CAMBRIDGE INTERNATIONAL AS & A LEVEL CHEMISTRY · 9701

CHEMISTRY



EXAM QUESTION PACK

16 HYDROXY COMPOUNDS

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Chapter 16

Hydroxy compounds

16.1 Alcohols

933. 9701_m22_qp_12 Q: 29

A reaction occurs when a sample of 1-chloropropane is heated under reflux with sodium hydroxide dissolved in ethanol.

Which row is correct?

	type of reaction	name of product
A	elimination	propan-1-ol
B	elimination	propene
C	substitution	propan-1-ol
D	substitution	propene

---

934. 9701_m21_qp_12 Q: 21

How many tertiary alcohols have the molecular formula $C_6H_{14}O$?

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

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935. 9701_s21_qp_11 Q: 25

When an organic compound is oxidised, any oxygen atom gained by the organic molecule is considered to be from a water molecule also producing $2H^+ + 2e^-$. Any hydrogen atom lost may be considered to be lost as $H^+ + e^-$.

These changes can be represented by the following two equations.

$$H_2O \rightarrow [O] + 2H^+ + 2e^-$$

$$[H] \rightarrow H^+ + e^-$$

Compound X is oxidised by heating under reflux with hot, acidified potassium dichromate(VI) for one hour. The half-equation for the reduction reaction is shown.

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

Under these conditions, one mole of potassium dichromate(VI) oxidises three moles of X.

What could X be?

A propanal

B propan-1-ol

C propan-1,2-diol

D propan-1,3-diol

---

936. 9701_s21_qp_11 Q: 29

The table describes four reactions of propene.

Which row is correct?

	reagent used	name of main organic product
A	aqueous bromine	2-bromopropane
B	cold acidified aqueous potassium manganate(VII)	propane-1,3-diol
C	hydrogen chloride	2-chloropropane
D	steam	propan-1-ol

---

937. 9701_s21_qp_12 Q: 26

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

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938. 9701_s21_qp_12 Q: 27

Which reaction will form a strong organic base?

A ethanol and acidified sodium dichromate

B ethanol and hot aluminium oxide

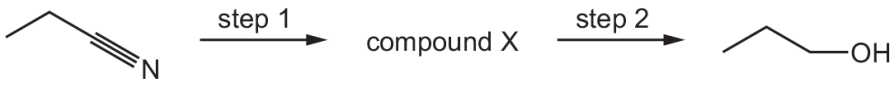
C ethanol and sodium

D ethanol and hydrogen chloride

---

939. 9701_s21_qp_12 Q: 29

The synthesis shown may be used for the production of propan-1-ol.



Which row gives the correct reagents for steps 1 and 2?

	step 1	step 2
A	HCl(aq)	H_2 + Ni
B	HCl(aq)	LiA$l$$H_4$
C	NaOH(aq)	H_2 + Ni
D	NaOH(aq)	$NaBH_4$

---

940. 9701_s21_qp_13 Q: 24

A mixture of ethanol and methanol is burned in oxygen to produce 35 cm^3 of CO_2 and 55 cm^3 of H_2O.

Complete combustion occurs and the volumes of both products are measured at 101 kPa and 120 °C.

What is the molar ratio, ethanol : methanol, in the mixture?

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

---

941. 9701_s21_qp_13 Q: 25

Two reactions are shown. Only one product is identified in each reaction.

$$\text{ethanol} + \text{acidified } Cr_2O_7^{2-} \rightarrow \text{ethanal}$$

$$\text{ethanol} + \text{sodium} \rightarrow \text{sodium ethoxide}$$

Which statement about these reactions is correct?

A The formations of both ethanal and sodium ethoxide are redox reactions.

B The formations of both ethanal and sodium ethoxide result in colour changes.

C The formation of ethanal is catalysed by potassium dichromate.

D The formation of sodium ethoxide is a dehydration reaction.

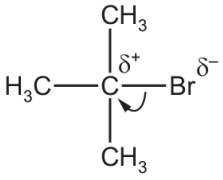
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942. 9701_w21_qp_11 Q: 23

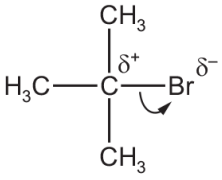
When 2-bromo-2-methylpropane reacts with aqueous sodium hydroxide, an alcohol is formed.

Which diagram describes the first step in the reaction mechanism?

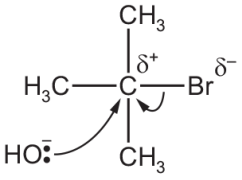
A



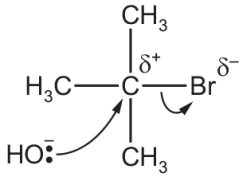
B



C



D



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943. 9701_w21_qp_11 Q: 24

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 $(CH_3)_3COH$

---

944. 9701_w21_qp_11 Q: 25

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 $CH_2(OH)CH_2CH(OH)CH_2CH_3$

---

945. 9701_w21_qp_12 Q: 26

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

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946. 9701_w21_qp_12 Q: 27

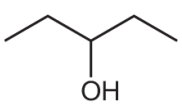
Structural and stereoisomerism should be taken into account when answering this question.

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

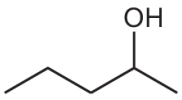
Only **two** organic products are formed.

What could be X?

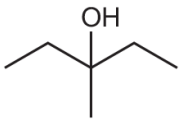
A



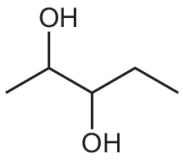
B



C



D



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947. 9701_w21_qp_13 Q: 25

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 $CH_3C(OH)(CH_3)CH_2CH_2OH$

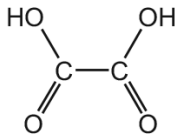
C $CH_3CH(OH)CH_2CH(OH)CH_3$

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

---

948. 9701_m20_qp_12 Q: 22

The diagram shows the structure of ethanedioic acid.



