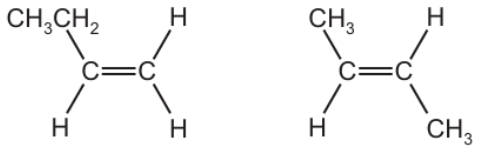
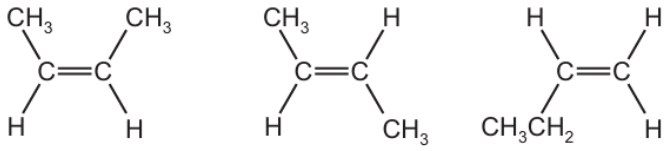
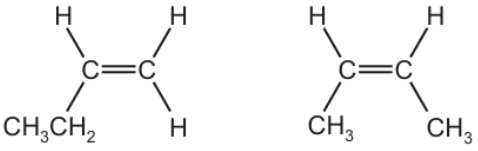
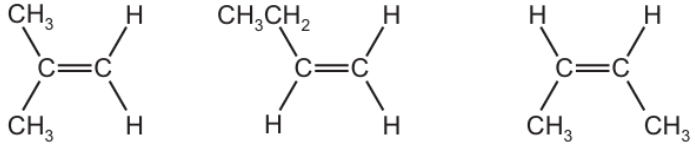
16. Hydroxy compounds

16.1 Alcohols

Paper 1

Question Paper

1 What are the **only** structures formed when butan-2-ol is heated with concentrated H_2SO_4?

A	
B	
C	
D	

2 The compound 'leaf alcohol' is partly responsible for the smell of new-mown grass.

leaf alcohol

$CH_3CH_2CH{=}CHCH_2CH_2OH$

What will be formed when 'leaf alcohol' is oxidised using an excess of hot acidified $K_2Cr_2O_7(aq)$?

A $CH_3CH_2CH(OH)CH(OH)CH_2CO_2H$

B $CH_3CH_2COCOCH_2CO_2H$

C $CH_3CH_2CH{=}CHCH_2CO_2H$

D $CH_3CH_2CO_2H$ and $HO_2CCH_2CO_2H$

3 Compound Y reacts with alkaline I_2(aq). When the products of this reaction are acidified, a dicarboxylic acid is produced. The formula of the dicarboxylic acid is HOOC–R–COOH where R consists of one or more CH_2 groups.

Which compound is Y?

A pentan-1,4-diol

B pentan-1,5-diol

C pentan-2,3-diol

D pentan-2,4-diol

4 Which alcohol gives only **one** possible oxidation product when warmed with dilute acidified potassium dichromate(VI)?

A butan-1-ol

B butan-2-ol

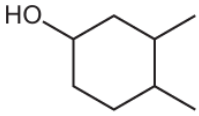
C 2-methylpropan-1-ol

D 2-methylpropan-2-ol

5 Compound X is a single, pure, optical isomer. Compound X is heated with an excess of concentrated H_2SO_4. Only **one** organic product is formed.

What is compound X?

A



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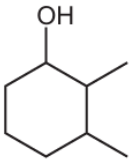

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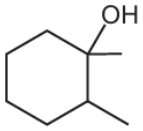

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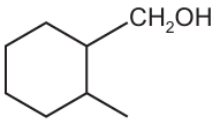


6 Compound X can be oxidised to compound Y.

Compound Y gives a yellow precipitate with alkaline I_2(aq).

What is compound X?

A butan-1-ol

B butan-2-ol

C methylpropan-1-ol

D methylpropan-2-ol

7 Which reaction will distinguish between propan-1-ol and propan-2-ol?

A warming with acidified $KMnO_4$

B warming with acidified $K_2Cr_2O_7$

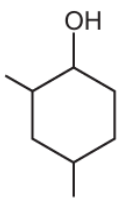
C dehydration, followed by reaction with $Br_2(aq)$

D mild oxidation, followed by reaction with Fehling's reagent

8 Alcohol X gives a yellow precipitate with alkaline $I_2(aq)$.

What is the structure of X?

