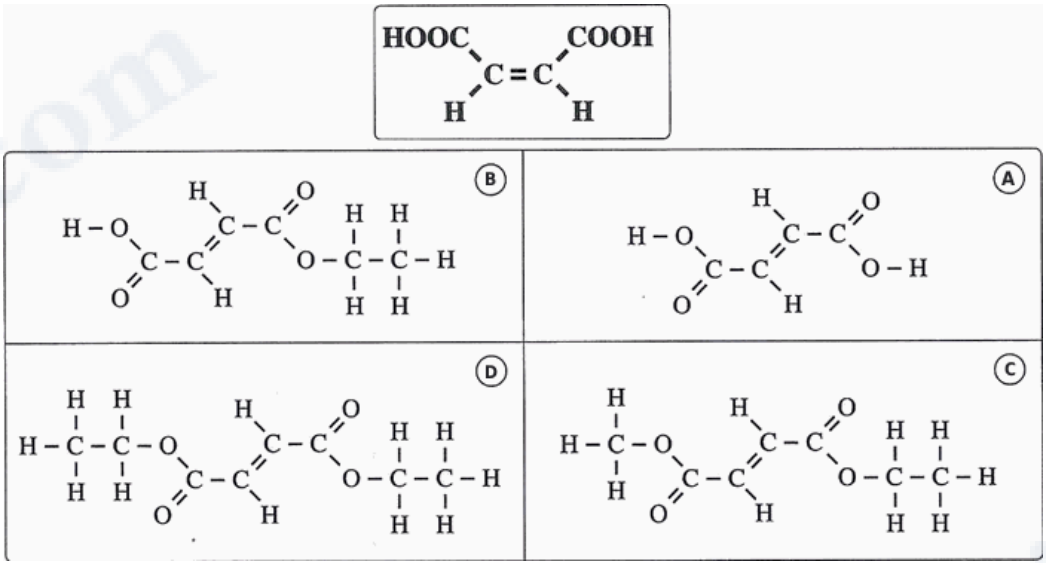


(A) ethanol with butanoic acid.
(B) propanol with propanoic acid.
(C) butanol with ethanoic acid.
(D) propanol with ethanoic acid.

14 When butanoic acid reacts with pentanol, an ester is produced whose chemical formula is .....

(A) $CH_3CH_2CH_2COOCH_2CH_2CH_2CH_3$
(B) $CH_3CH_2CH_2COOCH_2CH_2CH_2CH_2CH_3$
(C) $CH_3CH_2CH_2CH_2COOCH_2CH_2CH_2CH_2CH_3$
(D) $CH_3CH_2CH_2CH_2CH_2COOCH_2CH_2CH_2CH_3$

15 What is the compound produced by the esterification of the opposite organic acid with excess ethanol?



16 The formula of an ester is $CH_3CH_2COOCH_2CH_2CH_2CH_3$. Which of the following is correct?

(A) Acid part: butanoate , alcohol alkyl: butyl

(B) Acid part: butanoate , alcohol alkyl: propyl

(C) Acid part: propanoate , alcohol alkyl: butyl

(D) Acid part: propanoate , alcohol alkyl: propyl

17 Which of the following reactants are used to prepare ethyl butanoate?

(A) C_2H_5OH , C_3H_7COOH

(B) C_2H_5OH , C_4H_9COOH

(C) C_3H_7OH , C_3H_7COOH

(D) C_3H_7OH , C_4H_9COOH

18 Which of the following expresses the relation between the number of carbon, hydrogen and oxygen atoms in any ester compared with the sum of their numbers in the alcohol and the acid used to produce this ester?

(A) C : less , H : less , O : less

(B) C : less , H : equal , O : less

(C) C : equal , H : less , O : less

(D) C : equal , H : less , O : equal

19 Propyl methanoate is prepared by the reaction of $CH_3CH_2CH_2OH$ with .....

(A) HCOOH by addition.

(B) CH_3COOH by addition.

(C) HCOOH by condensation.

(D) CH_3COOH by condensation.

20 Which of the following compounds is an isomer of the compound produced by the reaction of ethanol with ethanoic acid and has the same functional group?

(A) Propanoic acid.
(B) Ethyl ethanoate.
(C) Butanoic acid.
(D) Methyl propanoate.

21 The opposite chemical formulas are for an alcohol (X) and an organic acid (Y):

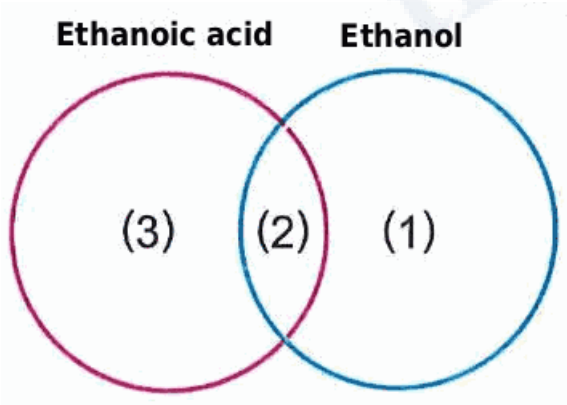
(X) : $CH_3CH(OH)CH_2CH_3$, (Y) : CH_3COOH

What is the name of the alcohol (X) and of the ester (Z) produced by the reaction of the alcohol with the acid (Y)?

(A) (X) : isobutyl alcohol , (Z) : isopropyl acetate ester.
(B) (X) : isobutyl alcohol , (Z) : secondary butyl acetate ester.
(C) (X) : secondary butyl alcohol , (Z) : secondary butyl acetate ester.
(D) (X) : secondary butyl alcohol , (Z) : isopropyl acetate ester.

22 The opposite Venn diagram shows the materials in whose manufacture ethanol and ethanoic acid are used, and the organic compound (2) produced by combining them.

Which of the following is correct?



(A) (1) : denatured alcohol , (2) : flavourings , (3) : perfumes.
(B) (1) : disinfectants , (2) : perfumes , (3) : insecticides.
(C) (1) : artificial silk , (2) : odour enhancers , (3) : disinfectants.
(D) (1) : preservatives , (2) : solvents , (3) : artificial silk.

23 Which of the following compounds reacts with the product of its complete oxidation, forming a liquid with a pleasant smell?

(A) Propanal.
(B) Propanoic acid.
(C) Propanone.
(D) 1-propanol.

24 An alkyl halide can be converted into an ester by the steps .....

(A) substitution, then oxidation, then reaction with an alcohol.

(B) addition, then reduction, then substitution.

(C) oxidation, then substitution, then reaction with an organic acid.

(D) substitution, then reduction, then oxidation.

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25 What is the product of the reaction of 1 mol of lactic acid with 1 mol of ethanoic acid?

(A) A carboxylic ester.

(B) A hydroxy ester.

(C) A carboxylic ketone.

(D) A hydroxy ketone.

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26 What is the product of the reaction of 1 mol of lactic acid with 1 mol of ethanol?

(A) A carboxylic ester.

(B) A hydroxy ester.

(C) A carboxylic ketone.

(D) A hydroxy ketone.

---

27 The following table shows the molar masses of three organic compounds:

2-butanol : 74 g/mol , methyl acetate : 74 g/mol , 2-methylbutane : 72 g/mol

Which of the following expresses the boiling points of these compounds?

(A) 2-butanol : 99°C , methyl acetate : 99°C , 2-methylbutane : 95°C

(B) 2-butanol : 99°C , methyl acetate : 57°C , 2-methylbutane : 28°C

(C) 2-butanol : 50°C , methyl acetate : 50°C , 2-methylbutane : 47°C

(D) 2-butanol : 99°C , methyl acetate : 57°C , 2-methylbutane : −7°C

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28 The following three compounds have the same molar mass.

Which of the following expresses the boiling points of the three compounds?

(A) C_3H_7COOH : 77.1°C , $CH_3COOC_2H_5$: 163.7°C , $C_5H_{11}OH$: 137.9°C

(B) C_3H_7COOH : 163.7°C , $CH_3COOC_2H_5$: 77.1°C , $C_5H_{11}OH$: 137.9°C

(C) C_3H_7COOH : 137.9°C , $CH_3COOC_2H_5$: 163.7°C , $C_5H_{11}OH$: 77.1°C

(D) C_3H_7COOH : 77.1°C , $CH_3COOC_2H_5$: 137.9°C , $C_5H_{11}OH$: 163.7°C

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29 Two compounds (A) and (B) are hydrocarbon derivatives with the same molar mass. The boiling point of compound (A) is 57°C, while the boiling point of compound (B) is 117.7°C. What are compounds (A) and (B)?

(A) (A) : ethyl butanoate , (B) : ethyl acetate

(B) (A) : 1-hexanol , (B) : methyl butanoate

(C) (A) : methyl acetate , (B) : 1-butanol

(D) (A) : 1-butanol , (B) : methyl acetate

30 The following table shows three compounds with equal molar masses:

$CH_3(CH_2)_2OH$: 97°C

CH_3COOH : 118°C

$HCOOCH_3$: (X)

What is the boiling point (X)?

(A) 31°C (B) 101°C (C) 114°C (D) 156°C

31 Which of the following esters gives propanoic acid and propanol when it is hydrolysed?

(B) $CH_3CH_2-\overset{\overset{O}{\|}}{C}-O-CH_2CH_2CH_3$	(A) $CH_3-\overset{\overset{O}{\|}}{C}-O-CH_2CH_2CH_2CH_3$
(D) $CH_3CH_2CH_2-\overset{\overset{O}{\|}}{C}-O-CH_2CH_3$	(C) $CH_3CH_2-O-\overset{\overset{O}{\|}}{C}-CH_2CH_2CH_3$

32 Butanoic acid can be obtained from .....

(A) the acid hydrolysis of butyl ethanoate.

(B) the alkaline hydrolysis of butyl ethanoate.

(C) the acid hydrolysis of ethyl butanoate.

(D) the alkaline hydrolysis of ethyl butanoate.

33 The acid hydrolysis of compound (X) forms two compounds that give the same colour with drops of bromothymol blue.

What is compound (X)?

(A) $CH_3COOCH_2CH_2OH$ (B) $CH_3COOCH_2CH_2COOH$

(C) $CH_3CH_2COOCH_2CH_2CH_3$ (D) $CH_3CH_2CH(OH)CH(OH)CH_2CH_3$

34 Compound (X) contains one ester group, and the mass percentage of oxygen in it is 27.6%
What are the two compounds produced by the acid hydrolysis of compound (X)?
[C = 12 , H = 1 , O = 16]

(A) 1-butanol and ethanoic acid.
(B) Ethanol and propanoic acid.
(C) Methanol and methanoic acid.
(D) 2-propanol and butanoic acid.

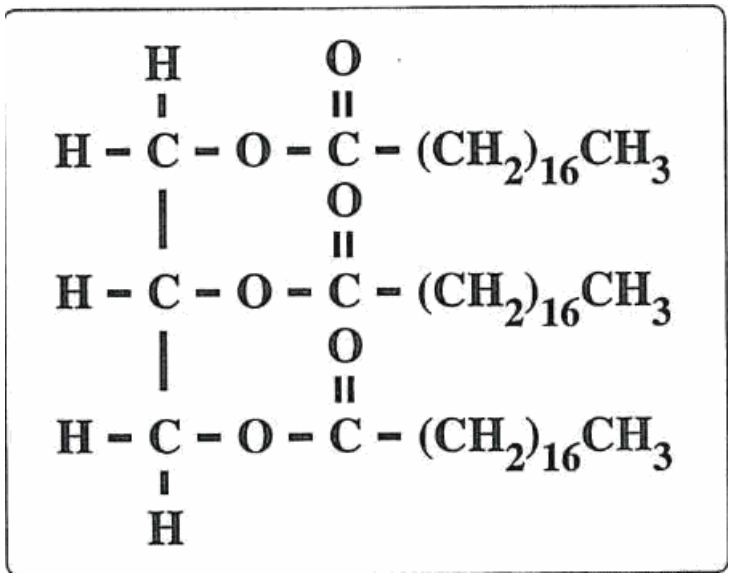
35 What are the products of the acid hydrolysis of the compound $(CH_3)_2CHOCO(CH_2)_2CH_3$?

(A) 1-propanol and butanoic acid.
(B) 2-propanol and butanoic acid.
(C) 1-propanol and propanoic acid.
(D) 2-propanol and propanoic acid.

36 An ester (X), when hydrolysed in an acidic medium, gives two compounds that each react with sodium hydroxide.
What is ester (X)?

(A) Ethyl acetate.
(B) Methyl formate.
(C) Ethyl benzoate.
(D) Phenyl ethanoate.

37 From the opposite compound: how many moles of $C_3H_8O_3$ are produced by the acid hydrolysis of one mole of this compound, and how many moles of oxygen are needed for the complete combustion of 1 mol of the other product of the hydrolysis, respectively?



(A) 1 mol , 26 mol
(B) 3 mol , 17 mol
(C) 1 mol , 17 mol
(D) 3 mol , 26 mol

38 What is the product of the alkaline hydrolysis of the opposite ester?
(The ester: $CH_3CH_2COOCH_2CH_3$)

(A) Propanoic acid + sodium ethoxide.
(B) Sodium propanoate + sodium ethoxide.
(C) Propanoic acid + ethanol.
(D) Sodium propanoate + ethanol.

39 Which compound gives both methanol and sodium ethanoate when treated with sodium hydroxide solution?

(A) CH_3COOCH_3
(B) $HCOOC_2H_5$
(C) $CH_3COOC_2H_5$
(D) $HOCH_2CH_2COOH$

40 What is the product of the hydrolysis of the compound $C_{15}H_{31}COOC_{16}H_{33}$ with excess sodium hydroxide solution?

