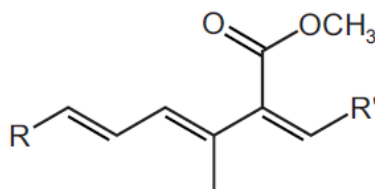


Hydroxyl Compounds – 2016

1. 9701/11/O/N/16/23

Part of the structure of a fungicide, strobilurin, is shown. R and R' are inert groups.

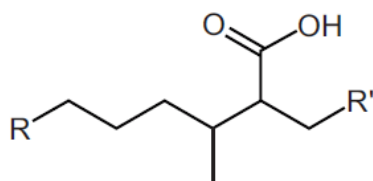


strobilurin

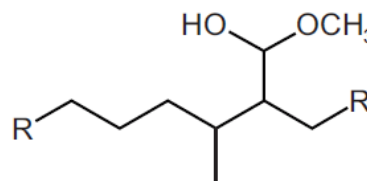
In this reaction, strobilurin is warmed with aqueous sulfuric acid producing compound X. Compound X is then treated with hydrogen in the presence of a nickel catalyst producing compound Y.

What could be the structure of compound Y?

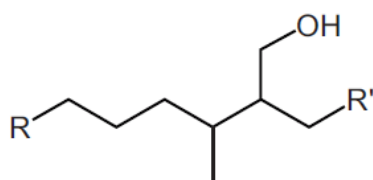
A



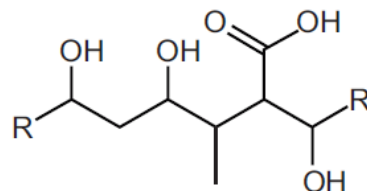
B



C

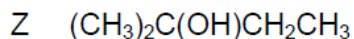
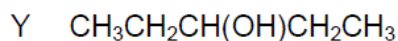
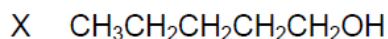


D



2. 9701/11/O/N/16/25

X, Y and Z are three isomeric alcohols.



Two or more of these alcohols react with mild oxidising agents.

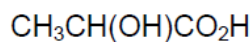
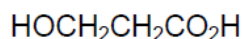
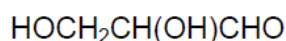
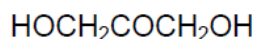
One of these alcohols, when dehydrated, will give a pair of cis-trans isomers with molecular formula C_5H_{10} .

Which row is correct?

	reacts with mild oxidising reagents	gives cis-trans isomers
A	X, Y and Z	Y only
B	X, Y and Z	Z only
C	X and Y only	Y only
D	X and Y only	Z only

3. 9701/11/O/N/16/39

Several structural isomers of $\text{C}_3\text{H}_6\text{O}_3$ are listed below.



Which statements about these structural isomers are correct?

- 1 One mole of each reacts with two moles of sodium.
- 2 Only one of the isomers contains a tertiary alcohol group.
- 3 They all contain a primary alcohol group.

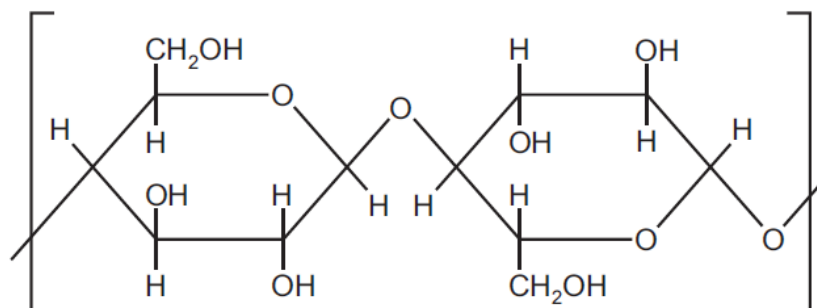
4. 9701/12/O/N/16/26
Ethane-1,2-diol, HOCH₂CH₂OH, reacts with an excess of ethanoic acid, CH₃CO₂H, in the presence of an acid catalyst. A compound is formed with the molecular formula C₆H₁₀O₄.

What is the structure of this compound?

- A CH₃OCOCH₂CH₂CO₂CH₃
 B CH₃CO₂CH₂CH₂CO₂CH₃
 C CH₃CO₂CH₂CH₂OCOCH₃
 D HOCH₂CH₂COCH₂OCOCH₃
5. 9701/12/O/N/16/27
Compound X is heated with a mild oxidising agent. One of the products of the reaction will react with hydrogen cyanide, forming 2-hydroxybutanenitrile.

What is compound X?