A



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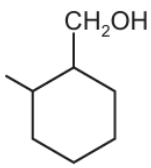

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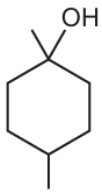

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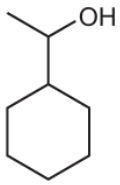


9 When ethanol reacts with sodium metal, ethoxide ions, $CH_3CH_2O^-$, are produced.

When water reacts with sodium metal, OH^- ions are produced.

Which statement about these reactions and the ethoxide ion is correct?

A At the same temperature, the rate of reaction between sodium and ethanol is greater than that between sodium and water.

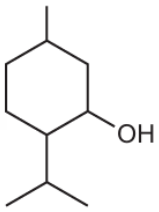
B $CH_3CH_2O^-$ is a stronger base than OH^- due to the electron-donating effect of the ethyl group.

C The negative charge on the oxygen in an ethoxide ion is delocalised.

D It is easier to deprotonate ethanol as it is more acidic than water.

10 Menthol is a naturally occurring alcohol.

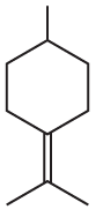
menthol



When menthol is heated with concentrated sulfuric acid it reacts. The products formed include compound T.

What is the structure of compound T?

A



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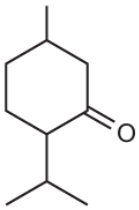

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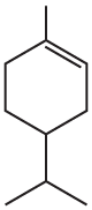

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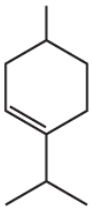


11 Which alcohol reacts with alkaline I_2(aq) to produce ethanoate ions?

A ethanol

B methylpropan-2-ol

C propan-2-ol

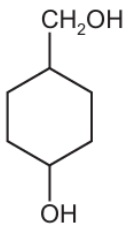
D butan-2-ol

12 Heating compound X, $C_7H_{14}O_2$, under reflux with an excess of acidified potassium dichromate(VI) produces compound Y.

Compound Y produces hydrogen gas with sodium metal and forms orange crystals with 2,4-DNPH reagent.

What could X be?

A



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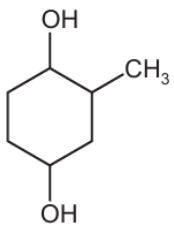


C

D $(CH_3)_2C(OH)CH_2CH_2CH_2CHO$

13 Which row describes the type of reaction that occurs when propan-1-ol reacts to form the named carbon-containing product?

	carbon-containing product	type of reaction
A	1-chloropropane	addition to propan-1-ol
B	carbon monoxide	complete combustion of propan-1-ol
C	propene	dehydration of propan-1-ol
D	propanal	reduction of propan-1-ol

14 How many structurally isomeric secondary alcohols are there with the molecular formula $C_5H_{12}O$?

A 1 **B** 2 **C** 3 **D** 4

15 Which compound gives a positive test with alkaline aqueous iodine and does **not** show optical isomerism?

A $CH_3COCH_2CH_2OH$

B $CH_3CH_2CH(OH)CHO$

C $CH_3COCH(OH)CH_3$

D $(CH_3)_2C(OH)CHO$

16 X, Y and Z are three isomeric alcohols.

X $CH_3CH_2CH_2CH_2CH_2OH$

Y $CH_3CH_2CH(OH)CH_2CH_3$

Z $(CH_3)_2C(OH)CH_2CH_3$

Separate samples of each alcohol are warmed with a mild oxidising agent and the results noted.

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

17 Compound G gives a pale yellow precipitate with alkaline I_2(aq).

What could be compound G?

A pentan-1-ol

B pentan-2-ol

C pentan-3-ol

D 2-methylpentan-2-ol

18 1.0 mol of an organic compound, J, requires 6.0 mol of oxygen for complete combustion.

1.0 mol of J reacts with sodium, producing 0.50 mol of a gas that gives a 'pop' with a lighted splint.

J reacts with an excess of hot acidified potassium manganate(VII) to produce an organic compound which gives an orange-red precipitate with 2,4-DNPH reagent.

Which compound is J?