(A) $C_{16}H_{33}COONa$, $C_{15}H_{31}ONa$
(B) $C_{16}H_{33}COONa$, $C_{15}H_{31}OH$
(C) $C_{16}H_{33}COONa$, $C_{15}H_{31}COONa$
(D) $C_{16}H_{33}OH$, $C_{15}H_{31}COONa$

41 The basic hydrolysis of a compound with the general formula $RCO^{18}OR$ forms .....

(A) an alkoxide and an organic acid containing ^{18}O
(B) an organic acid and an alkoxide containing ^{18}O
(C) an alcohol and a salt of an organic acid containing ^{18}O
(D) a salt of an organic acid and an alcohol containing ^{18}O

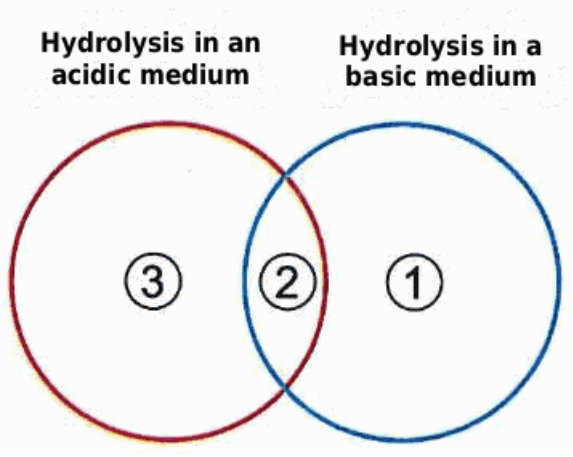
42 The alcohol produced by the alkaline hydrolysis of ethyl propanoate reacts with 2-methylpropanoic acid, forming the ester .....

(A) $(CH_3)_2CHCOOCH_2CH_3$
(B) $(CH_3)_2CHCOOCH_2CH_2CH_3$
(C) $CH_3COOCH_2CH(CH_3)CH_3$
(D) $CH_3CH_2COOCH_2CH(CH_3)CH_3$

43 The hydrolysis of ethyl butanoate using excess sodium hydroxide solution forms .....

(A) $CH_3CH_2CH_2COONa$
(B) CH_3COOH
(C) CH_3CH_2ONa
(D) $CH_3CH_2CH_2COONa + CH_3CH_2ONa$

44 The opposite Venn diagram shows the products of the hydrolysis of ethyl ethanoate.
(1) : hydrolysis in a basic medium only , (3) : hydrolysis in an acidic medium only , (2) : common to both.
Which of the following is correct?



(A) (1) : acid , (2) : salt , (3) : alcohol.
(B) (1) : salt , (2) : acid , (3) : alcohol.
(C) (1) : alcohol , (2) : acid , (3) : salt.
(D) (1) : salt , (2) : alcohol , (3) : acid.

45 The hydrolysis of the opposite compound by heating with excess sodium hydroxide solution produces .....
The compound: $HCOO–CH_2–CH_2–CH_2–OOC–CH_3$

(A) $HCOOH + HOCH_2CH_2CH_2OH + CH_3COOH$
(B) $HCOOH + NaOCH_2CH_2CH_2ONa + CH_3COOH$
(C) $HCOONa + HOCH_2CH_2CH_2OH + CH_3COONa$
(D) $HCOONa + NaOCH_2CH_2CH_2ONa + CH_3COONa$

46 Which of the following expresses the properties of the following compound?
$HO–CH_2–CH=CH–O–CO–CH_2–OH$

(A) With aqueous NaOH: forms a salt of an organic acid , with bromine water: the colour disappears , with aqueous Na_2CO_3: effervescence occurs
(B) With aqueous NaOH: forms an organic acid , with bromine water: no noticeable change , with aqueous Na_2CO_3: effervescence occurs
(C) With aqueous NaOH: forms a salt of an organic acid , with bromine water: the colour disappears , with aqueous Na_2CO_3: no effervescence
(D) With aqueous NaOH: forms an organic acid , with bromine water: no noticeable change , with aqueous Na_2CO_3: no effervescence

47 From the chemical formula of the opposite compound: $CH_3(CH_2)_{14}COONa$

What is this compound used for, and from which acid is this salt derived?

(A) Synthetic detergent / palmitic acid.

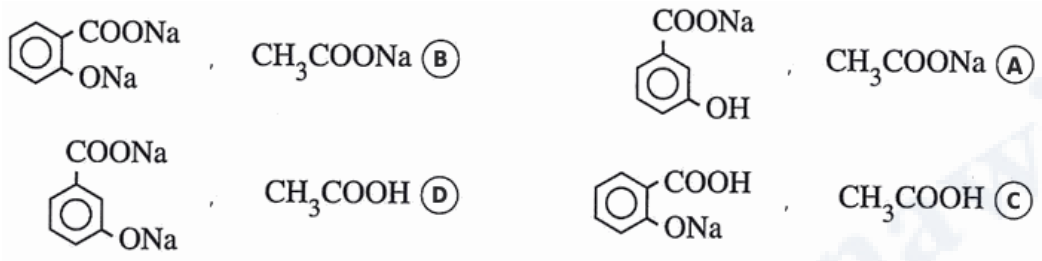
(B) Soap making / butyric acid.

(C) Synthetic detergent / pentadecanoic acid.

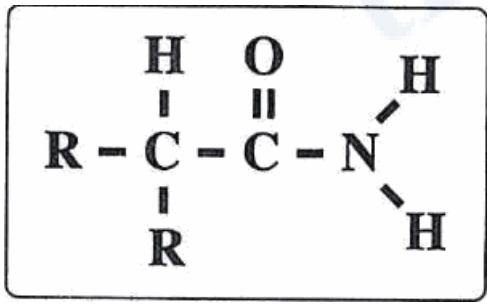
(D) Soap making / palmitic acid.

48 After the acid hydrolysis of an organic compound, excess sodium hydroxide solution was added.

Which of the following is likely to form?



49 The opposite structural formula represents .....

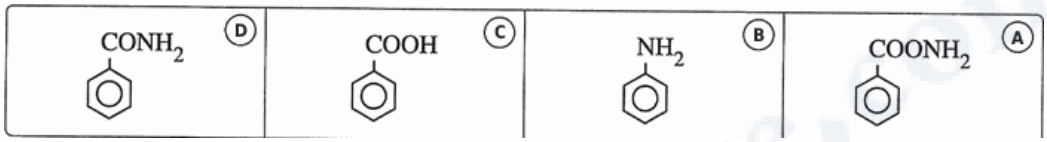


(A) amines. (B) aldehydes. (C) alcohols. (D) amides.

50 What is the general formula of the amides of aliphatic acids?

(A) RNH_2 (B) $RCOONH_2$ (C) $RONH_2$ (D) $RCONH_2$

51 Which of the following compounds is an amide?



52 All of the following are correct for the opposite compound, except .....

The compound: $CH_2=CH-CONH_2$

(A) It takes part in addition polymerization.

(B) It contains an amide group.

(C) It is an amino acid.

(D) It is an alkene derivative.

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53 The ammonolysis of isopropyl formate produces .....

(A) a primary alcohol and an acid amide whose molecule contains 5 atoms.

(B) a secondary alcohol and an acid salt whose molecule contains 5 atoms.

(C) a primary alcohol and an acid salt whose molecule contains 6 atoms.

(D) a secondary alcohol and an acid amide whose molecule contains 6 atoms.

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54 Three organic compounds (A), (B) and (C):

• Compound (A): a hydrocarbon prepared from propanol by an elimination reaction.

• Compound (B): an aromatic hydrocarbon derivative that is sparingly soluble in water (at 25°C).

• Compound (C): undergoes ammonolysis.

Which of the following is correct?

(A) (A) : removes the colour of bromine water , (B) : its solubility in water increases on heating , (C) : an ether

(B) (A) : does not remove the colour of bromine water , (B) : mixes completely with water (at 65°C) , (C) : not affected by (MnO_4^- / H^+)

(C) (A) : can undergo addition polymerization , (B) : contains a hydroxyl group , (C) : an ester

(D) (A) : can undergo condensation polymerization , (B) : does not contain a hydroxyl group , (C) : an ester

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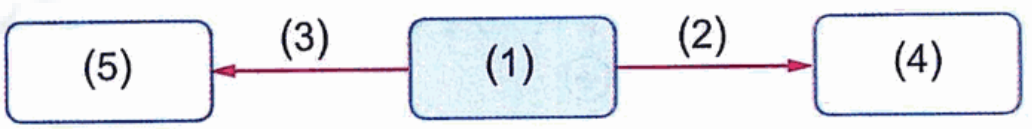
55 From the following chart:

• Compound (1): forms in the body because of hard physical effort.

• Compound (2): freezes at 16°C when it is pure.

• Compound (3): the simplest aliphatic alcohol.

Which of the following expresses compounds (1), (4) and (5)?



(A) (1) : reacts with sodium bicarbonate , (4) : has a characteristic smell , (5) : undergoes ammonolysis.

(B) (1) : does not react with NaOH(aq) , (4) : has a characteristic smell , (5) : undergoes hydrolysis.

(C) (1) : does not react with NaOH(aq) , (4) : a gas (at 25°C) , (5) : undergoes ammonolysis.

(D) (1) : reacts with sodium bicarbonate , (4) : a gas (at 25°C) , (5) : undergoes hydrolysis.

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56 What is the correct order of the chemical processes used to convert aromatic benzene into an aromatic compound with the molecular formula C_7H_7ON?

(A) Alkylation – oxidation – esterification – ammonolysis.

(B) Oxidation – ammonolysis – alkylation – esterification.

(C) Ammonolysis – alkylation – esterification – oxidation.

(D) Esterification – ammonolysis – oxidation – alkylation.

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57 The following two statements may describe 1-propanol:

• Statement (1): on complete oxidation by $Cr_2O_7^{2-}$ in an acidic medium, it forms an organic compound with a higher boiling point than 1-propanol.

• Statement (2): when ethanoic acid is added to it with a few drops of concentrated H_2SO_4, a compound with the taste of pears forms.

Which of the following describes 1-propanol?

(A) Statement (1) ✗ , statement (2) ✗

(B) Statement (1) ✗ , statement (2) ✓

(C) Statement (1) ✓ , statement (2) ✗

(D) Statement (1) ✓ , statement (2) ✓

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58 What process is used to convert oil into soap?

(A) Ammonolysis.
(B) Condensation.
(C) Hydration.
(D) Alkaline hydrolysis.

59 All of the following describe glycerides, except .....

(A) Fatty acids are used in preparing them.
(B) A trihydroxy alcohol is used in preparing them.
(C) They are salts of fatty acids.
(D) They are hydrolysed by an alkali, forming soap.

60 The sodium salt of a long-chain fatty acid is known as .....

(A) fat.
(B) oil.
(C) soap.
(D) synthetic detergent.

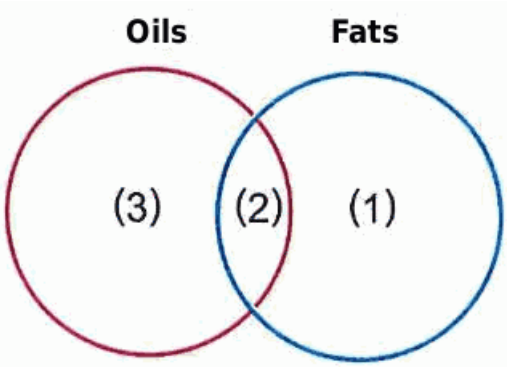
61 Four different samples of oils (W), (X), (Y) and (Z), equal in number of moles, each had 200 mL of hydrogen gas passed through it under suitable conditions for the reaction. The table shows the volume of H_2 gas left unreacted:

(W) : zero , (X) : 200 mL , (Y) : 168 mL , (Z) : 120 mL

Which of the following represents the unsaturated oil(s)?

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

62 The opposite Venn diagram shows some properties of fats and oils.
Which of the following is correct?



(A) (1) : their acids are unsaturated , (2) : long-chain , (3) : their acids are saturated.

(B) (1) : their acids are saturated , (2) : hydrolysed in H^+ , (3) : their acids are unsaturated.

(C) (1) : their acids are unsaturated , (2) : not hydrolysed in H^+ , (3) : their acids are saturated.

(D) (1) : their acids are saturated , (2) : soluble in water , (3) : their acids are unsaturated.

---

63 Which of the following is not one of the compounds that react to form oils?

(A) Pyrogallol.

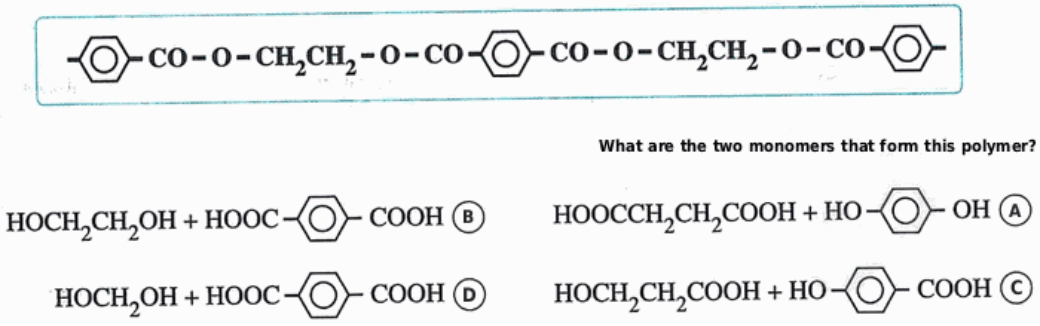
(B) A long-chain fatty acid.

(C) Glycerol.

(D) A short-chain fatty acid.

---

64 The following segment is from a polymer produced by condensation polymerization:
What are the two monomers that form this polymer?



---

65 A student assumed that the following three conditions are necessary for preparing polyesters:

(1) : the monomers contain –OH and –COOH groups.

(2) : small molecules are removed.

(3) : the two monomers used are identical.

Which of the following expresses the correct assumptions?