Ethanedioic acid reacts with ethanol in the presence of a few drops of concentrated sulfuric acid to form a diester. The molecular formula of the diester is $C_6H_{10}O_4$.

What is the structural formula of the diester?

A $CH_3CH_2CO_2CO_2CH_2CH_3$

B $CH_3CH_2OCOCO_2CH_2CH_3$

C $CH_3CH_2O_2CO_2CCH_2CH_3$

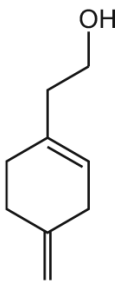
D $CH_3CO_2CH_2CH_2OCOCH_3$

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949. 9701_m20_qp_12 Q: 26

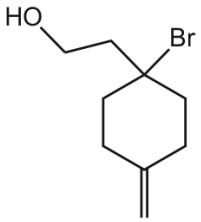
An excess of dry HBr is warmed with compound Y.

Y

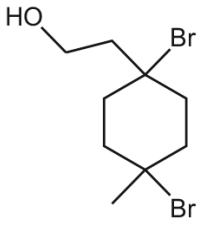


What is the major product of the reaction?

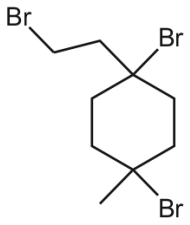
A



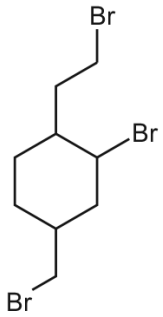
B



C



D

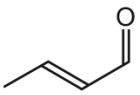


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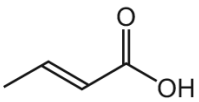
950. 9701_m20_qp_12 Q: 29

What is the skeletal formula of the compound formed when $CH_3CH{=}CHCH_2OH$ is heated, under reflux, with $K_2Cr_2O_7 / H^+$?

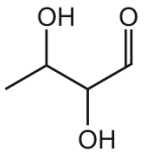
A



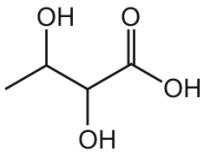
B



C



D



---

951. 9701_s20_qp_11 Q: 25

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

---

952. 9701_s20_qp_12 Q: 24

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

---

953. 9701_s20_qp_13 Q: 22

There are many non-cyclic alcohols that cannot be oxidised by warm acidified MnO_4^- ions. Alcohol X is the member of this set of alcohols with the **lowest** molecular mass.

How many moles of oxygen are required for the complete combustion of 1.0 mol of alcohol X?

A 3.5 mol **B** 4.5 mol **C** 6.0 mol **D** 6.5 mol

---

954. 9701_s20_qp_13 Q: 29

The ester ethyl methanoate is prepared in a school laboratory by reacting a carboxylic acid with an alcohol.

During the reaction, only 50.0% of the alcohol is converted into the ester.

Which mass of alcohol is needed to prepare 10.0 g of the ester?

A 3.11 g **B** 8.65 g **C** 12.4 g **D** 32.2 g

---

955. 9701_w20_qp_11 Q: 26

An alcohol with the molecular formula $C_5H_{12}O$ decolourises warm acidified potassium manganate(VII). The alcohol also gives a yellow precipitate with alkaline aqueous iodine.

What could be the identity of the alcohol?

A 2-methylbutan-2-ol

B 3-methylbutan-2-ol

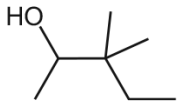
C pentan-1-ol

D pentan-3-ol

---

956. 9701_w20_qp_12 Q: 21

What is the correct name for the compound shown?



A 1,2,2-trimethylbutan-3-ol

B 2-ethyl-2-methylbutan-2-ol

C 3,3-dimethylpentan-2-ol

D 4-hydroxy-3,3-dimethylpentane

---

957. 9701_w20_qp_12 Q: 24

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

---

958. 9701_w20_qp_12 Q: 26

Which alcohol will give a yellow precipitate when warmed with alkaline aqueous iodine?

A $(CH_3)_2CHCH_2OH$

B $(CH_3)_3COH$

C $CH_3CH_2C(OH)(CH_3)_2$

D $CH_3CH(OH)CH_2CH_3$

---

959. 9701_m19_qp_12 Q: 25

Which product is formed when 3-methylpentane-1,3,4-triol is heated under reflux with an excess of acidified potassium dichromate(VI)?

A $HO_2CCH_2C(CH_3)(OH)COCH_3$

B $HO_2CCH_2COC(OH)(CH_3)_2$

C $OHCCH_2C(CH_3)(OH)COCH_3$

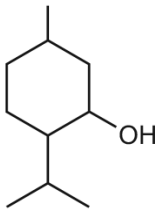
D $HO_2CCH_2CO(CH_3)COCH_3$

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960. 9701_m19_qp_12 Q: 26

Menthol is a naturally occurring alcohol.

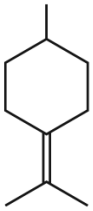
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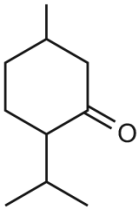
When menthol is heated with concentrated sulfuric acid it reacts. The products formed include compound T.

What could be the structure of compound T?

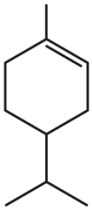
A



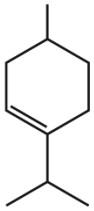
B



C



D



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961. 9701_m19_qp_12 Q: 27

Structural isomerism only should be considered when answering this question.

All the isomeric alcohols with the molecular formula $C_5H_{12}O$ are added separately to warm alkaline aqueous iodine.

How many of the isomers give a yellow precipitate?

A 0 **B** 1 **C** 2 **D** 3

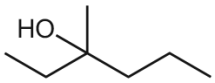
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962. 9701_s19_qp_11 Q: 26

Structural isomerism and stereoisomerism should be considered when answering this question.