A but-1-ene

B butan-2-ol

C propan-2-ol

D 2-methylpropan-2-ol

19 Crotyl alcohol, $CH_3CH=CHCH_2OH$, is a colourless liquid which is used as a solvent.

Crotyl alcohol will react separately with Br_2, $K_2Cr_2O_7/H^+$, conc. $KMnO_4/H^+$ and PCl_5 under suitable conditions.

Which row is correct?

	reactant	conditions	main product
A	Br_2	room temperature	$CH_3CH=CHCH_2Br$
B	$K_2Cr_2O_7/H^+$	heat under reflux	$CH_3CH=CHCHO$
C	conc. $KMnO_4/H^+$	heat under reflux	$CH_3CH=CHCO_2H$
D	PCl_5	room temperature	$CH_3CH=CHCH_2Cl$

20 Primary alcohols can be oxidised to aldehydes using either acidified potassium dichromate(VI) or acidified potassium manganate(VII). The reaction mixtures change colour as the oxidising agent is reduced.

What are the colour changes seen?

	acidified potassium dichromate(VI)		acidified potassium manganate(VII)	
	before	after	before	after
A	green	orange	purple	colourless
B	orange	green	colourless	purple
C	orange	green	purple	colourless
D	purple	colourless	orange	green

21 When an organic compound, Q, is treated with phosphorus pentachloride, fumes of hydrogen chloride are evolved. When Q is warmed with acidified aqueous potassium dichromate(VI), the solution turns green.

What is Q?

A CH_3CH_2CHO

B $CH_3CH_2CO_2H$

C $CH_3CH(OH)CH_3$

D $(CH_3)_3COH$

22 Alcohol Y gives a yellow precipitate with alkaline aqueous iodine. It can be oxidised to give a mixture of products including substance Z. Substance Z gives a red-brown precipitate with Fehling's solution.

Which alcohol could be Y?

A $CH_3CH(OH)CH(CH_3)CH_2OH$

B $CH_3C(OH)(CH_3)CH_2CH_2OH$

C $CH_3CH(OH)CH_2CH(OH)CH_3$

D $CH_2(OH)CH_2CH(OH)CH_2CH_3$

23 Compound P is heated under reflux with an excess of acidified potassium dichromate(VI) to form compound Q.

Compound Q has a **lower** boiling point than compound P.

What could be compound P?

A 2-methylbutan-1-ol

B 2-methylbutan-2-ol

C pentan-1-ol

D pentan-2-ol

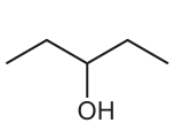
24 Structural and stereoisomerism should be taken into account when answering this question.

An organic compound, X, is dehydrated by heating with concentrated phosphoric(V) acid.

Only **two** organic products are formed.

What could be X?

A



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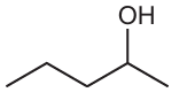

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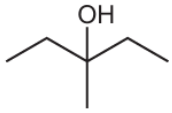

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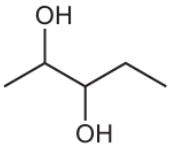


25 Alcohol X reacts with concentrated sulfuric acid to produce a mixture of products.

Two of the products are structural isomers of each other.

What could be X?

A hexan-2-ol

B pentan-1-ol

C pentan-3-ol

D propan-2-ol

26 Ethanol can be converted into ethene in a single reaction.

Ethanol can be converted into bromoethane in a single reaction.

Under standard laboratory conditions, is a catalyst used in these reactions?

	ethanol to ethene	ethanol to bromoethane
A	yes	yes
B	yes	no
C	no	yes
D	no	no

27 An alcohol has the molecular formula $C_5H_{12}O$. It has several isomers.

Which isomer forms a yellow precipitate with alkaline aqueous iodine?

A 2,2-dimethylpropan-1-ol

B 2-methylbutan-2-ol

C 3-methylbutan-2-ol

D pentan-3-ol

28 Which reagent could be used to distinguish between propane-1,2-diol and ethane-1,2-diol?

A alkaline aqueous iodine

B aqueous acidified dichromate(VI)

C ethanol and a few drops of concentrated sulfuric acid

D sodium metal

29 Alcohol X is oxidised to form compound Y.

The composition of Y is 54.54% carbon, 36.36% oxygen and 9.10% hydrogen. The M_r of Y is 88.0.