(A) Assumption (1) ✓ , assumption (2) ✗ , assumption (3) ✗

(B) Assumption (1) ✗ , assumption (2) ✓ , assumption (3) ✗

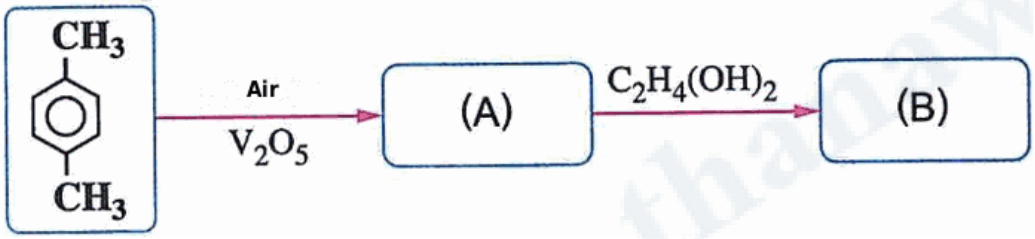
(C) Assumption (1) ✓ , assumption (2) ✓ , assumption (3) ✗

(D) Assumption (1) ✓ , assumption (2) ✓ , assumption (3) ✓

---

66 The following chart shows the reactions that take place under suitable conditions to form compounds (A) and (B):

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



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

(B) (A) : an organic acid , (B) : a copolymer.

(C) (A) : an alcohol , (B) : a copolymer.

(D) (A) : an organic acid , (B) : an ether.

---

67 Three polymers have the following properties:

• Polymer (A): an electrical insulator, dark brown in colour.

• Polymer (B): an electrical insulator and non-stick.

• Polymer (C): chemically inert and used for medical purposes.

What polymerization method is used to make these polymers?

(A) (A) : condensation , (B) : condensation , (C) : addition

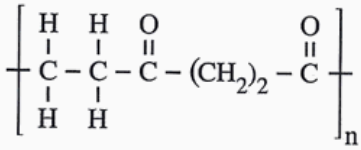
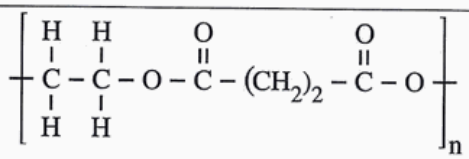
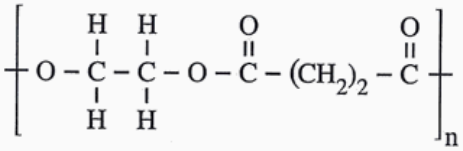
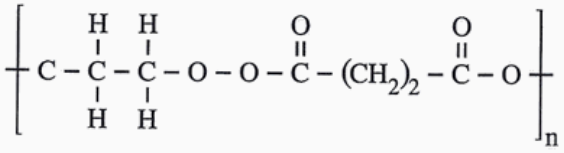
(B) (A) : addition , (B) : addition , (C) : condensation

(C) (A) : condensation , (B) : addition , (C) : condensation

(D) (A) : addition , (B) : condensation , (C) : addition

---

68 The following two monomers: $HOOC–(CH_2)_2–COOH$, $HO–CH_2–CH_2–OH$ can form the polymer .....

Polymer	Choices
	(A)
	(B)
	(C)
	(D)

69 The following represents the repeating unit of a polymer formed by condensation:

$–OOCCH_2COOCH_2CH_2CH_2–$

What monomers are used to form this polymer?

(A) $HOCH_2CH_2COOH$ only.

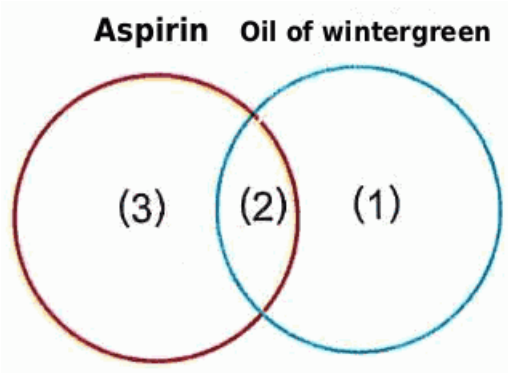
(B) $HOOCCH_2CH_2COOH + HOCH_2CH_2OH$

(C) $HOOCCOOH + HOCH_2CH_2CH_2CH_2OH$

(D) $HOOCCH_2COOH + HOCH_2CH_2CH_2OH$

70 The opposite Venn diagram shows the materials used to prepare oil of wintergreen and aspirin.

Which of the following is correct?



(A) (1) : methanol , (2) : salicylic acid , (3) : ethanoic acid.

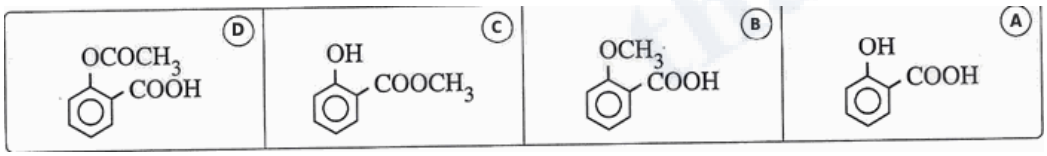
(B) (1) : salicylic acid , (2) : methanol , (3) : ethanoic acid.

(C) (1) : methanol , (2) : ethanoic acid , (3) : salicylic acid.

(D) (1) : ethanoic acid , (2) : salicylic acid , (3) : methanol.

---

71 The chemical formula of aspirin is .....



---

72 Aspirin forms by a(n) ..... reaction.

(A) condensation (B) alkylation (C) addition (D) hydrogenation

---

73 The molecule of each of the following compounds contains a methyl group, except .....

(A) Dacron. (B) oil of wintergreen.

(C) toluene. (D) aspirin.

---

74 The following compounds contain a (–COOH) group, except .....

(A) aspirin. (B) benzoic acid. (C) picric acid. (D) salicylic acid.

---

75 Which of the following compounds reacts with the salt $NaHCO_3$?

(A) Carbolic acid. (B) Ethylene. (C) Aspirin. (D) Picric acid.

---

76 What do oil of wintergreen and aspirin have in common?

(A) Medical importance.
(B) Each contains a –COO– group.
(C) The way they are used.
(D) Each contains a –COOH group.

---

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

(A) Salicylic acid is monobasic.
(B) Ethyl salicylate is an ester.
(C) Salicylic acid gives a violet colour with $FeCl_3$ solution and reacts with $NaHCO_3$
(D) Methyl salicylate is not found in natural plant oils.

---

78 The pure acid (X) looks like ice when it freezes, and its dilute solutions are used as food additives.

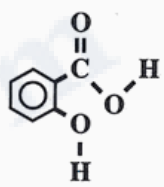
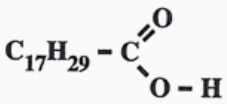
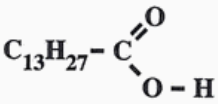
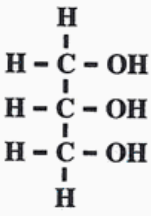
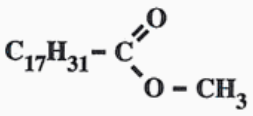
Which of the following shows the uses of acid (X)?

(A) Making aspirin ✓ , making artificial silk ✗ , sulphonation of benzene ✓
(B) Making aspirin ✗ , making artificial silk ✓ , sulphonation of benzene ✗
(C) Making aspirin ✓ , making artificial silk ✓ , sulphonation of benzene ✗
(D) Making aspirin ✗ , making artificial silk ✗ , sulphonation of benzene ✓

---

79 From the following table:

Which of the following is correct?

(A) 	(B) 	(C) CH_3OH
(D) 	(E) 	(F) 

(A) Compounds (A) and (B) are used to prepare methyl salicylate, and compounds (D) and (E) are produced by the hydrolysis of a saturated triglyceride.

(B) Compounds (A) and (C) are used to prepare methyl salicylate, and compounds (E) and (F) are produced by the hydrolysis of a saturated triglyceride.

(C) Compound (A) is used to prepare methyl salicylate, and compounds (D) and (E) are produced by the hydrolysis of a saturated triglyceride.

(D) Compound (A) is used to prepare methyl salicylate, and compounds (B) and (C) are produced by the hydrolysis of a saturated triglyceride.

---

80 All of the following describe the aliphatic compound produced by the hydrolysis of oil of wintergreen, except .....

(A) It is one of the components of red spirit.

(B) It is affected by $KMnO_4$ solution acidified with H_2SO_4

(C) It has no isomers.

(D) It reacts with NaOH solution.

---

81 Three oxygen-containing organic compounds:

• Compound (1): the mass of oxygen in it is x g and its molar mass is 32 g/mol

• Compound (2): the mass of oxygen in it is 3x g and its molar mass is 138 g/mol

• Compound (3): the mass of oxygen in it is 2x g and its molar mass is 60 g/mol

What is the molar mass of the ester produced by the reaction of 1 mol of compound (1) with 1 mol of compound (3)? And what is the importance of the ester produced by the reaction of compound (2) with compound (3)?

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

(A) 92 g/mol / making candles.
(B) 92 g/mol / lowers fever.
(C) 74 g/mol / reduces blood clotting.
(D) 74 g/mol / relieves rheumatic pain.

---

82 All of the following describe the product of the hydrolysis of one mole of aspirin, except .....

(A) It reacts with 3 mol of sodium hydroxide.
(B) It reacts with 106 g of sodium carbonate [Na_2CO_3 = 106 g/mol].
(C) It turns bromothymol blue light green.
(D) In it [H^+] is greater than [OH^-].

---

83 How many moles of hydrogen are needed for the complete reduction of the hydrolysis products of 1 mol of aspirin?

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

---

84 The complete reduction, by suitable reducing agents (under suitable conditions), of the hydrolysis products of aspirin gives compounds containing a(n) ..... group.

(A) secondary alcohol
(B) primary alcohol
(C) carbonyl
(D) formyl

---

85 What is the correct order of the processes used to convert chlorobenzene into the active substance in aspirin?

(A) Oxidation – alkylation – alkaline hydrolysis.
(B) Oxidation – alkaline hydrolysis – alkylation.
(C) Alkaline hydrolysis – alkylation – oxidation.
(D) Alkaline hydrolysis – oxidation – alkylation.

Essay questions — 17 questions

1 Write the common name and the IUPAC name of each of:

(1) $H–COOCH_2CH_3$

(2) $C_2H_5–CO–O–C_3H_7$

2 One of the organic compounds is represented by the formula $CH_3CH_2COOCH_3$:

(1) Write the IUPAC name of this compound.

(2) Draw the structural formulas of the two compounds used to prepare this compound, and state which of them has the higher boiling point.

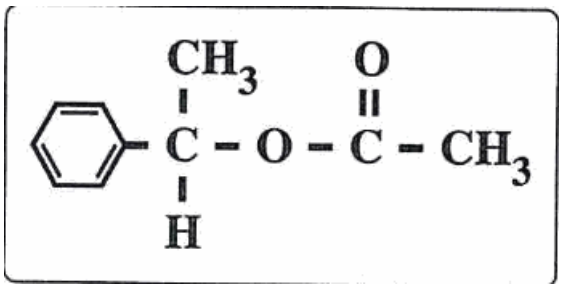
3 Polymer (X) is made of the two monomers: $HOOC–C_6H_4–COOH$ (terephthalic acid) , $HOCH_2CH_2OH$

Deduce the formula of the copolymer (X) produced by the condensation of these two monomers, and state a medical use of this polymer.

4 The opposite figure shows the structural formula of a compound:

(1) What is the functional group in the molecule of this compound that explains its pleasant smell?

(2) Deduce the structural formulas of the two compounds used to prepare this compound, and give the IUPAC name of the aliphatic compound.



5 Butanoic acid is an aliphatic organic acid:

(1) State the property on which a practical experiment to prove that this acid is weak is based.

(2) Draw the structural formula of the organic compound produced by the reaction of 1 mol of butanoic acid with 1 mol of ethylene glycol.

6 Acid (X) is extracted from butter:

(1) Draw the structural formula of the aldehyde used to prepare this acid.

(2) Write the symbolic equation for the reaction of acid (X) with ethanol.

7 The first member of the alcohols reacts with the first member of the aliphatic acids, forming ester (X):

(1) Draw the structural formula of ester (X), and write its IUPAC name.

(2) Use "higher than" or "lower than" to compare the boiling point of ester (X) with each of the alcohol and the acid it is derived from.

8 Ethyl propanoate is produced by the reaction of alcohol (X) with organic acid (Y):

(1) Write the names of the alcohol and the acid used.

(2) Draw the structural formula of the product.

9 Ethyl acetate is hydrolysed in an acidic medium, forming alcohol (A) and acid (B).

Draw the structural formula of each of:

(1) the aldehyde corresponding to alcohol (A).

(2) the alcohol corresponding to acid (B).

10 Write the ammonolysis equation of each of the following esters, and write the name of the amide produced from ester (1):

Ester (1): $CH_3–CO–O–C_2H_5$

Ester (2): $H–COOCH_2CH_3$

11 The opposite structural formula represents an ester produced by the reaction of alcohol (A) with acid (B): $C_2H_5–CO–O–C_3H_7$

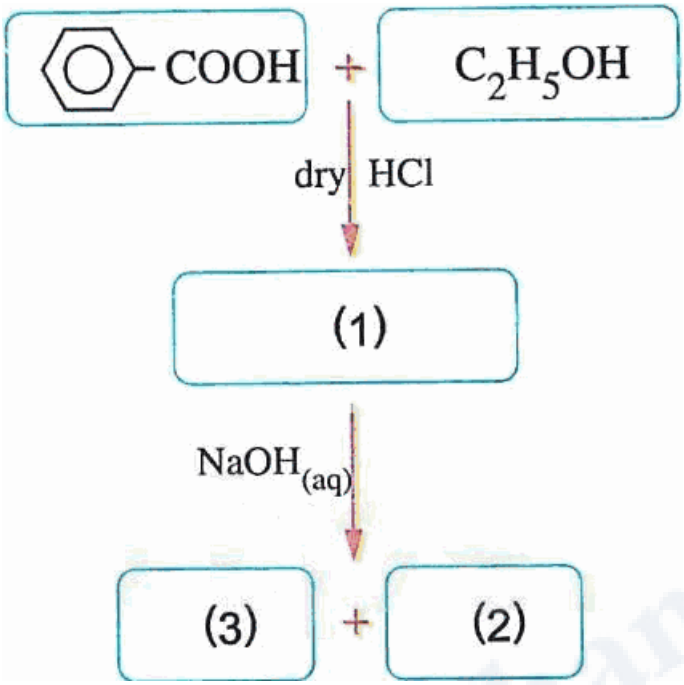
(1) Write the symbolic equation for preparing alcohol (A) from a suitable alkyl halide.