3-methylhexan-3-ol reacts with hot, concentrated sulfuric acid to form several isomeric compounds with the molecular formula C_7H_{14}.

3-methylhexan-3-ol



How many isomeric compounds could be formed in this reaction?

A 3 **B** 4 **C** 5 **D** 6

---

963. 9701_s19_qp_11 Q: 27

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 $CH_3CH_2COCH_3$

---

964. 9701_s19_qp_12 Q: 24

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

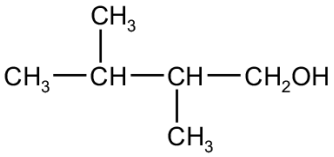
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965. 9701_s19_qp_13 Q: 26

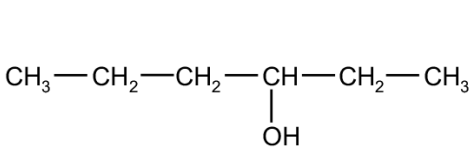
Structural isomerism and stereoisomerism should be considered when answering this question.

Which isomer of $C_6H_{13}OH$ gives the greatest number of different alkenes when it is dehydrated?

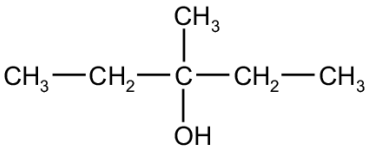
A



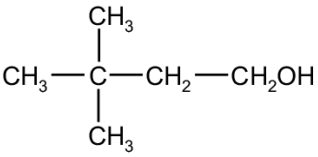
B



C



D



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966. 9701_s19_qp_13 Q: 29

Which pair of substances could react to give the ester $CH_3CH_2CO_2CH_3$?

A ethanol and ethanoic acid

B methanol and ethanoic acid

C methanol and propanoic acid

D propan-1-ol and methanoic acid

---

967. 9701_w19_qp_11 Q: 5

Ethanal, CH_3CHO, ethanol, C_2H_5OH, and methoxymethane, CH_3OCH_3, are three organic compounds.

Which compound has the highest boiling point and what is the interaction that causes this boiling point to be the highest?

	highest boiling point	interaction
A	methoxymethane	permanent dipole-dipole forces
B	ethanal	hydrogen bonds
C	ethanol	hydrogen bonds
D	ethanal	permanent dipole-dipole forces

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968. 9701_w19_qp_11 Q: 25

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 $CH_3CH_2CH_2CH_2OH$

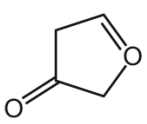
D $CH_3CH_2CH(OH)CH_2CH_3$

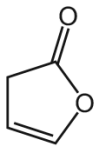
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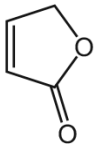
969. 9701_w19_qp_11 Q: 29

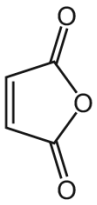
When $CH_2(OH)CH{=}CHCO_2H$ is warmed with a little concentrated sulfuric acid, a cyclic compound is formed.

What is the skeletal formula of the cyclic compound?

A 

B 

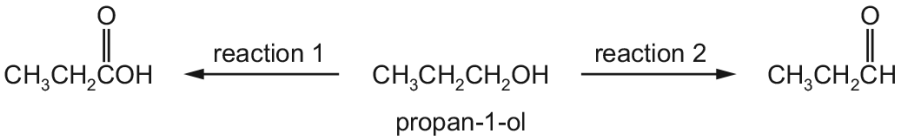
C 

D 

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970. 9701_w19_qp_12 Q: 24

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.

---

971. 9701_w19_qp_12 Q: 25

What is the smallest amount of oxygen molecules needed for the complete combustion of 40.0 g of methanol?

A 1.88 moles **B** 2.50 moles **C** 3.75 moles **D** 5.00 moles

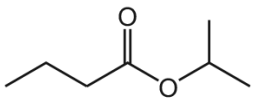
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972. 9701_w19_qp_12 Q: 28

Esters can be prepared by the reaction of a carboxylic acid with an alcohol in the presence of concentrated sulfuric acid.

Which row gives the correct names of the reagents that would be suitable to prepare ester Z?

Z



	alcohol	carboxylic acid
A	butan-1-ol	methyl propanoic acid
B	propan-1-ol	butanoic acid
C	propan-2-ol	butanoic acid
D	propan-2-ol	propanoic acid

---

973. 9701_s18_qp_11 Q: 21

Which pair of alcohols are isomers of each other?

A butan-1-ol and 2,2-dimethylpropan-1-ol

B butan-2-ol and 2-methylpropan-2-ol

C pentan-1-ol and 2-methylpropan-2-ol

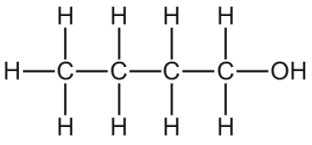
D propan-2-ol and 2-methylpropan-2-ol

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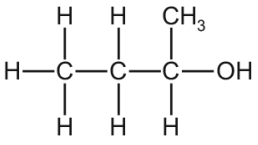
974. 9701_s18_qp_11 Q: 23

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

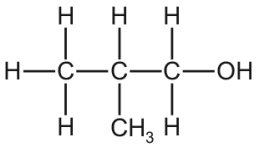
A



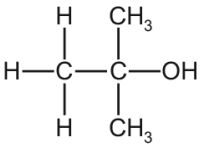
B



C



D



---

975. 9701_s18_qp_11 Q: 24

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

---

976. 9701_s18_qp_12 Q: 22

Maleic acid is used in the food industry and for stabilising drugs. It is the cis-isomer of butenedioic acid and has the structural formula $HO_2CCH{=}CHCO_2H$.

What is the product formed from the reaction of maleic acid with cold, dilute, acidified manganate(VII) ions?