- A butan-1-ol
 B butan-2-ol
 C propan-1-ol
 D propan-2-ol
6. 9701/12/O/N/16/32
A cathedral in New Zealand has been constructed from cardboard. Cardboard contains polymer molecules. Part of one such polymer molecule is shown below.

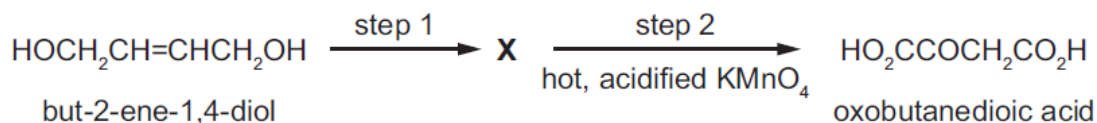


Which statements about this polymer are correct?

- 1 The polymer molecules can form hydrogen bonds with each other.
- 2 The polymer can form intermolecular forces with water molecules.
- 3 The polymer will not burn easily because it is a secondary alcohol.

7. 9701/12/F/M/16/23

But-2-ene-1,4-diol is converted in two steps through an intermediate X into oxobutanedioic acid.



What could be the reagent for step 1 and what is the intermediate X?

	reagent for step 1	X
A	cold, acidified KMnO ₄	HOCH ₂ CH ₂ CH(OH)CH ₂ OH
B	hot, acidified K ₂ Cr ₂ O ₇	HO ₂ CCH=CHCO ₂ H
C	steam and concentrated H ₂ SO ₄	HOCH ₂ CH(OH)CH ₂ CH ₂ OH
D	warm, acidified K ₂ Cr ₂ O ₇	OHCCH(OH)CH ₂ CHO

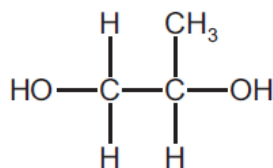
8. 9701/12/F/M/16/26

Which row correctly shows a primary, a secondary and a tertiary alcohol?

	primary	secondary	tertiary
A	$\begin{array}{c} \text{CH}_2\text{OH} \\ \\ \text{CH}_2 \\ \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{CH}_2\text{OH} \\ \\ \text{CHOH} \\ \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{CH}_2\text{OH} \\ \\ \text{CHOH} \\ \\ \text{CH}_2\text{OH} \end{array}$
B	$\begin{array}{c} \text{CH}_2\text{OH} \\ \\ \text{CH}_3-\text{C}-\text{H} \\ \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{C}-\text{OH} \\ \\ \text{CH}_3 \end{array}$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{C}-\text{H} \\ \\ \text{CH}_2\text{OH} \end{array}$
C	$\begin{array}{c} \text{CH}_2\text{OH} \\ \\ \text{CH}_3-\text{C}-\text{H} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{CH}_2\text{OH} \\ \\ \text{CH}_3-\text{C}-\text{CH}_2\text{OH} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{CH}_2\text{OH} \\ \\ \text{CH}_3-\text{C}-\text{CH}_2\text{OH} \\ \\ \text{CH}_2\text{OH} \end{array}$
D	$\begin{array}{c} \text{H} \\ \\ \text{CH}_3-\text{C}-\text{OH} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{C}-\text{OH} \\ \\ \text{H} \end{array}$	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{C}-\text{OH} \\ \\ \text{CH}_3 \end{array}$