(2) Draw the structural formula of the amide of acid (B).

12 From the opposite chart:

(1) What are the names of compounds (2) and (3), if only compound (3) is neutral to litmus?

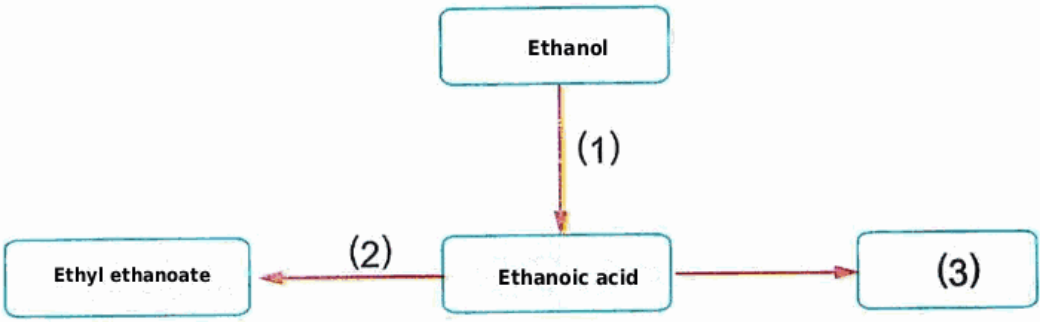
(2) Compare compounds (2) and (3) "in terms of: reaction with soda lime".



13 From the opposite chart:

(1) State the type of reactions (1) and (2).

(2) Write the equation for preparing an alkane from salt (3).



14 Write the symbolic equations for preparing a compound used to relieve rheumatic pain from methyl chloride.

15 Write the symbolic equations for preparing acetamide from ethanol.

16 Write the symbolic equation for preparing each of:

(1) $HCOOCH_3$

(2) $C_6H_5COOCH_3$

---

17 Explain the following:

(1) Dry HCl gas is used in the esterification of benzoic acid with methanol, and concentrated sulphuric acid is not used.

(2) The acidity of a mixture of 1 mol of propanoic acid and 1 mol of ethanol.

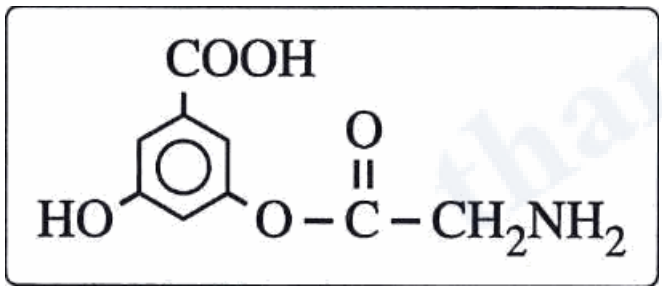
Past exam questions — 64 questions

1 A monobasic carboxylic acid (containing a number of carboxyl groups equal to its number of carbon atoms) is added to an alcohol whose freezing point is −110.5°C (Sample exam 2026)
Which of the following expresses the number of isomers of the product that have the same functional group?

(A) 0 (B) 1 (C) 2 (D) 3

---

2 Study the opposite compound: (Sample exam 2026)
Which of the following expresses the correct results when the following experiments are carried out on this compound?
Experiment 1: adding sodium bicarbonate.
Experiment 2: reduction with hydrogen, then adding iron(III) chloride solution.
Experiment 3: acid hydrolysis.



(A) (1) effervescence occurs and a gas that turns clear limewater milky is given off , (2) the solution turns violet , (3) benzoic acid forms.
(B) (1) no effervescence , (2) the solution turns violet , (3) acetic acid forms.
(C) (1) no effervescence , (2) the colour does not change , (3) glycine forms.
(D) (1) effervescence occurs and a gas that turns clear limewater milky is given off , (2) the solution turns violet , (3) glycine forms.

---

3 Three organic compounds (A), (B) and (C) have the molecular formula $C_4H_8O_2$ (Sample exam 2026)

(A): reacts with cold sodium hydroxide.

(B): does not react with cold sodium hydroxide.

(C): undergoes saponification and produces the simplest alcohol.

Which of the following is correct?

(A) (A) : butyric acid / (B) : ethyl ethanoate.

(B) (C) : propyl methanoate / (B) : methyl propanoate.

(C) (A) : 2-methylpropanoic acid / (C) : ethyl ethanoate.

(D) (C) : methyl propanoate / (B) : butanoic acid.

---

4 Which of the following processes is correct for obtaining a compound with the formula C_nH_nO from the compound $C_7H_6O_2$? (Sample exam 2026)

(A) Basic hydrolysis. (B) Dehydration. (C) Acid hydrolysis. (D) Neutralization.

---

5 Which of the following pairs of compounds can be used to produce a polymer (in only three chemical processes) that is used to make arteries and heart valves? (Sample exam 2026)

(A) Ethylene and para-methyltoluene.

(B) Ethylene glycol and terephthalic acid.

(C) Ethanol and para-methyltoluene.

(D) Acetylene and ethanol.

---

6 A carboxylic acid has the formula $C_3H_6O_3$. The following reactions were carried out on it: (Sample exam 2026)

Reaction (1): methanol was added to it, and it reacted as an acid.

Reaction (2): acetic acid was added to it, and it reacted as an alcohol.

Which of the following expresses the product of each of reactions (1) and (2)?

(A) (1) : $CH_3CH(OCOCH_3)COOH$, (2) : $CH_3CH(OH)COOCH_3$

(B) (1) : $CH_3CH(OH)COOCH_3$, (2) : $CH_3CH(OCOCH_3)COOH$

(C) (1) : CH_3COOCH_3 , (2) : $CH_3CH(OH)COOH$

(D) (1) : $CH_3CH(OH)COOCH_3$, (2) : CH_3COOCH_3

---

7 The acid hydrolysis of propyl formate ester produces a compound (X) that reacts with sodium hydroxide. (Sample exam 2026)

All of the following are properties of compound (X), except .....

(A) It has no isomers.
(B) Its molecular formula is CH_2O_2
(C) It reacts with hydrohalic acids.
(D) Some insects secrete it.

---

8 (X , Y , Z) are three organic compounds: (Sample exam 2026)

(X): the simplest aliphatic hydroxyl compound.

(Y): the simplest aromatic hydroxy carboxylic acid.

(Z): produced by the reaction of (X) and (Y).

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

(A) (X) : methyl alcohol , (Y) : salicylic acid , (Z) : acetylsalicylic acid
(B) (X) : ethyl alcohol , (Y) : benzoic acid , (Z) : ethyl benzoate ester
(C) (X) : methyl alcohol , (Y) : salicylic acid , (Z) : methyl salicylate ester
(D) (X) : phenol , (Y) : formic acid , (Z) : phenyl formate ester

---

9 From the following chart: (Sample exam 2026)

C_6H_6 → alkylation → X → oxidation → Y → ($+C_2H_5OH$) → Z

Which of the following expresses compound (Z)?

(A) Benzyl ethanoate.
(B) Ethyl benzoate.
(C) Phenyl ethanoate.
(D) Methyl benzoate.

---

10 From the following table: (Sample exam 2026)

Experiment 1: compound X + CH_3OH → a compound with a fruity smell.

Experiment 2: compound Y + acidified $KMnO_4$ → the violet colour disappears.

Experiment 3: compound Z + bromine water → a white precipitate forms.

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

(A) (X) : acetic acid , (Y) : 2-propanol , (Z) : carbolic acid.
(B) (X) : carbolic acid , (Y) : 2-methyl-2-propanol , (Z) : acetic acid.
(C) (X) : methanoic acid , (Y) : benzoic acid , (Z) : carbolic acid.
(D) (X) : acetaldehyde , (Y) : 2-propanol , (Z) : carbolic acid.

---

11 Which of the following expresses the correct order of the chemical processes needed to prepare propane from propyl propanoate? (Sample exam 2026)

(A) Basic hydrolysis → dry distillation of the acid salt → catalytic hydrogenation.

(B) Basic hydrolysis → dehydration → catalytic hydrogenation.

(C) Acid hydrolysis → oxidation → dehydration.

(D) Acid hydrolysis → oxidation → adding sodium hydroxide.

---

12 Which of the following hydroxyl compounds cannot be obtained by the ammonolysis of an isomer of ethyl benzoate? (Sample exam 2026)

(A) CH_3OH

(B) $C_6H_5CH_2CH_2OH$

(C) $C_6H_5CH_2OH$

(D) C_2H_5OH

---

13 (X , Y , Z) are three hydrocarbon derivatives: (Sample exam 2026)

(X): has the general formula $C_nH_{2n}O_2$ and reacts with active metals.

(Y): has the general formula $C_nH_{2n}O_2$ and does not react with active metals.

(Z): has the general formula $C_nH_{2n+2}O$ and reacts with active metals.

If the molar masses of (X , Y , Z) are equal, which of the following is correct about the boiling point?

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

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

(C) The boiling point of (Y) is higher than that of (X).

(D) The boiling point of (X) is higher than that of (Z).

---

14 Three organic compounds used in making polymers: (Sample exam 2026)

(The reaction of the first compound with the second compound) gives a polymer used to treat heart diseases.

(The reaction of the third compound with an aldehyde) gives a polymer used to make ashtrays.

Which of the following expresses each of the three compounds?

(A) First: ethyne , second: hydrogen fluoride , third: Teflon

(B) First: ethylene glycol , second: phthalic acid , third: carbolic acid

(C) First: ethylene glycol , second: terephthalic acid , third: carbolic acid

(D) First: phthalic acid , second: carbolic acid , third: ethylene glycol

---

15 Compound (X) has the molecular formula: C_7H_7NO (Sample exam 2026)

Which of the following esters is used to prepare compound (X)?

(A) $C_6H_5–COO–CH_3$ (B) $C_6H_5–OOC–CH_3$

(C) $C_5H_{11}–COO–CH_3$ (D) $C_5H_{11}–OOC–CH_3$

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

When excess sodium hydroxide is added to one mole of each of the three compounds:

(B): uses twice the amount of NaOH that (A) uses.

(C): does not react.

When (A) is heated with (C), a compound used in making flavourings forms.

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

(A) (A) : $C_3H_6O_3$, (B) : $C_7H_6O_3$, (C) : C_2H_6O

(B) (A) : $C_7H_6O_3$, (B) : $C_3H_6O_3$, (C) : C_2H_6O

(C) (A) : C_2H_6O , (B) : $C_3H_6O_3$, (C) : $C_7H_6O_3$

(D) (A) : $C_3H_6O_3$, (B) : C_2H_6O , (C) : $C_7H_6O_3$

17 Which of the following expresses the IUPAC name of the products of the acid hydrolysis of the compound $C_6H_5OOCCH_3$? (Sample exam 2026)

(A) Acetic acid and hydroxybenzene. (B) Ethanoic acid and phenol.

(C) Methanol and benzoic acid. (D) Methyl alcohol and benzoic acid.

18 Three organic acids (A , B , C): (Sample exam 2026)

(A): produced by the reaction of 3 moles of caustic soda with one mole of 1,1,1-trichloroethane.

(B): produced by the fermentation of milk sugar by some kinds of bacteria.

(C): reacts with methanol, forming a substance used to relieve rheumatic pain.

Which of the following expresses the previous acids?

(A) (A) : $C_2H_4O_2$, (B) : $C_3H_6O_3$, (C) : $C_7H_6O_3$

(B) (A) : $C_3H_6O_3$, (B) : $C_2H_4O_2$, (C) : $C_7H_6O_3$

(C) (A) : $C_2H_4O_2$, (B) : $C_7H_6O_3$, (C) : $C_3H_6O_3$

(D) (A) : $C_3H_6O_3$, (B) : $C_7H_6O_3$, (C) : $C_2H_4O_2$

19 Glycolic acid (hydroxyethanoic acid) has the formula $HO–CH_2COOH$. The following experiments were carried out on it: (Sample exam 2026)

Experiment (A): reaction with methanol.

Experiment (B): reaction with acetic acid.

Which of the following expresses the chemical formula of the product of each of experiments (A) and (B)?

(A) (A) : $HO–CH_2–COOCH_3$, (B) : $CH_3COO–CH_2–COOH$

(B) (A) : $CH_3–COO–CH_2COOH$, (B) : $HO–CH_2–COOCH_3$

(C) (A) : $HO–CH_2COOH$, (B) : $CH_3–COO–CH_2–COO–CH_3$

(D) (A) : $CH_3O–CH_2COOH$, (B) : $HO–CH_2COO–CH_3$

---

20 (A , B , C) are three organic compounds with the following molecular formulas: (Sample exam 2026)

(A) : $C_3H_6O_3$, (B) : $C_2H_4O_2$, (C) : $C_4H_8O_2$

The ammonolysis of compound (C) gives the amide of compound (B).

All of the following express reactions of compounds (A , B , C), except .....

(A) (A) and (B) react with metal carbonates, while (C) does not react with them.

(B) (A) does not react with (B) but reacts with alcohols.

(C) (A) and (B) react with active metals; (C) reacts with metal hydroxides on heating.

(D) One of the isomers of (C) reacts with active metals and their hydroxides, carbonates and bicarbonates.

---

21 Which of the following expresses the correct order of the chemical processes needed to obtain propane from a compound with the chemical formula $CH_3CH_2COOCH_2CH_2CH_3$? (Sample exam 2026)

(A) Basic hydrolysis → dry distillation → catalytic hydrogenation.

(B) Basic hydrolysis → dehydration → catalytic hydrogenation.

(C) Acid hydrolysis → oxidation → dehydration.

(D) Acid hydrolysis → reduction → dehydration.

---

22 (X , Y) are organic compounds: (Sample exam 2026)

(X): its molecular formula is $C_3H_8O_3$

(Y): its general formula is $C_nH_{2n}O_2$, where (n) is not less than 4

When one mole of (X) reacts with 3 mol of (Y), compound (Z) forms.

Which of the following expresses a use of compound (Z)?

(A) Artificial heart arteries.
(B) Preventing blood clots.
(C) Making soap.
(D) An ointment to relieve rheumatic pain.