A $HO_2CCH(OH)CH(OH)CO_2H$

B HO_2CCO_2H

C $HO_2CCH_2CH(OH)CO_2H$

D $HO_2CCOCOCO_2H$

---

977. 9701_s18_qp_12 Q: 26

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

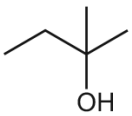
D 3-methylpentan-3-ol

---

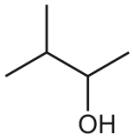
978. 9701_s18_qp_13 Q: 25

Which compound is a secondary alcohol that can be dehydrated to form an alkene with M_r = 70?

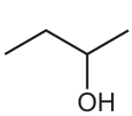
A



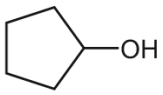
B



C



D



---

979. 9701_s18_qp_13 Q: 26

When 0.0075 mol of alcohol X are completely burnt in excess oxygen and the gases produced are passed through an excess of limewater (calcium hydroxide solution), 3.0 g of calcium carbonate are produced.

When X is warmed with acidified potassium dichromate(VI) there is a colour change from orange to green.

What could be the identity of X?

A $CH_3CH(OH)CH_2CH_3$

B $(CH_3)_3COH$

C $CH_3CH_2CH_2OH$

D $CH_3CH(OH)CH_3$

---

980. 9701_s18_qp_13 Q: 29

An ester X has the structural formula $CH_3CO_2CH(CH_3)CH_2CH_3$. X can be prepared by heating an alcohol **Y**, under reflux, with ethanoic acid and an acid catalyst.

What is the correct name for **Y**?

A butan-1-ol

B butan-2-ol

C butan-3-ol

D methylpropan-2-ol

---

981. 9701_w18_qp_11 Q: 23

The conversion of propene to propan-2-ol can be carried out in two stages represented by the equations shown.

reaction 1 $CH_3CH{=}CH_2(g) + HI(g) \rightarrow CH_3CHICH_3(l)$

reaction 2 $CH_3CHICH_3(l) + KOH(aq) \rightarrow CH_3CH(OH)CH_3(aq) + K^+(aq) + I^-(aq)$

How can these two reactions be described?

	reaction 1	reaction 2
A	addition	elimination
B	addition	substitution
C	elimination	substitution
D	substitution	elimination

---

982. 9701_w18_qp_11 Q: 24

An organic molecule W contains 3 carbon atoms. It requires 4.5 molecules of oxygen for complete combustion.

What could W be?

A propane

B propanoic acid

C propanone

D propan-1-ol

---

983. 9701_w18_qp_12 Q: 26

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

---

984. 9701_m17_qp_12 Q: 26

Propan-2-ol undergoes many reactions.

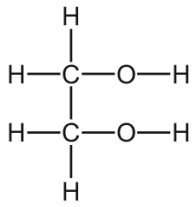
Which row is correct?

	reagent added to propan-2-ol	product
A	acidified $KMnO_4$	CH_3CH_2CHO
B	Cl_2	$CH_3CHClCH_3$
C	conc. H_2SO_4	CH_3CHCH_2
D	methanoic acid	$HCO_2CH_2CH_2CH_3$

---

985. 9701_m17_qp_12 Q: 27

Ethane-1,2-diol has the following structure.



Without breaking the C–C bond, there are five possible oxidation products.

What is the **total** number of aldehyde groups and carboxylic acid groups in these five products?

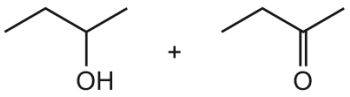
	–CHO	–COOH
A	3	3
B	3	4
C	4	3
D	4	4

---

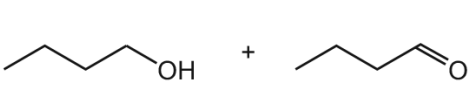
986. 9701_m17_qp_12 Q: 30

Which two compounds can react together to produce an ester?

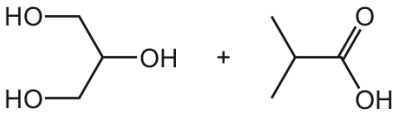
A



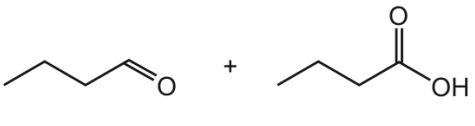
B



C



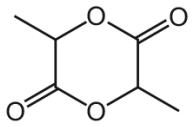
D



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987. 9701_s17_qp_11 Q: 24

Lactide is an intermediate in the manufacture of a synthetic fibre.



lactide

Which compound, on heating with an acid catalyst, can produce lactide?

A hydroxyethanoic acid

B 2-hydroxybutanoic acid

C 2-hydroxypropanoic acid

D 3-hydroxypropanoic acid

---

988. 9701_s17_qp_11 Q: 28

A sample of 2.30 g of ethanol was mixed with an excess of aqueous acidified potassium dichromate(VI). The reaction mixture was then boiled under reflux for one hour. The required organic product was then collected by distillation. The yield of product was 60.0%.

Which mass of product was collected?

A 1.32 g **B** 1.38 g **C** 1.80 g **D** 3.00 g

---

989. 9701_s17_qp_12 Q: 6

Which reaction involves a decrease in the bond angle at a carbon atom?

A bromoethane refluxed with ethanolic sodium hydroxide

B complete combustion of methane in air

C ethanol heated with conc. H_2SO_4

D polymerisation of ethene

---

990. 9701_s17_qp_12 Q: 24

A sample of 2.76 g of ethanol was mixed with an excess of aqueous acidified potassium dichromate(VI). The reaction mixture was then boiled under reflux for one hour. The required organic product was then collected by distillation.

The yield of product was 75.0%.

Which mass of product was collected?

A 1.26 g **B** 1.98 g **C** 2.07 g **D** 2.70 g

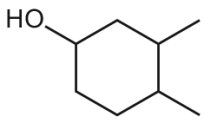
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991. 9701_s17_qp_12 Q: 25

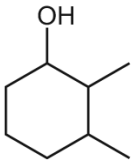
Compound X is a single, pure, optical isomer. X is heated with an excess of concentrated H_2SO_4. Only one organic product is formed.