What could be the structure of alcohol X?

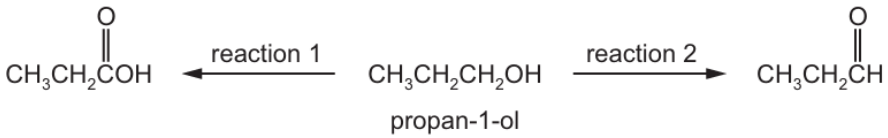
A $CH_3CH_2CH(OH)CH_3$

B $CH_3CH_2CH_2CH_2CH_2OH$

C $CH_3CH_2CH_2CH_2OH$

D $CH_3CH_2CH(OH)CH_2CH_3$

30 Propan-1-ol can be reacted with acidified potassium dichromate(VI) to form propanoic acid, reaction 1, or propanal, reaction 2.



How can the reaction be carried out to ensure that reaction 2 occurs rather than reaction 1?

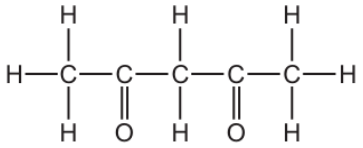
A An excess of acidified potassium dichromate(VI) is used.

B An excess of concentrated sulfuric acid is added.

C The reaction mixture is distilled immediately after mixing.

D The reaction mixture is heated under reflux.

31 The diagram shows the structure of Y.



Two suggestions are made about Y.

1 Y can be oxidised by hot, acidified dichromate(VI) ions.

2 One mole of Y gives one mole of tri-iodomethane when it reacts with an excess of alkaline aqueous iodine.

Which suggestions are correct?

A both 1 and 2

B 1 only

C 2 only

D neither 1 nor 2

32 An organic compound T undergoes the following reactions.

- T is oxidised by hot, acidified potassium manganate(VII).
- T reacts with sodium to give hydrogen.

What could be compound T?

A $CH_3CH_2CH(OH)CH_3$

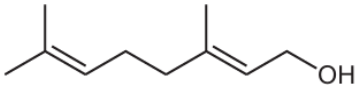
B $CH_3CH_2CH_2CHO$

C $(CH_3)_3COH$

D $CH_3CH_2COCH_3$

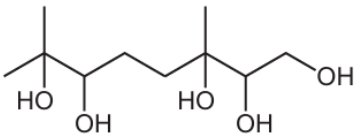
33 A molecule of geraniol is shown.

geraniol



What is formed when geraniol is reacted with an excess of cold, dilute, acidified manganate(VII) ions?

A



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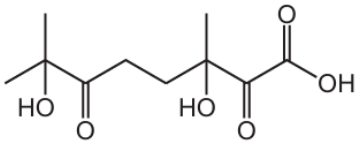

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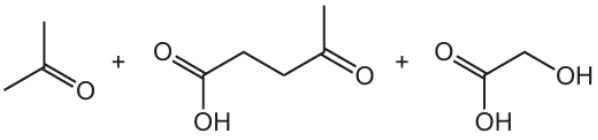

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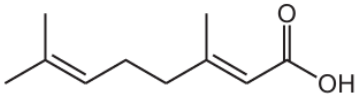


34 Alcohol W **cannot** be made by reducing a carboxylic acid with $LiAlH_4$. Alcohol W gives only one product when dehydrated with concentrated sulfuric acid.

What could be the identity of W?

A butan-1-ol

B butan-2-ol

C propan-1-ol

D propan-2-ol

35 Sodium reacts with 1 mol of compound Y to produce 1 mol of $H_2(g)$.

Which compound could Y be?