---

23 Which of the following expresses the structural formula of the compound produced by the reaction of the oxidation product of ethyl alcohol with the reduction product of benzoic acid? (Sample exam 2026)

(A) $C_6H_5CH_2OCOCH_3$
(B) $C_6H_5CH_2COOCH_3$
(C) $CH_3COOC_6H_5$
(D) $C_6H_5OCOCH_3$

---

24 The acid hydrolysis of propyl benzoate produces an acidic compound (X), and when compound (X) reacts with the simplest aliphatic alcohol, compound (Y) is produced. (Sample exam 2026)

Which of the following is an isomer of compound (Y)?

(A) Phenyl formate.
(B) Butyl formate.
(C) Phenyl acetate.
(D) Phenyl benzoate.

---

25 Two organic compounds (X , Y): the molecular formula of compound (X) is $C_2H_6O_2$, while compound (Y) has the formula $C_2H_4O_2$ (Sample exam 2026)

Which of the following is correct?

(A) Both react with sodium hydroxide.
(B) Both react with hydrohalic acids.
(C) Both can be oxidized by potassium permanganate solution.
(D) When they react together, an ester forms.

---

26 Which of the following pairs of compounds react to produce the compound $C_2H_5OOCC_6H_5$? (1st session 2025)

(A) Phenol and ethanoic acid.
(B) Phenol and propanoic acid.
(C) Benzoic acid and methanol.
(D) Benzoic acid and ethanol.

---

27 Three organic compounds: (1st session 2025)

Compound (A): has the formula $C_nH_{2n}O_2$ and does not react with $NaHCO_3$

Compound (B): the simplest compound with the formula $C_nH_{2n}O$ that is not oxidized by ordinary oxidizing agents.

Compound (C): has the formula $C_nH_{2n+2}O$ and reacts with sodium.

Which of the following is correct?

(A) The boiling point of (A) is higher than that of (C) with the same molar mass.

(B) Compound (B) is produced by the oxidation of compound (C) and by the reduction of compound (A).

(C) Compound (C) is oxidized to give compound (B) and is used in preparing compound (A).

(D) Compound (A) is the product of the reaction of compound (C) with compound (B).

---

28 Which of the following expresses the correct order of the chemical processes used to prepare Dacron fibres? (1st session 2025)

(A) Alkylation of toluene / complete oxidation / esterification.

(B) Catalytic reforming of methylhexane / oxidation / esterification.

(C) Catalytic reforming of heptane / oxidation / esterification.

(D) Catalytic hydration of ethyne / oxidation / esterification.

---

29 Four organic compounds: (1st session 2025)

Compound (A) : $C_7H_6O_3$ • Compound (B) : C_6H_6O

Compound (C) : CH_4O • Compound (D) : $C_3H_6O_2$

Which of the following is correct?

(A) Compound (B) reacts with compound (C) to form a heat-insulating compound.

(B) Compound (A) reacts with compound (C) to form Dacron fibres.

(C) The acid hydrolysis of compound (D) gives compound (B).

(D) Compound (A) reacts with compound (C) and gives oil of wintergreen.

---

30 Which of the following pairs are not isomers? (2nd session 2024)

(A) Ethyl acetate and propanoic acid.

(B) 2-ethyl-1-butene and 2-hexene.

(C) 2-butanol and diethyl ether.

(D) Propanal and acetone.

---

31 The molecular formulas of compounds (X) and (Y) are: (2nd session 2024)

(X) : C_4H_8O , (Y) : $C_6H_{12}O_2$

Which of the following choices expresses the correct IUPAC name of each of them?

(A) (X) : butanol , (Y) : hexanoic.

(B) (X) : butanaldehyde , (Y) : propyl propanoate ester.

(C) (X) : butanal , (Y) : ethyl butanoate ester.

(D) (X) : butanol , (Y) : butyl acetate ester.

---

32 The following table shows the boiling points of three organic compounds (X), (Y) and (Z) with the same molar mass: (2nd session 2024)

(X) : 31.8°C , (Y) : 97.8°C , (Z) : 118°C

Which of the following choices expresses these compounds?

(A) (X) : ester , (Y) : acid , (Z) : alcohol.

(B) (X) : acid , (Y) : alcohol , (Z) : ester.

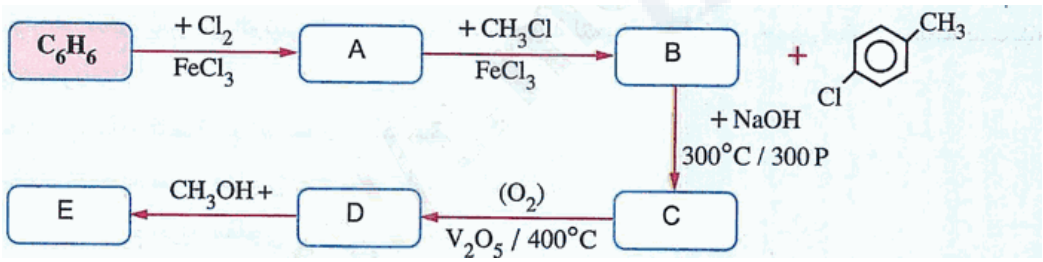
(C) (X) : alcohol , (Y) : acid , (Z) : ester.

(D) (X) : ester , (Y) : alcohol , (Z) : acid.

---

33 From the following chart: (2nd session 2024)

Which of the following choices is correct?



(A) Compound (D) is phthalic acid, and compound (E) is an ester used to relieve rheumatic pain.

(B) Compound (B) is ortho-chlorotoluene, and compound (E) is an ester used to relieve headaches.

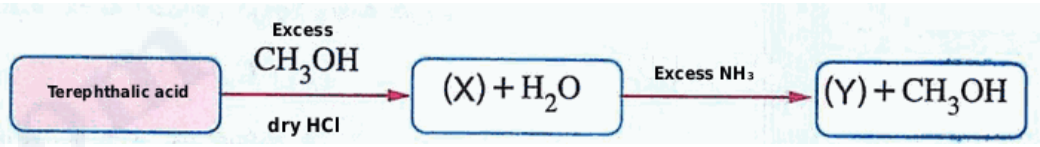
(C) Compound (D) is salicylic acid, and compound (E) is an ester used to prevent blood clots.

(D) Compound (A) is chlorobenzene, and compound (E) is an ester used to relieve rheumatic pain.

---

34 Study the following chart: (2nd session 2024)

The choice that expresses substances (X) and (Y) is .....



(A) (X) : hydrolysed in an acidic medium, giving a dibasic aromatic acid , (Y) : a monoamide compound.

(B) (X) : hydrolysed in an acidic medium, giving a monohydric aliphatic alcohol , (Y) : a monoamide compound.

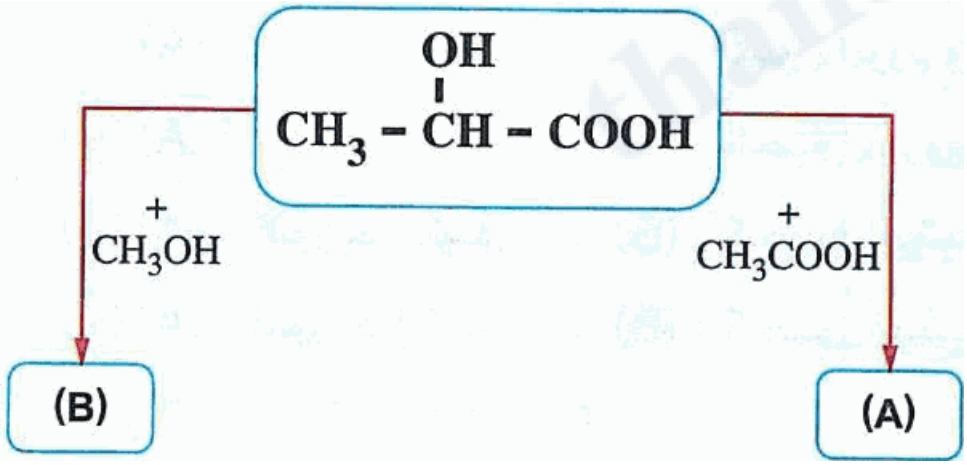
(C) (X) : reacts with NaOH, giving a dihydric aromatic alcohol , (Y) : a diamide compound.

(D) (X) : reacts with NaOH, giving a salt that can be used to prepare benzene , (Y) : a diamide compound.

---

35 From the opposite chart: (1st session 2023)

Which of the following choices is correct?



(A) Compound (A) does not effervesce when sodium carbonate is added to it.

(B) Compound (B) forms acetamide by ammonolysis.

(C) Compound (A) removes the violet colour of acidified potassium permanganate.

(D) Compound (B) removes the violet colour of acidified potassium permanganate.

---

36 (X), (Y) and (Z) are three hydrocarbon derivatives. (Trial exam / March 2023)

(X): can be oxidized and reduced.

(Y): an isomer of an alcohol.

(Z): produced by the reaction of an acid with an alcohol.

Which of the following choices is correct?

(A) (X) : aldehyde , (Y) : ether , (Z) : ester.

(B) (X) : ketone , (Z) : ester.

(C) (X) : aldehyde , (Z) : ether.

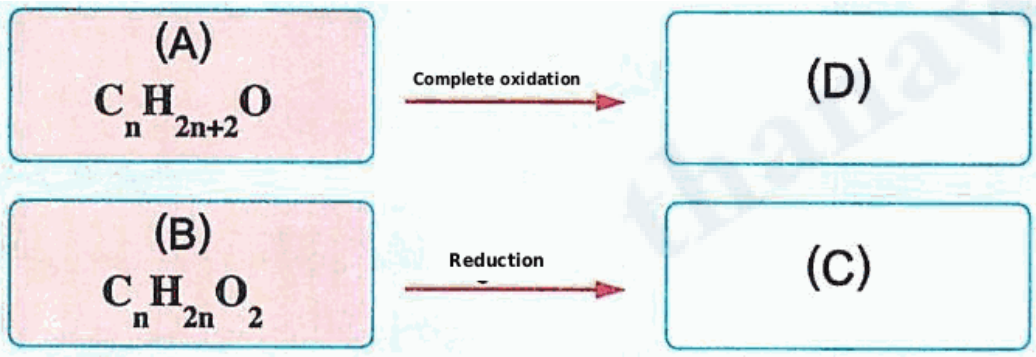
(D) (X) : alcohol , (Y) : ester.

---

37 From the following charts: (1st session 2024)

If n = 2 in compound A and n = 3 in compound B

Which of the following choices is correct?



(A) When compound (C) combines with compound (D), an isomer of pentanone is produced.

(B) The boiling point of compound (C) is higher than that of compound (D).

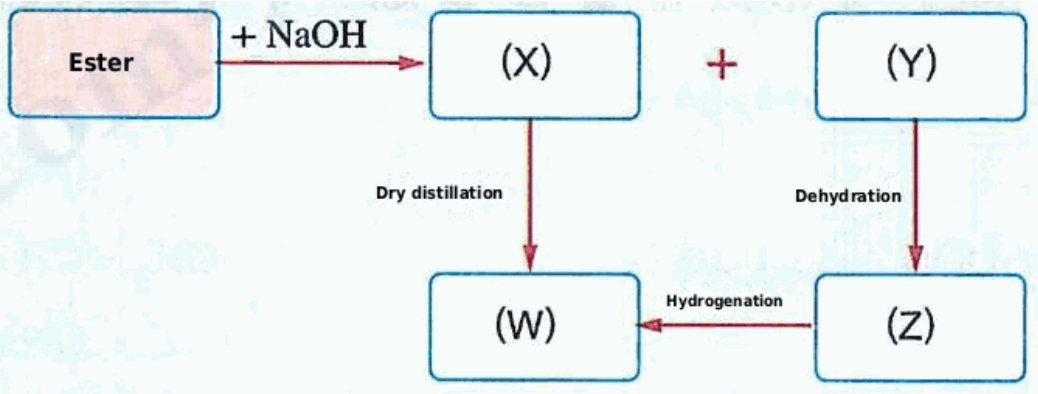
(C) When compound (C) combines with compound (D), an isomer of pentanoic acid is produced.

(D) Compound (B) is an isomer of compound (D).

---

38 Study the opposite chart: (1st session 2024)

Which of the following choices is correct?



(A) (Y) : ethanol , (W) : propane.

(B) (X) : sodium ethanoate , (Z) : ethene.

(C) (Y) : propanol , (W) : ethane.

(D) (X) : sodium propanoate , (Z) : ethene.

---

39 Three organic compounds (A), (B) and (C): when (A) is added to (C), a flavouring is produced; when sodium hydroxide is added to (B) or (C), a reaction takes place; and when sodium hydroxide is added to (A), no reaction takes place. So the three compounds are ..... (Trial exam / June 2021)

(A) (A) : alcohol , (B) : phenol , (C) : acid.

(B) (A) : phenol , (B) : alcohol , (C) : acid.

(C) (A) : acid , (B) : alcohol , (C) : phenol.

(D) (A) : acid , (B) : phenol , (C) : alcohol.

---

40 When 1 mol of ethylene glycol reacts with 2 mol of acetic acid, the product is ..... (1st session 2021)

(A) $CH_3COO-CH_2-CH_2-OOCCH_3$

(B) $CH_3OOC-CH_2-CH_2-COOCH_3$

(C) $CH_3COOC_2H_5$

(D) $CH_3COO(CH_2)_2CH_3$

---

41 Water can be obtained from all of the following reactions, except ..... (Trial exam / March 2023)

(A) combustion of ethane.

(B) reaction of propanoic acid with methanol.

(C) adding acidified $KMnO_4$(aq) to 1-propanol.

(D) polymerization of propylene.

---

42 The molecular isomer of the compound $C_6H_5COOCH_3$ is called ..... (Trial exam / June 2021)

(A) phenyl acetate.

(B) methyl heptanoate.

(C) ethyl hexanoate.

(D) phenyl formate.

---

43 Which of the following is an isomer of ethyl pentanoate? (1st session 2021)

(A) Pentyl formate.