What could X be?

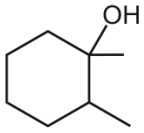
A



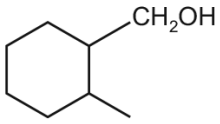
B



C



D



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992. 9701_s17_qp_12 Q: 28

A carboxylic acid, P, has no possible chain isomers. It reacts with an alcohol, Q, that has only one positional isomer.

What could be the ester formed from a reaction between P and Q?

A butyl propanoate

B ethyl butanoate

C pentyl ethanoate

D propyl pentanoate

---

993. 9701_s17_qp_13 Q: 26

Which statement about butan-1-ol, butan-2-ol, and 2-methylbutan-2-ol is **not** correct?

A They all react with methanoic acid to form an ester.

B They all react with sodium.

C They can all be dehydrated to form an alkene.

D They can all be oxidised to a carbonyl compound.

---

994. 9701_s17_qp_13 Q: 27

Which compound will react with acidified potassium dichromate(VI) **and** with alkaline aqueous iodine?

A $CH_3COCH_2CH_3$

B $CH_3CH(OH)CH_2CH_3$

C $CH_3CH_2CH_2CHO$

D $CH_3CH_2CH_2CH_2OH$

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995. 9701_s17_qp_13 Q: 30

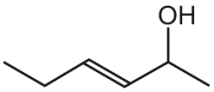
How many esters with the molecular formula $C_5H_{10}O_2$ can be made by reacting a **primary** alcohol with a carboxylic acid?

A 4 **B** 5 **C** 6 **D** 8

---

996. 9701_w17_qp_11 Q: 21

What is the name of compound **X**?



compound **X**

A *trans*-2-hydroxyhex-3-ene

B *trans*-2-hydroxyhexene

C *trans*-5-hydroxyhex-3-ene

D *trans*-5-hydroxyhexene

---

997. 9701_w17_qp_12 Q: 26

Many, but not all, organic reactions need to be heated before a reaction occurs.

Which reaction occurs quickly at room temperature (20 °C)?

A $CH_3OH + PCl_5 \rightarrow CH_3Cl + POCl_3 + HCl$

B $CH_3CH_2Br + KCN \rightarrow CH_3CH_2CN + KBr$

C $CH_3CH_2OH \rightarrow C_2H_4 + H_2O$

D $CH_3CH_2CN + 2H_2O \rightarrow CH_3CH_2CO_2H + NH_3$

---

998. 9701_w17_qp_12 Q: 27

When compound X is warmed with dilute, acidified potassium dichromate(VI) there is no colour change. X does not give an orange precipitate with 2,4-dinitrophenylhydrazine reagent.

What could X be?

A butan-2-ol

B ethanal

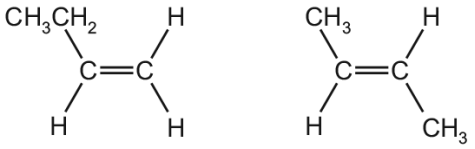
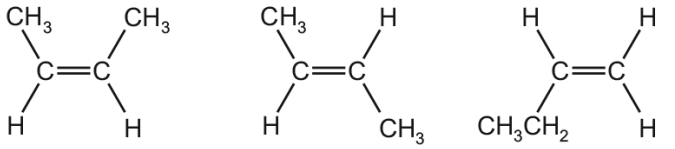
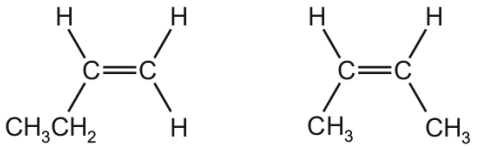
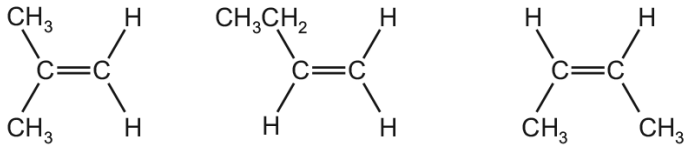
C methylpropan-2-ol

D propanone

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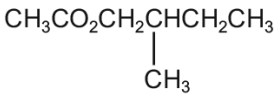
999. 9701_w17_qp_12 Q: 28

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

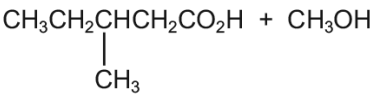
A	
B	
C	
D	

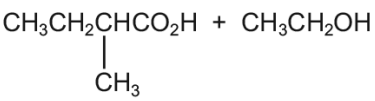
1000. 9701_w17_qp_12 Q: 30

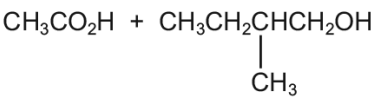
An ester with an odour of banana has the following formula.

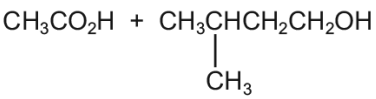


Which pair of reactants, under suitable conditions, will produce this ester?