A $CH_3CH_2CH_2CH_2OH$

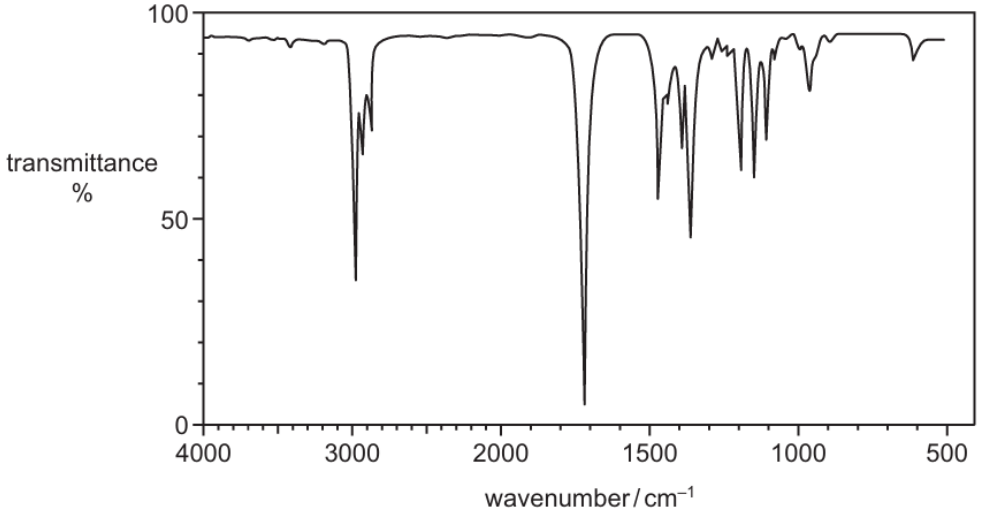
B $(CH_3)_3COH$

C $CH_3CH_2CH_2CO_2H$

D $CH_3CH(OH)CO_2H$

36 **J** is a branched-chain alcohol, $C_5H_{12}O$. **J** is heated under reflux with an excess of $Cr_2O_7^{2-}/H^+$ until no further reaction occurs. An organic compound **K** is formed in good yield.

The infra-red spectrum of **K** is shown.



What are the structures of the branched-chain alcohol **J** and compound **K**?

	J	K
A	$CH_3CH(CH_3)CH_2CH_2OH$	$CH_3CH(CH_3)CH_2CHO$
B	$CH_3CH_2CH(OH)CH_2CH_3$	$CH_3CH_2COCH_2CH_3$
C	$CH_3CH(CH_3)CH(OH)CH_3$	$CH_3CH(CH_3)COCH_3$
D	$CH_3CH(CH_3)CH_2CH_2OH$	$CH_3CH(CH_3)CH_2COOH$

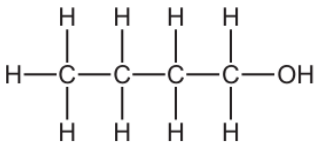
37 The reactions of four organic compounds are given in the table.

Which compound could be propan-2-ol?

	reagent / observations	
	when oxidised with $Cr_2O_7^{2-}/H^+$, gives an organic product with a boiling point greater than the original compound	when added to ethanoic acid, and a few drops of conc. H_2SO_4, gives a sweet-smelling compound
A	no	no
B	no	yes
C	yes	no
D	yes	yes

38 Which alcohol can be dehydrated to give two products which are structural isomers of each other?

A



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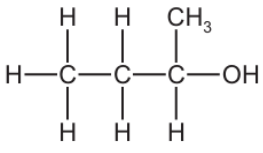

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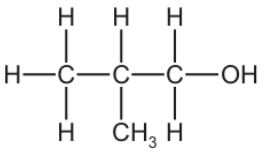
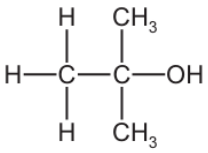


D



39 Which reagent could detect the presence of alcohol in a mixture consisting mainly of alkanes and alkenes?

A Na

B Br_2 (in CCl_4)

C $KMnO_4$(aq)

D 2,4-dinitrophenylhydrazine

40 Which alcohol will react with an acidified solution of potassium dichromate(VI) to produce a ketone containing six carbon atoms?

A 2,2-dimethylbutan-1-ol

B 2-methylpentan-3-ol

C 3,3-dimethylpentan-2-ol

D 3-methylpentan-3-ol