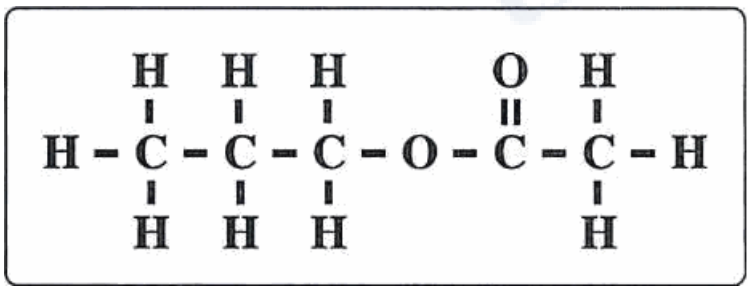
(B) Propyl butanoate.

(C) Phenyl benzoate.

(D) Phenyl acetate.

---

44 According to the IUPAC system, the opposite compound is called ..... (2nd session 2021)



(A) methyl butanoate.

(B) ethyl propanoate.

(C) propyl acetate.

(D) propyl ethanoate.

---

45 Octanoic acid is a fatty acid that is the main component of coconut oil. (1st session 2023)
All of the following are isomers of it, except .....

(A) hexyl ethanoate.

(B) pentyl propanoate.

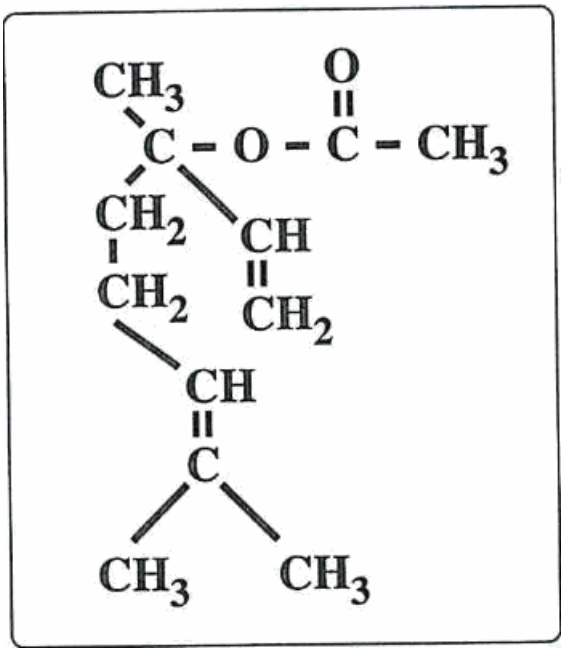
(C) butyl butyrate.

(D) butyl pentanoate.

---

46 The structural formula in front of you represents the chemical structure of basil ester. (2nd session 2023)

When this compound is saturated and then hydrolysed in an acidic medium, ... forms.



(A) acetic acid and 3,7-dimethyl-3-octanol

(B) ethanol and 3,7-dimethyloctanoic acid

(C) acetic acid and 2,6-dimethyl-6-octanol

(D) methanol and 3,7-dimethyloctanoic acid

---

47 Which of the following pairs are not isomers? (2nd session 2023)

(A) Phenyl acetate ester , ethyl benzoate ester.

(B) Phenyl acetate ester , methyl benzoate ester.

(C) Para-chlorotoluene , chlorophenylmethane.

(D) Phenyl formate , benzoic acid.

---

48 The ester that is an isomer of the compound CH_3COOCH_3 can be prepared from ..... (Trial exam / June 2021)

(A) formic acid + ethyl alcohol.

(B) acetic acid + methyl alcohol.

(C) formic acid + methyl alcohol.

(D) acetic acid + ethyl alcohol.

---

49 Phenyl methanoate can be obtained, under suitable conditions, from ..... (1st session 2022)

(A) benzoic acid and methanoic acid.
(B) formic acid and picric acid.
(C) formic acid and carbolic acid.
(D) benzoic acid and ethanoic acid.

50 The correct order of the following compounds according to their boiling points is ..... (Trial exam / June 2021)

(A) Propanoic acid > propanol > methyl acetate.
(B) Propanol > methyl acetate > propanoic acid.
(C) Methyl acetate > propanol > propanoic acid.
(D) Methyl acetate > propanoic acid > propanol.

51 Hydrogen bonds form between the molecules of the following compounds, except ..... (1st session 2022)

(A) acetic acid. (B) ethanol. (C) dihydroxyethane. (D) ethyl ethanoate.

52 The following table shows the functional groups of compounds (A), (B) and (C): (2nd session 2022)

(A) : –COOR , (B) : –COOH , (C) : –OH

The correct order of these compounds according to the number of hydrogen bonds between every 2 molecules of the same compound is .....

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

53 When the isomers of the compound $C_6H_{12}O_2$ are each hydrolysed separately in a basic medium, the alcohol produced that has the highest boiling point is ..... (2nd session 2021)

(A) $C_6H_{13}OH$ (B) C_2H_5OH (C) CH_3OH (D) C_4H_9OH

54 The following table shows the ways of obtaining compounds (A), (B) and (C) under suitable conditions for each process: (2nd session 2022)

Reactant: ethene , process: oxidation , product: (A)

Reactant: ethene , process: catalytic hydration , product: (B)

Reactant: triglyceride ester , process: basic hydrolysis , product: (C) + the salt of the acid

The order of compounds (A), (B) and (C) according to boiling point is .....

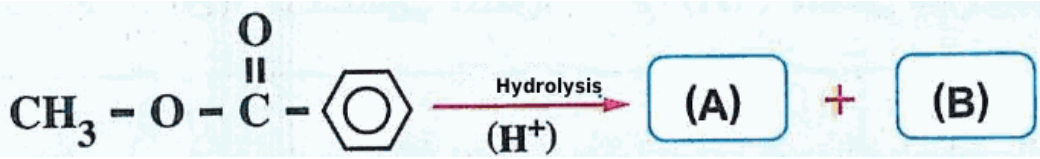
(A) A < B < C (B) C < A < B (C) B < A < C (D) A < C < B

55 Butyl ethanoate is hydrolysed in an acidic medium. Which of the following is an isomer of the alcohol produced? (2nd session 2022)

(A) C_3H_7CHO (B) $C_2H_5COCH_3$ (C) C_3H_7COOH (D) $C_3H_7OCH_3$

56 From the following chart: (2nd session 2022)

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



(A) (A) : an aromatic acid , (B) : a phenol.

(B) (A) : an aromatic acid , (B) : an alcohol.

(C) (A) : an aliphatic acid , (B) : an alcohol.

(D) (A) : an aliphatic acid , (B) : a phenol.

57 Ester (A) is derived from the oxidation product of toluene. The ammonolysis of this ester produced compounds (C) and (B). (2nd session 2021)

Compound (C) is aromatic and acidic.

Which of the following is correct?

(A) (A) : phenyl benzoate , (B) : benzamide.

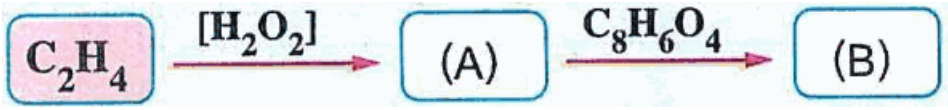
(B) (A) : phenyl benzoate , (B) : benzyl alcohol.

(C) (A) : methyl benzoate , (B) : benzamide.

(D) (A) : methyl benzoate , (B) : benzyl alcohol.

58 From the opposite chart: (Trial exam / March 2023)

The uses of (A) and (B) are .....



(A) (A) : fuel , (B) : an insulating material in electrical appliances.

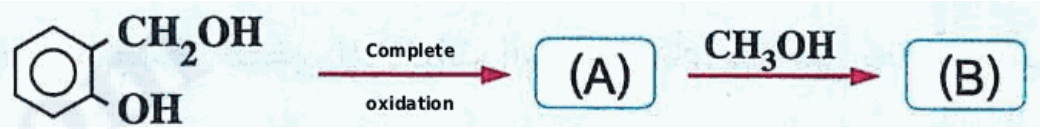
(B) (A) : making drugs , (B) : in car radiators.

(C) (A) : in car radiators , (B) : making artificial heart valves.

(D) (A) : making artificial heart valves , (B) : making tubes to replace damaged arteries.

59 From the opposite reaction chart: (1st session 2022)

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



(A) (A) : catechol , (B) : aspirin.

(B) (A) : oil of wintergreen , (B) : aspirin.

(C) (A) : salicylic acid , (B) : methyl salicylate.

(D) (A) : benzoic acid , (B) : methyl benzoate.

---

60 An organic compound (A) reacts with an organic compound (B) to produce a substance that has a role in treating heart diseases. (2nd session 2021)

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

(A) (A) : terephthalic acid , (B) : ethylene glycol.

(B) (A) : phenol , (B) : formaldehyde.

(C) (A) : phenol , (B) : ethylene glycol.

(D) (A) : glycerol , (B) : sulphuric acid.

---

61 From the opposite chart: A + B → C (2nd session 2022)

(A) and (C) react with caustic soda solution under suitable conditions, and (B) does not react with caustic soda solution.

Which of the following choices is correct?

(A) (B) : methanoic acid , (C) : methyl ethanoate.

(B) (A) : phenol , (B) : methanoic acid.

(C) (A) : ethanol , (C) : propanoic acid.

(D) (A) : benzoic acid , (C) : methyl benzoate.

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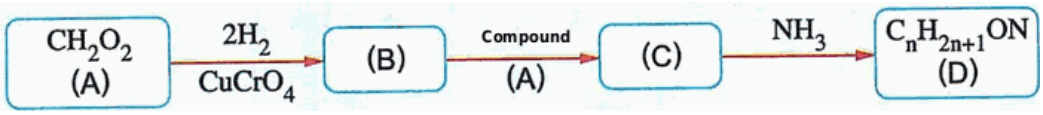
62 Study the following chart, then answer the following questions: (Sample exam 2026)

(1) What is the common name of compound (A)?

(2) Write the structural formula of the compound produced by the reaction of (B) with $C_7H_6O_3$

(3) What is the IUPAC name of compound (C)?

(4) Write the structural formula of compound (D).



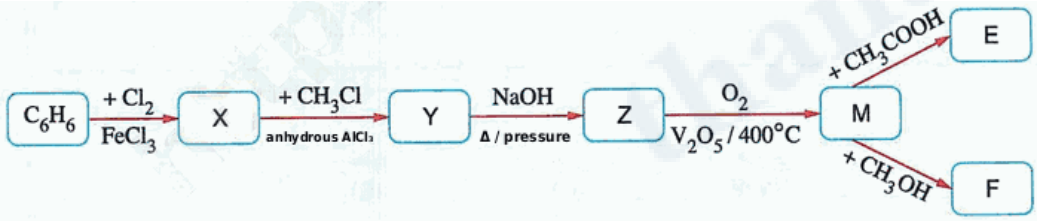
63 From the following chart: (Sample exam 2026)

Compound (E) is used as a medical drug, and it is advised to take it with plenty of water to prevent stomach ulcers.

(1) Write the chemical formula of compounds (Z) and (Y).

(2) Write the chemical formula of the acid produced by the acid hydrolysis of compound (F).

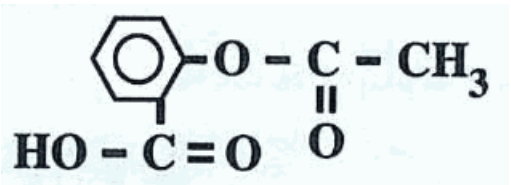
(3) State a use of compound (F).



64 The opposite structural formula of aspirin: (Trial exam / March 2023)

(1) Calculate the number of moles of sodium hydroxide that must be added to complete the reaction with 1 mol of aspirin solution, with heating.

(2) Calculate the number of moles of hydrogen that must be added to aspirin solution to convert it into a neutral aliphatic compound, under suitable conditions.



Answer key and solutions

Multiple choice questions

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

1 **Answer (B)**

The ester group –COO– contains a C = O bond and a C – O bond.

2 **Answer (B)**

$CH_3COOCH_2CH_3$ (ethyl acetate) contains the –COO– group, so it is an ester.

3 **Answer (D)**

$CH_3COO–$ is the acetate (ethanoate) part and $C_6H_5–$ is the phenyl group.

So the name is phenyl ethanoate or phenyl acetate.

4 **Answer (A)**

Propanoate = $CH_3CH_2COO–$, methyl = $CH_3–$

Formula: $CH_3CH_2COOCH_3$

5 **Answer (A)**

The acid part has a chain of 5 carbon atoms (pentanoate), numbered from the carbon atom of COO.

It has two methyl groups on atoms 2 and 4, and the alcohol part is methyl.

Name: methyl 2,4-dimethylpentanoate.

6 **Answer (A)**

Ethyl benzoate: $C_6H_5COOC_2H_5$ (the ring is attached to the carbon atom of COO).

7 **Answer (C)**

Ethyl ethanoate has the formula $C_4H_8O_2$

2-methylbutanoic acid has the formula $C_5H_{10}O_2$, so it is not an isomer of it.

8 **Answer (B)**

Methyl benzoate $C_6H_5COOCH_3$ has the formula $C_8H_8O_2$

Phenylacetic acid $C_6H_5CH_2COOH$ has the same molecular formula.

9 **Answer (D)**

Pentyl acetate is $C_7H_{14}O_2$

Propyl propanoate is $C_6H_{12}O_2$, so it is not an isomer of it.

10 **Answer (A)**

The 74 g/mol ester has the formula $C_3H_6O_2$

Its isomers that do not form hydrogen bonds are the esters only: methyl acetate and ethyl formate.

Number = 2

11 **Answer (C)**

The acid part has 5 carbon atoms (pentanoic acid) and the alcohol part is ethyl (ethanol).

12 **Answer (C)**

The acid part is $CH_3CH_2CH_2CO-$ (butanoic acid).

The alcohol part is $-CH(CH_3)_2$ (2-propanol).

13 **Answer (A)**

The alcohol part is CH_3CH_2-O- (ethanol).

The acid part is $-CO-CH_2CH_2CH_3$ (butanoic acid).

14 **Answer (B)**

$C_3H_7COOH + C_5H_{11}OH \rightarrow C_3H_7COOC_5H_{11} + H_2O$

The acid part has 4 carbon atoms and the alcohol part has 5 carbon atoms.