A 

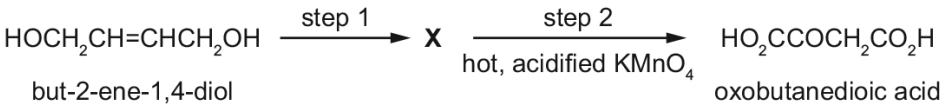
B 

C 

D 

1001. 9701_m16_qp_12 Q: 23

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

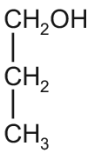
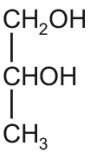
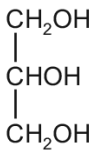
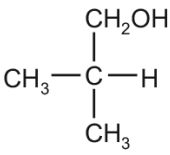
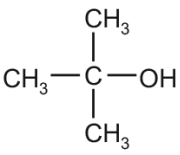
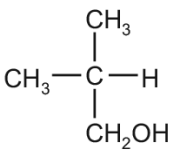
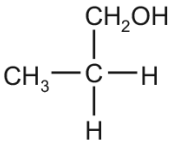
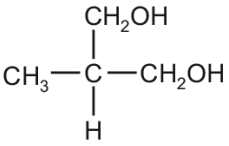
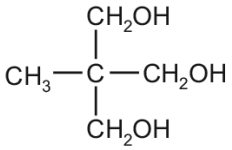
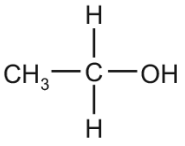
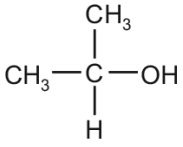
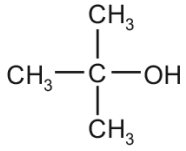


What could be the reagent for step 1 and what is the intermediate **X**?

	reagent for step 1	**X**
A	cold, acidified $KMnO_4$	$HOCH_2CH_2CH(OH)CH_2OH$
B	hot, acidified $K_2Cr_2O_7$	$HO_2CCH{=}CHCO_2H$
C	steam and concentrated H_2SO_4	$HOCH_2CH(OH)CH_2CH_2OH$
D	warm, acidified $K_2Cr_2O_7$	$OHCCH(OH)CH_2CHO$

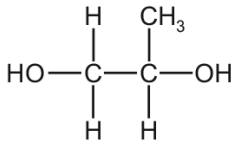
1002. 9701_m16_qp_12 Q: 26

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

	primary	secondary	tertiary
A			
B			
C			
D			

1003. 9701_m16_qp_12 Q: 27

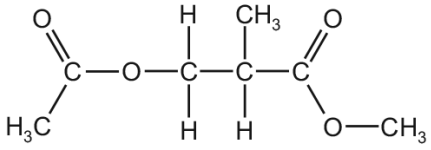
The fragrance compounds of perfumes are often dissolved in solvent **Y**, which has a molecular formula $C_7H_{12}O_4$. It is made by reacting propane-1,2-diol with ethanoic acid in the presence of an acid catalyst.



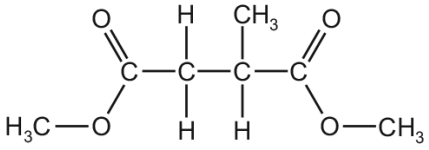
propane-1,2-diol

What is the structure of solvent **Y**?

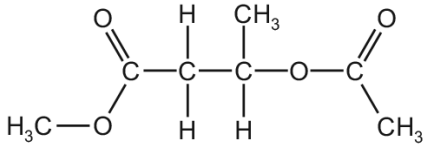
A



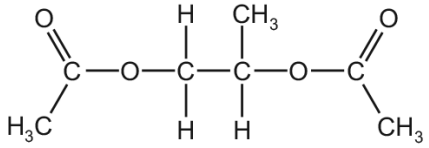
B



C



D



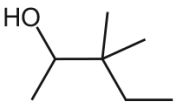
1004. 9701_s16_qp_12 Q: 29

How many isomeric esters, including structural isomers and stereoisomers, can be made with the molecular formula $C_5H_{10}O_2$, if methanoic acid is one of the two reactants used?

A 2 **B** 3 **C** 4 **D** 5

1005. 9701_s16_qp_13 Q: 20

What is the correct name of the molecule with the skeletal formula shown?



A 1,2,2-trimethylbutan-3-ol

B 2-ethyl-2-methylbutan-2-ol

C 3,3-dimethylpentan-2-ol

D 4-hydroxy-3,3-dimethylpentane

1006. 9701_s16_qp_13 Q: 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 dm^3 **B** 144 dm^3 **C** 156 dm^3 **D** 288 dm^3

1007. 9701_s16_qp_13 Q: 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

1008. 9701_s16_qp_13 Q: 28

Which reaction will give 2-chloropropane in the best yield?

A propane gas with chlorine gas in the presence of ultraviolet light

B propan-2-ol with dilute NaCl(aq)

C propan-2-ol with SOCl_2(l)

D propene with dilute HCl(aq)

1009. 9701_w16_qp_11 Q: 25

X, Y and Z are three isomeric alcohols.

X $CH_3CH_2CH_2CH_2CH_2OH$

Y $CH_3CH_2CH(OH)CH_2CH_3$

Z $(CH_3)_2C(OH)CH_2CH_3$

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

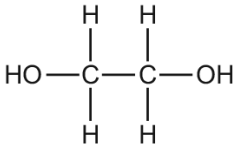
One of these alcohols, when dehydrated, will give a pair of cis-trans isomers with molecular formula C_5H_{10}.

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

1010. 9701_w16_qp_11 Q: 30

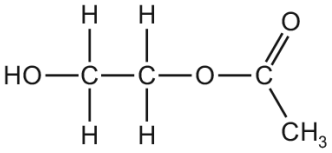
A solvent, **X**, used in printing inks has a molecular formula $C_6H_{10}O_4$. It may be made by reacting ethane-1,2-diol with ethanoic acid in the presence of an acid catalyst.



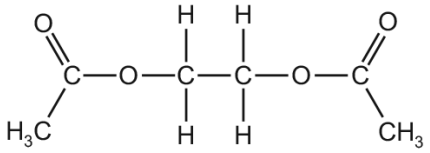
ethane-1,2-diol

What is the structure of solvent **X**?