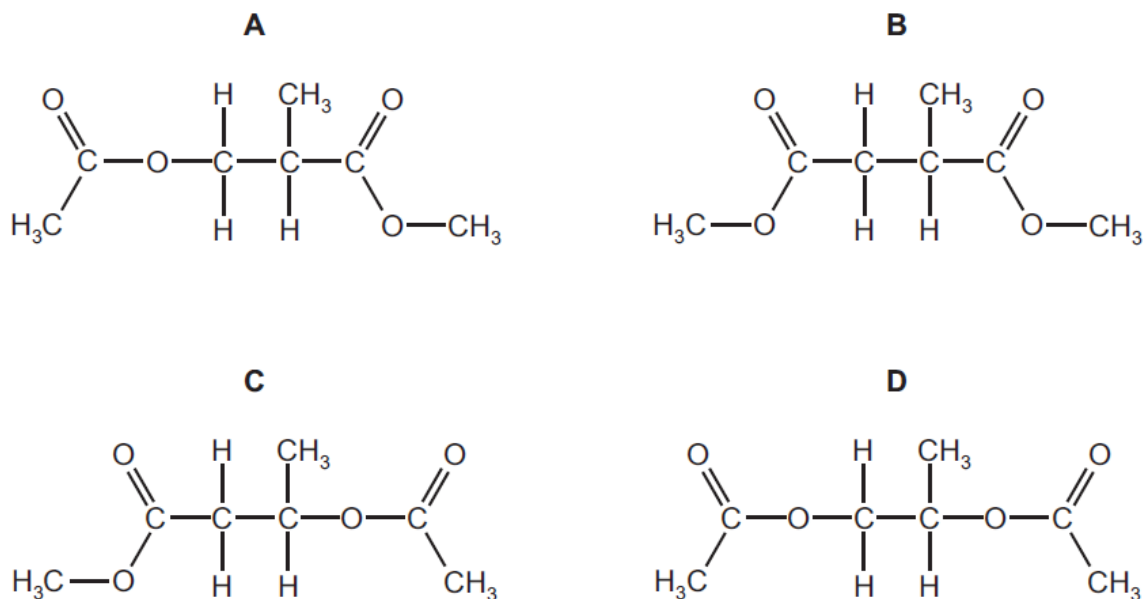
9. 9701/12/F/M/16/27

The fragrance compounds of perfumes are often dissolved in solvent Y, which has a molecular formula $C_7H_{12}O_4$. It is made by reacting propane-1,2-diol with ethanoic acid in the presence of an acid catalyst.



propane-1,2-diol

What is the structure of solvent Y?



10. 9701/12/F/M/16/28

Which mixture could be used to produce propyl methanoate?

- A $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ and CH_3OH
- B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ and HCO_2H
- C $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and HCO_2H
- D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$ and CH_3OH

11. 9701/12/F/M/16/37

Which reagents, when used in an excess, can be used to make sodium lactate, $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{Na}$, from lactic acid, $\text{CH}_3\text{CH}(\text{OH})\text{CO}_2\text{H}$?

- 1 Na
- 2 NaHCO_3
- 3 NaOH

12. 9701/12/F/M/16/39

An unknown organic compound **Z** reacts with sodium to give a combustible gas as one product. **Z** does **not** give a yellow precipitate with alkaline aqueous iodine.

What is a possible identity of **Z**?

- 1 ethanoic acid
- 2 pentan-3-ol
- 3 propan-1-ol

13. 9701/12/F/M/16/40

Compound **X** has the molecular formula $\text{C}_3\text{H}_6\text{O}_3$.

Heating **X** under reflux with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ forms $\text{HO}_2\text{CCOCO}_2\text{H}$.

Reacting **X** with NaBH_4 forms $\text{HOCH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$.

What is a possible structural formula for **X**?

- 1 $\text{HOCH}_2\text{CH}_2\text{CO}_2\text{H}$
- 2 $\text{HOCH}_2\text{CH}(\text{OH})\text{CHO}$
- 3 $\text{HOCH}_2\text{COCH}_2\text{OH}$

14. 9701/11/M/J/16/24

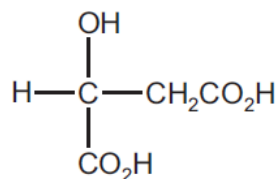
Alcohol **Y** gives product **Z** after mild oxidation. **Z** gives a positive result with Tollens' reagent and with 2,4-dinitrophenylhydrazine reagent.

What could be the identity of alcohol **Y**?

- A butan-1-ol
- B butan-2-ol
- C butan-2,3-diol
- D 2-methylbutan-2-ol

15. 9701/11/M/J/16/26

Malic acid is found in apples.



malic acid

Which reagent will react with all three –OH groups present in the malic acid molecule?

- A ethanol in the presence of concentrated sulfuric acid
- B potassium hydroxide
- C sodium
- D sodium carbonate

16. 9701/11/M/J/16/29

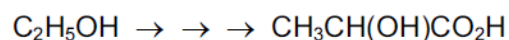
The ester $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$ was hydrolysed under acidic conditions.

What are the organic products of this hydrolysis?

- A butanoic acid and 2-methylpropan-1-ol
- B butanoic acid and 2-methylpropan-2-ol
- C butan-1-ol and 2-methylpropanoic acid
- D propanoic acid and 2-methylpropan-1-ol

17. 9701/11/M/J/16/39

Several steps are involved in the synthesis of 2-hydroxypropanoic acid from ethanol.

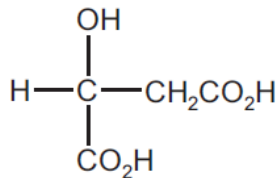


Which statements concerning this synthesis are correct?

- 1 The chain length can be increased during a step involving reaction between HCN and an aldehyde.
- 2 The carboxyl group can be made by hydrolysis of a nitrile by boiling with NaOH(aq) and then acidifying.
- 3 The ethanol should be first oxidised by heating it under reflux with an excess of acidified potassium dichromate(VI).