15 **Answer (D)**

The acid is dicarboxylic, and with excess ethanol both groups are esterified.

The product is the diethyl ester (D).

16 **Answer (C)**

CH_3CH_2COO- is the propanoate part , $-CH_2CH_2CH_2CH_3$ is the butyl alkyl.

17 **Answer (A)**

Ethyl butanoate $C_3H_7COOC_2H_5$ is made from the acid C_3H_7COOH and ethanol C_2H_5OH

18 **Answer (C)**

$CH_3COOH + C_2H_5OH \rightarrow CH_3COOC_2H_5 + H_2O$

The number of C atoms is equal, while H and O are less in the ester because a water molecule is removed.

19 **Answer (C)**

$HCOOH + CH_3CH_2CH_2OH \rightarrow HCOOCH_2CH_2CH_3 + H_2O$

In esterification a water molecule is removed, so it is a condensation reaction.

20 **Answer (D)**

The product is ethyl acetate $C_4H_8O_2$ (an ester).

Its isomer with the same functional group (ester) is methyl propanoate.

21 **Answer (C)**

(X) : 2-butanol = secondary butyl alcohol.

With acetic acid it forms secondary butyl acetate.

22 **Answer (B)**

(1) ethanol only: disinfectants.

(2) the ester (ethyl acetate): perfumes.

(3) ethanoic acid only: insecticides.

23 **Answer (D)**

Complete oxidation of 1-propanol gives propanoic acid.

Alcohol + acid → ester (propyl propanoate), which has a pleasant smell.

24 **Answer (A)**

By substitution (hydrolysis), the alkyl halide gives an alcohol.

Oxidation of the alcohol gives an acid, and the acid with an alcohol gives an ester.

25 **Answer (A)**

Lactic acid $CH_3CH(OH)COOH$ reacts through its OH group with ethanoic acid.

So an ester forms that still has a COOH group (a carboxylic ester).

26 **Answer (B)**

Lactic acid reacts through its COOH group with ethanol.

So an ester forms that still has an OH group (a hydroxy ester).

27 **Answer (B)**

Boiling point: alcohol (hydrogen bonds) > ester > alkane.

2-butanol 99°C , methyl acetate 57°C , 2-methylbutane 28°C

28 **Answer (B)**

For equal molar masses: acid > alcohol > ester.

C_3H_7COOH : 163.7°C , $C_5H_{11}OH$: 137.9°C , $CH_3COOC_2H_5$: 77.1°C

29 **Answer (C)**

(A) has a low boiling point, so it is an ester, and (B) is higher, so it is an alcohol.

Methyl acetate (74 g/mol) and 1-butanol (74 g/mol).

30 **Answer (A)**

$HCOOCH_3$ is an ester that does not form hydrogen bonds.

So its boiling point is much lower than that of the alcohol and the acid: 31°C

31 **Answer (B)**

Propanoic acid CH_3CH_2COOH + propanol $CH_3CH_2CH_2OH$

The ester: $CH_3CH_2COOCH_2CH_2CH_3$ (B).

32 **Answer (C)**

Butanoic acid is the acid part of ethyl butanoate.

Hydrolysis in an acidic medium gives the acid itself (the alkaline medium gives its salt).

33 **Answer (B)**

For the two products to give the same colour with bromothymol blue, they must both be acids.

$CH_3COOCH_2CH_2COOH \rightarrow CH_3COOH + HOCH_2CH_2COOH$

34 **Answer (A)**

The ester has two oxygen atoms $(32\ g)$.

$32 \div 0.276 = 116\ g/mol$, so the formula is $C_6H_{12}O_2$

Butyl acetate $(C_6H_{12}O_2)$ gives 1-butanol and ethanoic acid.

35 **Answer (B)**

$(CH_3)_2CH–O–$ is the 2-propanol part.

$–CO(CH_2)_2CH_3$ is the butanoic acid part.

36 **Answer (D)**

Phenyl ethanoate is hydrolysed into ethanoic acid and phenol.

Both react with NaOH

37 **Answer (A)**

Hydrolysis of one mole gives 1 mol of glycerol $C_3H_8O_3$ and 3 mol of stearic acid.

$C_{17}H_{35}COOH + 26O_2 \rightarrow 18CO_2 + 18H_2O$

38 **Answer (D)**

Hydrolysis in an alkaline medium gives the salt of the acid and the alcohol.

Sodium propanoate + ethanol.

39 **Answer (A)**

Methanol is produced (alcohol part $CH_3–$) and sodium ethanoate (acid part $CH_3COO–$).

The ester: CH_3COOCH_3

40 **Answer (D)**

$C_{15}H_{31}COOC_{16}H_{33} + NaOH \rightarrow C_{15}H_{31}COONa + C_{16}H_{33}OH$

41 **Answer (D)**

In hydrolysis, the bond between the carbonyl group and the oxygen breaks.

So the ^{18}O atom stays with the alcohol part in the alcohol, and the salt of the acid forms.

42 **Answer (A)**

Ethyl propanoate gives ethanol.

$C_2H_5OH + (CH_3)_2CHCOOH \rightarrow (CH_3)_2CHCOOC_2H_5 + H_2O$

43 **Answer (A)**

$CH_3CH_2CH_2COOC_2H_5 + NaOH \rightarrow CH_3CH_2CH_2COONa + C_2H_5OH$

44 **Answer (D)**

Basic medium: salt + alcohol , acidic medium: acid + alcohol.

Common (2): alcohol , (1): salt , (3): acid.

45 **Answer (C)**

The compound is a diester; with excess NaOH it gives the salts of the two acids and the dihydric alcohol.

$HCOONa + HOCH_2CH_2CH_2OH + CH_3COONa$

46 **Answer (C)**

The compound has an ester group, so it is hydrolysed by NaOH, giving a salt of an organic acid.

It has a double bond, so it removes the colour of bromine water.

It has no COOH group, so no effervescence occurs with Na_2CO_3

47 **Answer (D)**

$CH_3(CH_2)_{14}COONa$ is sodium palmitate, which is a soap.

It is derived from palmitic acid $C_{15}H_{31}COOH$

48 **Answer (B)**

For example aspirin: it is hydrolysed into ethanoic acid and salicylic acid.

NaOH reacts with COOH and the phenolic OH: CH_3COONa and the disodium salicylate salt (ortho).

49 **Answer (D)**

The $-CONH_2$ group is the amide group.

50 **Answer (D)**

The general formula of acid amides: $RCONH_2$

51 **Answer (D)**

Benzamide $C_6H_5CONH_2$ contains the $-CONH_2$ group.

52 **Answer (C)**

$CH_2=CH-CONH_2$ has an amide group and has no amine and carboxyl groups.

So it is not an amino acid.

53 **Answer (D)**

$HCOOCH(CH_3)_2 + NH_3 \rightarrow HCONH_2 + (CH_3)_2CHOH$

2-propanol is a secondary alcohol, and formamide $HCONH_2$ has 6 atoms.

54 **Answer (C)**

(A) propene: can undergo addition polymerization.

(B) phenol: contains a hydroxyl group.

(C) undergoes ammonolysis: an ester.

55 **Answer (A)**

(1) lactic acid reacts with sodium bicarbonate.

With acetic acid (2) it forms an ester (4), a liquid with a characteristic smell.

With methanol (3) it forms an ester (5) that undergoes ammonolysis.

56 **Answer (A)**

C_7H_7ON is benzamide $C_6H_5CONH_2$

Alkylation (toluene) → oxidation (benzoic acid) → esterification (methyl benzoate) → ammonolysis (benzamide).

57 **Answer (D)**

Its oxidation gives propanoic acid, which has a higher boiling point. ✓

With ethanoic acid it forms propyl acetate, which tastes of pears. ✓

58 **Answer (D)**

Oil with an alkali (alkaline hydrolysis) gives soap and glycerol.

59 **Answer (C)**

Glycerides are esters of fatty acids with glycerol, not salts.

60 **Answer (C)**

The sodium salt of a long-chain fatty acid is soap.

61 **Answer (D)**

An unsaturated oil reacts with H_2, so the volume of gas left decreases.

(W), (Y) and (Z) reacted with H_2, but (X) did not react.

62 **Answer (B)**

The acids of fats are saturated and the acids of oils are unsaturated.

Both are hydrolysed in H^+

63 **Answer (A)**

Oils are esters of glycerol with fatty acids, and pyrogallol is not involved.

64 **Answer (B)**

The polymer is Dacron, made from ethylene glycol and terephthalic acid.

65 **Answer (C)**

A polyester needs monomers with OH and COOH, and a water molecule is removed. ✓ ✓

The two monomers do not have to be identical. ✗

66 **Answer (B)**

Oxidation of para-xylene gives terephthalic acid (an organic acid).

With ethylene glycol it forms Dacron (a copolymer).

67 **Answer (C)**

(A) Bakelite: condensation , (B) Teflon: addition , (C) Dacron: condensation.

68 **Answer (C)**

$HOOC–(CH_2)_2–COOH + HO–CH_2CH_2–OH$ form a polyester.

The unit: $–O–CH_2–CH_2–O–CO–(CH_2)_2–CO–$

69 **Answer (D)**

The unit $–OOC–CH_2–COO–CH_2CH_2CH_2–$

The monomers: $HOOCCH_2COOH$ and $HOCH_2CH_2CH_2OH$

70 **Answer (A)**

Oil of wintergreen: salicylic acid + methanol.

Aspirin: salicylic acid + ethanoic acid.

(1) methanol , (2) the common one, salicylic acid , (3) ethanoic acid.

71 **Answer (D)**

Aspirin (acetylsalicylic acid): an $OCOCH_3$ group and a COOH group in the ortho position.

72 **Answer (A)**

Aspirin forms by esterification and a water molecule is removed, so it is a condensation reaction.

73 **Answer (A)**

Dacron does not contain a methyl group.

Oil of wintergreen (OCH_3), toluene and aspirin ($OCOCH_3$) contain a methyl group.

74 **Answer (C)**

Picric acid (trinitrophenol) has no COOH group.

75 **Answer (C)**

Aspirin has a COOH group, so it reacts with $NaHCO_3$

76 **Answer (B)**

Both are esters containing the –COO– group.

77 **Answer (D)**

Methyl salicylate (oil of wintergreen) is found in natural plant oils.

78 **Answer (C)**

(X) is (glacial) acetic acid.

It is used in making aspirin and artificial silk, and it is not used in the sulphonation of benzene.

79 **Answer (C)**

(A) salicylic acid is used to prepare methyl salicylate.

A saturated triglyceride gives a saturated fatty acid (D) $C_{13}H_{27}COOH$ and glycerol (E).

80 **Answer (D)**

The aliphatic product is methanol, and it does not react with NaOH solution.

81 **Answer (C)**

(1) methanol (x = 16) , (2) salicylic acid (48 g of oxygen) , (3) ethanoic acid.

Methyl ethanoate: 74 g/mol

(2) + (3) gives aspirin, which reduces blood clotting.

82 **Answer (C)**

The products are salicylic acid and ethanoic acid, which are both acids.

Bromothymol blue turns yellow in an acidic medium, not green.

83 **Answer (C)**

The two products are salicylic acid and ethanoic acid; each COOH group is reduced to CH_2OH by 2 mol of H_2

2 + 2 = 4 mol

84 **Answer (B)**

Reduction of COOH gives CH_2OH, so the products contain a primary alcohol group.

85 **Answer (C)**

Alkaline hydrolysis of chlorobenzene gives phenol.

Alkylation gives ortho-cresol, and oxidation gives salicylic acid.

Essay questions

1 **Model answer**

(1) Common name: ethyl formate , IUPAC: ethyl methanoate.

(2) Common name: propyl propionate , IUPAC: propyl propanoate.

2 **Model answer**

(1) Methyl propanoate.

(2) CH_3OH (methanol) , CH_3CH_2COOH (propanoic acid).

Propanoic acid has a higher boiling point than methyl alcohol.

3 **Model answer**

Formula of polymer (X): $HO–CO–C_6H_4–CO–O–CH_2–CH_2–OH$ (Dacron).

Medical use: it is used to make artificial heart valves or tubes used to replace damaged arteries.

4 **Model answer**

(1) The ester group –COO–

(2) $C_6H_5–CH(CH_3)–OH$ and CH_3COOH

IUPAC name of the aliphatic compound: ethanoic acid.

5 **Model answer**

(1) Its weak conduction of electric current.

(2) $C_3H_7COOH + HOCH_2CH_2OH \rightarrow C_3H_7COOCH_2CH_2OH + H_2O$

Structural formula: $CH_3–CH_2–CH_2–CO–O–CH_2–CH_2–OH$

6 **Model answer**

(1) Butanal: $CH_3–CH_2–CH_2–CHO$

(2) $CH_3CH_2CH_2COOH + C_2H_5OH \rightarrow CH_3CH_2CH_2COOC_2H_5 + H_2O$ (conc. H_2SO_4)

7 **Model answer**

(1) $H–CO–O–CH_3$, methyl methanoate.

(2) The boiling point of ester (X) is lower than the boiling points of both the alcohol and the acid it is derived from.

8 **Model answer**

(1) Alcohol (X): ethyl alcohol , organic acid (Y): propanoic acid.

(2) $CH_3–CH_2–CO–O–CH_2–CH_3$

9 **Model answer**

Alcohol (A): C_2H_5OH , acid (B): CH_3COOH

(1) Acetaldehyde: $CH_3–CHO$

(2) Ethanol: $CH_3–CH_2–OH$

10 **Model answer**

$CH_3COOC_2H_5 + NH_3 \rightarrow CH_3CONH_2 + C_2H_5OH$

The amide produced from ester (1): acetamide.

$HCOOCH_2CH_3 + NH_3 \rightarrow HCONH_2 + CH_3CH_2OH$

11 **Model answer**

(1) $C_3H_7Br + KOH(aq) \rightarrow C_3H_7OH + KBr$ (by heating)

(2) The amide of acid (B): $CH_3–CH_2–CONH_2$

12 **Model answer**

(1) Compound (2): sodium benzoate , compound (3): ethyl alcohol.