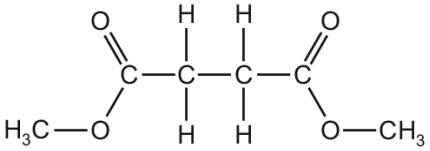
A



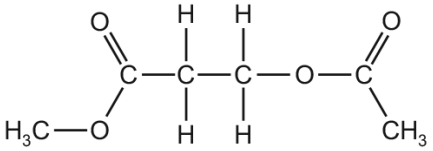
B



C



D



1011. 9701_w16_qp_12 Q: 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

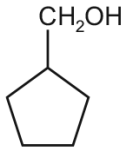
B butan-2-ol

C propan-1-ol

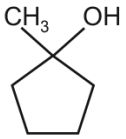
D propan-2-ol

1012. 9701_s15_qp_11 Q: 27

Which reagent will give a different observation with compounds W and X?



W



X

A hot $SOCl_2$

B hot acidified $K_2Cr_2O_7$

C NaOH(aq)

D warm Fehling's reagent

1013. 9701_s15_qp_12 Q: 20

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

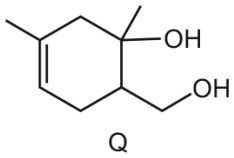
B 2-methylpentan-3-ol

C 3,3-dimethylpentan-2-ol

D 3-methylpentan-3-ol

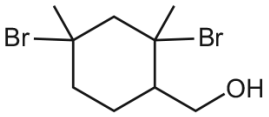
1014. 9701_s15_qp_12 Q: 21

What is the major product formed when compound Q is warmed with excess HBr?

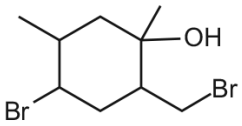


Q

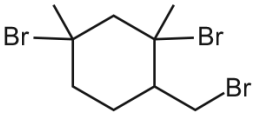
A



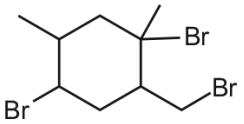
B



C



D



1015. 9701_s15_qp_12 Q: 24

Which reaction would **not** give propene?

A adding excess hot concentrated sulfuric acid to propan-1-ol

B adding warm aqueous sodium hydroxide to 2-bromopropane

C adding warm ethanolic sodium hydroxide to 1-bromopropane

D passing propan-2-ol vapour over heated aluminium oxide

1016. 9701_s15_qp_12 Q: 26

Use of the Data Booklet is relevant to this question.

2.40 g of propan-2-ol were mixed with excess acidified potassium dichromate(VI). The reaction mixture was then boiled under reflux for twenty minutes. The organic product was then collected by distillation. The yield of product was 75.0%.

What mass of product was collected?

A 1.74 g **B** 1.80 g **C** 2.22 g **D** 2.32 g

1017. 9701_s15_qp_13 Q: 20

An organic compound **Z**

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

What could be compound **Z**?

A $(CH_3)_3COH$

B $CH_3CH_2CH_2CHO$

C $CH_3CH_2CH(OH)CH_3$

D $CH_3CH_2COCH_3$

1018. 9701_w15_qp_12 Q: 20

Which ester is formed when the alcohol CH_3CH_2OH is reacted with $CH_3CH_2CH_2CO_2H$?

A butyl ethanoate

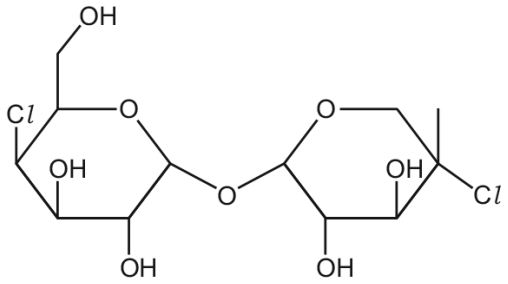
B ethyl butanoate

C ethyl propanoate

D propyl ethanoate

1019. 9701_w15_qp_12 Q: 25

Compound X has been investigated for use as an artificial sweetener.



X

The two C–Cl bonds can be hydrolysed by hot NaOH(aq). The C-O-C bonds **cannot** be hydrolysed by hot NaOH(aq).

What are the numbers of specified types of –OH groups before and after hydrolysing the two C–Cl bonds?

	before hydrolysis	after hydrolysis		
	secondary	primary	secondary	tertiary
A	0	1	2	4
B	0	2	1	4
C	4	1	5	1
D	4	2	4	1

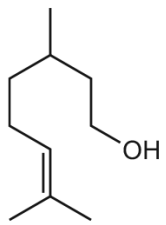
1020. 9701_w15_qp_12 Q: 26

The compounds below are all produced by plants.

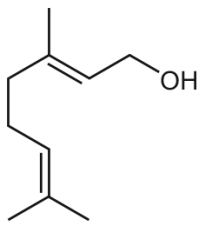
Each compound is warmed with acidified potassium dichromate(VI).

Which compound will give a different observation to the other three?

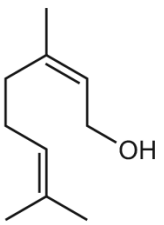
A



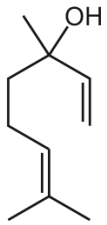
B



C



D



Chapter 16

Hydroxy compounds

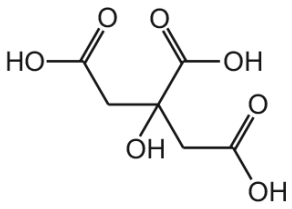
STEMUP.CO.UK

16.1 Alcohols

129. 9701_s21_qp_23 Q: 5

Compound **X** contains the same functional groups as citric acid.

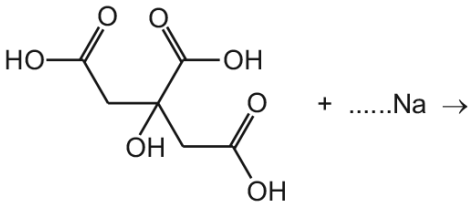
citric acid



The table describes some of the similarities and differences between citric acid and compound **X**.

	citric acid	**X**
chiral centre	no	yes
reaction with Na	fizzing	fizzing
reaction with $H^+/Cr_2O_7^{2-}$	remains orange	orange to green

(a) Complete the equation to show the reaction of excess sodium with citric acid. Show the skeletal structure of the product.