18. 9701/12/M/J/16/25

Malic acid is found in apples.



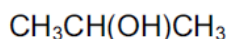
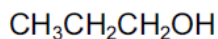
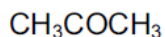
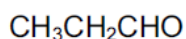
malic acid

Which reagent will react with only one of the –OH groups in the malic acid molecule?

- A ethanoic acid in the presence of concentrated sulfuric acid
- B sodium
- C sodium hydrogen carbonate
- D sodium hydroxide

19. 9701/12/M/J/16/28

How many of the following compounds produce a carboxylic acid on heating under reflux with an excess of hot acidified $\text{K}_2\text{Cr}_2\text{O}_7$?



- A 1 B 2 C 3 D 4

20. 9701/12/M/J/16/29

How many isomeric esters, including structural isomers and stereoisomers, can be made with the molecular formula $\text{C}_5\text{H}_{10}\text{O}_2$, if methanoic acid is one of the two reactants used?

- A 2 B 3 C 4 D 5

21. 9701/12/M/J/16/30

Compound X, $C_4H_8O_2$, has an unbranched carbon chain. An aqueous solution of X has an approximate pH of 3.

Compound Y, C_3H_8O , is a secondary alcohol.

X and Y are reacted together in the presence of a little concentrated sulfuric acid to form Z as the major organic product.

What is the structural formula of Z?

- A $(CH_3)_2CHCO_2CH_2CH_2CH_3$
- B $CH_3(CH_2)_2CO_2CH(CH_3)_2$
- C $CH_3(CH_2)_2CO_2(CH_2)_2CH_3$
- D $(CH_3)_2CHCO_2CH(CH_3)_2$

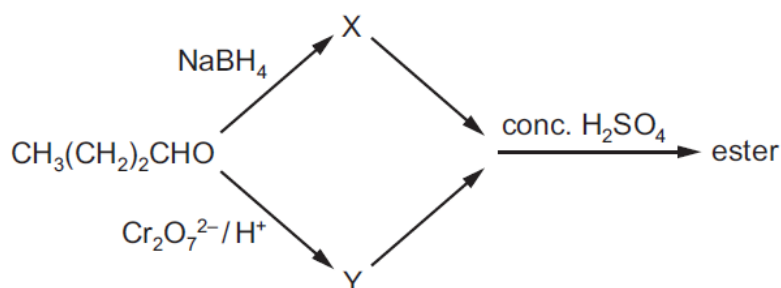
22. 9701/12/M/J/16/40

Which syntheses will be successful?

- 1 $CH_3CH_2CH_3$ from $CH_3CH=CH_2 + LiAlH_4$
- 2 $CH_3CH(OH)CH_3$ from $CH_3COCH_3 + NaBH_4$
- 3 $CH_3CH_2CH_2OH$ from $CH_3CH_2CHO + NaBH_4$

23. 9701/13/M/J/16/22

An ester with an aroma of pineapples can be synthesised in the laboratory from butanal using this reaction scheme.



What is the structural formula of the **ester**?

- A $CH_3(CH_2)_2CO_2(CH_2)_2CH_3$
- B $CH_3(CH_2)_2CO_2(CH_2)_3CH_3$
- C $CH_3(CH_2)_3CO_2(CH_2)_2CH_3$
- D $CH_3(CH_2)_3CO_2(CH_2)_3CH_3$

24. 9701/13/M/J/16/26

Which volume of oxygen, at room temperature and pressure, is needed for complete combustion of 1.0 mol of methylpropan-1-ol?

- A 108 dm³ B 144 dm³ C 156 dm³ D 288 dm³

25. 9701/13/M/J/16/27

An unknown organic compound reacts with sodium to give a combustible gas as one product but does **not** give a yellow precipitate with alkaline aqueous iodine.

What is a possible identity of the unknown organic compound?

- A propanal
B propan-1-ol
C propan-2-ol
D propanone

26. 9701/13/M/J/16/29

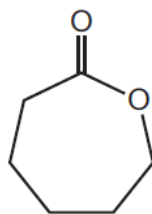
The ester, CH₃CH₂CO₂CH₃, is hydrolysed by boiling with aqueous sodium hydroxide.

Which compound is one of the products?

- A ethanol
B propan-1-ol
C sodium methanoate
D sodium propanoate

27. 9701/13/M/J/16/30

Caprolactone is a cyclic ester. It is being used increasingly for the manufacture of specialist polymers.



caprolactone

From which compound could caprolactone be made by a single reaction?

- A $\text{OHCCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$
- B $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- C $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
- D $\text{HO}_2\text{CCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$