(2) Reaction with soda lime: compound (2) reacts , compound (3) does not react.

13 **Model answer**

(1) Reaction (1): complete oxidation , reaction (2): esterification.

(2) $CH_3COONa + NaOH \rightarrow CH_4 + Na_2CO_3$ (CaO, by heating)

14 **Model answer**

$CH_3Cl + KOH \rightarrow CH_3OH + KCl$ (by heating)

$HOC_6H_4COOH + CH_3OH \rightarrow HOC_6H_4COOCH_3 + H_2O$ (oil of wintergreen)

15 **Model answer**

$C_2H_5OH + CH_3COOH \rightarrow CH_3COOC_2H_5 + H_2O$ (conc. H_2SO_4)

$CH_3COOC_2H_5 + NH_3 \rightarrow CH_3CONH_2 + C_2H_5OH$

16 **Model answer**

(1) $HCOOH + CH_3OH \rightarrow HCOOCH_3 + H_2O$ (conc. H_2SO_4)

(2) $C_6H_5COOH + CH_3OH \rightarrow C_6H_5COOCH_3 + H_2O$ (dry HCl gas)

17 **Model answer**

(1) Because concentrated sulphuric acid reacts with the benzene ring of benzoic acid by substitution (sulphonation).

(2) Because the reaction is reversible, so propanoic acid remains present in the reaction medium.

Past exam questions

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

51	52	53	54	55	56	57	58	59	60
D	D	D	C	D	B	A	C	C	A

61	62	63	64
D	—	—	—

1 **Answer (B)**

The acid is formic acid HCOOH (one carbon atom and one carboxyl group).

The alcohol is ethanol, and the product is ethyl formate $HCOOC_2H_5$

It has one ester isomer: methyl acetate CH_3COOCH_3

2 **Answer (D)**

The compound has a COOH group: it reacts with $NaHCO_3$ and CO_2 is given off, which turns limewater milky.

It has a phenolic OH group: it turns violet with $FeCl_3$

It has an ester bond with aminoacetic acid, so hydrolysis gives glycine.

3 **Answer (A)**

(A) reacts with cold NaOH, so it is an acid: butyric acid.

(B) does not react in the cold, so it is an ester: ethyl ethanoate.

Saponification of (C) gives methanol, so it is methyl propanoate.

4 **Answer (C)**

$C_7H_6O_2$ here is phenyl formate $HCOOC_6H_5$

Its acid hydrolysis gives phenol C_6H_6O (C_nH_nO) and formic acid.

5 **Answer (A)**

The polymer is Dacron (from ethylene glycol and terephthalic acid).

Ethylene → (oxidation) ethylene glycol , para-methyltoluene → (oxidation) terephthalic acid, then condensation polymerization.

So there are only three processes.

6 **Answer (B)**

The acid is lactic acid $CH_3CH(OH)COOH$

With methanol it reacts as an acid: $CH_3CH(OH)COOCH_3$

With acetic acid it reacts as an alcohol: $CH_3CH(OCOCH_3)COOH$

7 **Answer (C)**

Hydrolysis of propyl formate gives formic acid (X) HCOOH

Formic acid does not react with hydrohalic acids.

8 **Answer (C)**

(X) is methyl alcohol, (Y) is salicylic acid.

Their reaction gives methyl salicylate (oil of wintergreen).

9 **Answer (B)**

Benzene → (alkylation) toluene → (oxidation) benzoic acid → (+C_2H_5OH) ethyl benzoate.

10 **Answer (A)**

(X) acetic acid: with methanol it gives an ester with a fruity smell.

(Y) 2-propanol (a secondary alcohol) removes the colour of $KMnO_4$

(Z) carbolic acid gives a white precipitate with bromine water.

11 **Answer (B)**

Propyl propanoate → (basic hydrolysis) 1-propanol → (dehydration) propene → (catalytic hydrogenation) propane.

12 **Answer (D)**

Isomers of ethyl benzoate ($C_9H_{10}O_2$) include: methyl phenylacetate, benzyl acetate and phenylethyl formate.

By ammonolysis they give CH_3OH, $C_6H_5CH_2OH$ and $C_6H_5CH_2CH_2OH$

C_2H_5OH is produced from ethyl benzoate itself, not from an isomer of it.

13 **Answer (D)**

(X) is a carboxylic acid, (Y) is an ester, (Z) is an alcohol.

For equal masses, boiling point: acid > alcohol > ester.

14 **Answer (C)**

Dacron (for treating heart diseases) is made from ethylene glycol and terephthalic acid.

Bakelite (ashtrays) is made from carbolic acid and formaldehyde.

15 **Answer (A)**

Compound (X) is benzamide $C_6H_5CONH_2$

It is prepared by the ammonolysis of methyl benzoate $C_6H_5COOCH_3$

16 **Answer (A)**

(A) lactic acid $C_3H_6O_3$ uses 1 mole of NaOH

(B) salicylic acid $C_7H_6O_3$ uses 2 moles of NaOH

(C) ethanol does not react, and with (A) it forms an ester.

17 **Answer (B)**

$C_6H_5OOCCH_3$ is phenyl acetate.

Its hydrolysis gives ethanoic acid and phenol.

18 **Answer (A)**

(A) acetic acid $C_2H_4O_2$, (B) lactic acid $C_3H_6O_3$

(C) salicylic acid $C_7H_6O_3$ forms oil of wintergreen with methanol.

19 **Answer (A)**

With methanol it reacts as an acid: $HO–CH_2–COOCH_3$

With acetic acid it reacts as an alcohol: $CH_3COO–CH_2–COOH$

20 **Answer (B)**

(A) lactic acid, (B) acetic acid, (C) ethyl acetate.

Lactic acid contains an alcoholic OH, so it reacts with acetic acid; so statement (B) is wrong.

21 **Answer (B)**

Propyl propanoate → (basic hydrolysis) 1-propanol → (dehydration) propene → (hydrogenation) propane.

22 **Answer (C)**

(X) glycerol reacts with 3 moles of a fatty acid, forming an oil or a fat (Z).

Oils and fats are used in making soap.

23 **Answer (A)**

Oxidation of ethyl alcohol gives acetic acid, and reduction of benzoic acid gives benzyl alcohol.

The ester produced is benzyl acetate: $C_6H_5CH_2OCOCH_3$

24 **Answer (C)**

(X) is benzoic acid, and with methanol it gives methyl benzoate (Y) $C_8H_8O_2$

Its isomer is phenyl acetate $CH_3COOC_6H_5$ ($C_8H_8O_2$).

25 **Answer (D)**

(X) is ethylene glycol and (Y) is acetic acid.

Their reaction together forms an ester.

26 **Answer (D)**

$C_2H_5OOCC_6H_5$ is ethyl benzoate, produced from benzoic acid and ethanol.

27 **Answer (C)**

(A) is an ester, (B) is acetone, (C) is an alcohol.

2-propanol is oxidized to acetone, and it reacts with an acid to prepare an ester.

28 **Answer (A)**

Toluene → (alkylation) para-xylene → (complete oxidation) terephthalic acid → (esterification with ethylene glycol) Dacron.

29 **Answer (D)**

(A) is salicylic acid $C_7H_6O_3$ and (C) is methanol CH_4O

Their reaction (esterification) gives methyl salicylate, which is oil of wintergreen.

30 **Answer (A)**

Ethyl acetate $C_4H_8O_2$ and propanoic acid $C_3H_6O_2$ have different molecular formulas.

The other pairs have the same molecular formula.

31 **Answer (C)**

C_4H_8O : butanal.

$C_6H_{12}O_2$: ethyl butanoate $(C_3H_7COOC_2H_5)$.

32 **Answer (D)**

The compounds have the same molar mass.

The ester does not form hydrogen bonds, so its boiling point is lower.

The acid forms more hydrogen bonds than the alcohol, so its boiling point is higher.

33 **Answer (D)**

$C_6H_6 + Cl_2$ → (A) chlorobenzene.

(A) + CH_3Cl → (B) ortho-chlorotoluene (+ para-chlorotoluene).

(B) + NaOH → (C) ortho-cresol, then oxidation → (D) salicylic acid.

(D) + CH_3OH → (E) methyl salicylate (oil of wintergreen), to relieve rheumatic pain.

34 **Answer (D)**

(X) is dimethyl terephthalate; it reacts with NaOH and gives sodium terephthalate.

Distilling the salt with soda lime gives benzene.

(Y) by ammonolysis: terephthalamide (a diamide compound).

35 **Answer (D)**

(B) methyl lactate (an ester) contains a secondary alcoholic OH group.

So it is oxidized and removes the colour of acidified permanganate.

36 **Answer (A)**

(X) is oxidized and reduced: an aldehyde.

(Y) an isomer of an alcohol: an ether.

(Z) produced by the reaction of an acid with an alcohol: an ester.

37 **Answer (C)**

(A) C_2H_6O ethanol by complete oxidation → (D) acetic acid.

(B) $C_3H_6O_2$ propanoic acid by reduction → (C) propanol.

(C) + (D) → propyl acetate $C_5H_{10}O_2$, an isomer of pentanoic acid.

38 **Answer (D)**

(X) a sodium salt and (Y) an alcohol are produced by the basic hydrolysis of the ester.

(X) sodium propanoate by dry distillation → (W) ethane.

(Y) ethanol by dehydration → (Z) ethene, and by hydrogenation → ethane.

39 **Answer (A)**

(A) + (C) → an ester (flavouring), so one is an acid and the other an alcohol.

(A) does not react with NaOH, so it is the alcohol, and (C) is the acid.

(B) reacts with NaOH, so it is a phenol.

40 **Answer (A)**

One mole of glycol has two OH groups that react with 2 mol of acetic acid.

Product: $CH_3COO–CH_2–CH_2–OOCCH_3$

41 **Answer (D)**

Polymerization of propylene is addition only, and no water is produced.

Combustion, esterification and oxidation produce water.

42 **Answer (A)**

$C_6H_5COOCH_3$ has the formula $C_8H_8O_2$

Phenyl acetate $CH_3COOC_6H_5$ also has the formula $C_8H_8O_2$

43 **Answer (B)**

Ethyl pentanoate is $C_7H_{14}O_2$

Propyl butanoate $C_3H_7COOC_3H_7$ has the formula $C_7H_{14}O_2$

44 **Answer (D)**

The formula is $CH_3COO–CH_2CH_2CH_3$

The acid is ethanoic acid and the alcohol is propanol: propyl ethanoate.

45 **Answer (D)**

Octanoic acid is $C_8H_{16}O_2$

Butyl pentanoate $C_4H_9COOC_4H_9$ has the formula $C_9H_{18}O_2$, so it is not an isomer.

46 **Answer (A)**

Saturation turns the double bonds into single bonds, and acid hydrolysis separates acetic acid.

The alcohol produced: $CH_3CH_2–C(CH_3)(OH)–CH_2CH_2CH_2–CH(CH_3)_2$

Its name: 3,7-dimethyl-3-octanol.

47 **Answer (A)**

Phenyl acetate is $C_8H_8O_2$ and ethyl benzoate is $C_9H_{10}O_2$

Their formulas are different, so they are not isomers.

48 **Answer (A)**

The isomer of CH_3COOCH_3 is $HCOOC_2H_5$ (ethyl formate).

It is prepared from formic acid + ethyl alcohol.

49 **Answer (C)**

Phenyl methanoate $HCOOC_6H_5$

It is prepared from formic (methanoic) acid + carbolic acid (phenol).

50 **Answer (A)**

The acid's hydrogen bonds are stronger than the alcohol's, and the ester does not form hydrogen bonds.

Propanoic acid > propanol > methyl acetate.

51 **Answer (D)**

Esters have no hydrogen bonds between their molecules because they have no OH

52 **Answer (D)**

The ester does not form hydrogen bonds, and the alcohol forms one bond between every two molecules.

The acid forms two bonds between every two molecules.

A < C < B

53 **Answer (D)**

The largest alcohol that can be produced from $C_6H_{12}O_2$ esters among the choices is C_4H_9OH (from butyl acetate).

The greater the molar mass of the alcohol, the higher its boiling point.

54 **Answer (C)**

(A) ethylene glycol (two OH groups) , (B) ethanol (one OH group).

(C) glycerol (three OH groups) has the highest boiling point.

B < A < C

55 **Answer (D)**

Hydrolysis of butyl ethanoate gives butanol $C_4H_{10}O$

$C_3H_7OCH_3$ is an ether with the same formula $C_4H_{10}O$, so it is an isomer of it.

56 **Answer (B)**

Hydrolysis of methyl benzoate gives benzoic acid (aromatic) and methanol (an alcohol).

57 **Answer (A)**

The oxidation product of toluene is benzoic acid, so the ester is a benzoate.

(C) aromatic and acidic: phenol, so the ester is phenyl benzoate.

Ammonolysis gives (B) benzamide and phenol.

58 **Answer (C)**

$C_2H_4 + H_2O_2 \rightarrow$ (A) ethylene glycol (in car radiators).

(A) + $C_8H_6O_4$ (terephthalic acid) → (B) Dacron (used in making artificial heart valves).

59 **Answer (C)**

Complete oxidation of the CH_2OH group gives COOH: (A) salicylic acid.

(A) + $CH_3OH \rightarrow$ (B) methyl salicylate.

60 **Answer (A)**

Terephthalic acid + ethylene glycol → Dacron.

Dacron is used in making artificial heart valves.

61 **Answer (D)**

A + B → C (esterification), and (B) does not react with NaOH, so it is an alcohol.

(A) benzoic acid and (C) methyl benzoate react with NaOH

62 **Model answer**

(1) (A) : formic acid.

(2) Methyl salicylate: $HO–C_6H_4–COOCH_3$ (the OH group in the ortho position).

(3) Methyl methanoate.

(4) $HCONH_2$ ($H–CO–NH_2$).

63 **Model answer**

(1) (Y) : ortho-chlorotoluene ($CH_3–C_6H_4–Cl$).

(Z) : ortho-cresol ($CH_3–C_6H_4–OH$).

(2) Salicylic acid $HO–C_6H_4–COOH$

(3) A local ointment to relieve rheumatic pain.

64 **Model answer**

(1) 3 mol

(2) 5 mol