[3]

(b) (i) Use the information in the table to deduce the skeletal formula of **X**, $C_3H_6O_3$. Draw the skeletal formula of **X** in the box. Label the chiral centre of compound **X** with an asterisk (*).

[2]

(ii) Explain why compound **X** reacts with acidified $Cr_2O_7^{2-}$ but citric acid does not.

.....

.....

..... [2]

(c) Compound **X** is one of a pair of stereoisomers.

Stereoisomerism occurs when a molecule has at least one of two key features.

State the two key features that give rise to stereoisomerism.

1 .....

.....

2 .....

.....

[2]

(d) A structural isomer of compound **X** does not fizz when added to sodium.

Explain what is meant by *structural isomer*.

.....

..... [1]

[Total: 10]

---

130. 9701_w19_qp_22 Q: 3

A series of reactions for phosphorus and its compounds is shown.

$$P \xrightarrow[\text{reaction 1}]{\text{excess } Cl_2} PCl_5 \xrightarrow[\text{reaction 2}]{H_2O} H_3PO_4 \xrightarrow[\text{reaction 3}]{NH_3} (NH_4^+)(H_2PO_4^-)$$

(a) (i) State what you would observe in reaction **1**.

.....

..... [1]

(ii) State the type of reaction that occurs in reaction **2**.

..... [1]

(iii) H_3PO_4 can be produced by direct reaction of phosphorus with nitric acid.

$$P + 5HNO_3 \rightarrow H_2O + 5NO_2 + H_3PO_4$$

Use oxidation numbers to show that this reaction is a redox reaction.

.....

.....

..... [2]

(b) Reaction **3** is a neutralisation reaction in which NH_3 acts as a base.

(i) Explain how NH_3 acts as a base in reaction **3**.

.....

..... [1]

(ii) Draw the three-dimensional shape of the ammonium ion, NH_4^+. Give the bond angle.

bond angle = ... ° [1]

(iii) State the industrial importance of compounds such as $(NH_4^+)(H_2PO_4^-)$.

..... [1]

(c) PCl_5 can be used to convert alcohols to halogenoalkanes.

(i) Write an equation for the reaction of C_2H_5OH with PCl_5 to form C_2H_5Cl.

..... [1]

(ii) State the type of reaction in **(i)**.

..... [1]

(iii) Halogenoalkanes can also be prepared by reacting alcohols with hydrogen halides, such as HCl and HI.

- HCl is prepared using NaCl and concentrated H_2SO_4.
- HI is prepared by reacting NaI with concentrated H_3PO_4.

Suggest why HI is **not** prepared by the reaction of NaI with concentrated H_2SO_4.

.....

.....

..... [2]

(iv) The rate of the hydrolysis reaction of halogenoalkanes with NaOH(aq) is dependent on the halogen that is bonded to carbon.

State and explain the order of reactivity when NaOH(aq) reacts separately with C_2H_5Cl, C_2H_5Br and C_2H_5I.

.....

.....

..... [2]

[Total: 13]

131. 9701_s18_qp_21 Q: 4

X is $CH_3CH(OH)CH_2CH_3$.

(a) The reaction between **X** and alkaline aqueous iodine produces a yellow precipitate.

(i) Give the name of the compound formed as a yellow precipitate in this reaction.

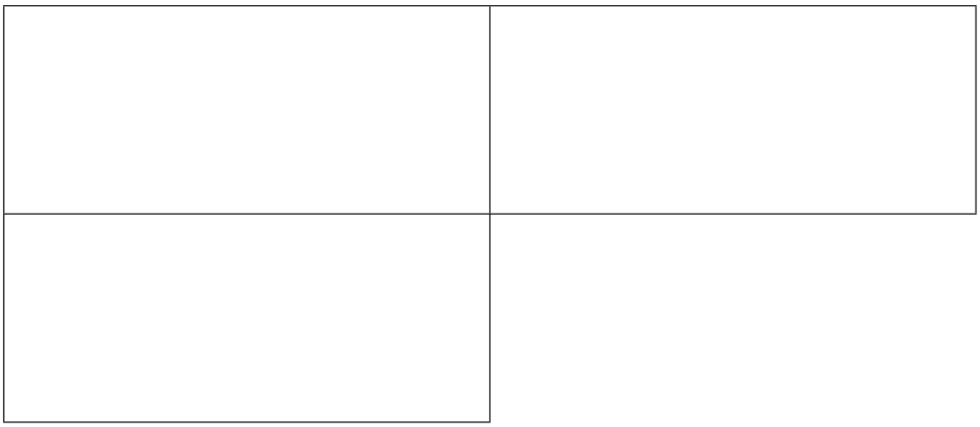
..... [1]

(ii) Give the name of **X**.

..... [1]

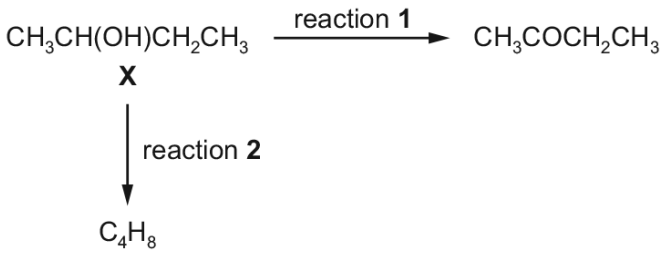
(b) There are three structural isomers of **X** that are alcohols.

Draw the structures of these three isomers of **X**.



[2]

(c) Two reactions of **X** are shown.



(i) Identify the type of reaction involved in reaction **1**.

..... [1]

(ii) Identify the reagents for reaction **1**.

..... [1]

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(iii) Reaction **2** can be carried out by passing the vapour of **X** over hot aluminium oxide.

The product of reaction **2**, C_4H_8, is actually a mixture of three isomers.

Give the full names of the three isomers formed by reaction **2**.

1 .....

2 .....

3 .....

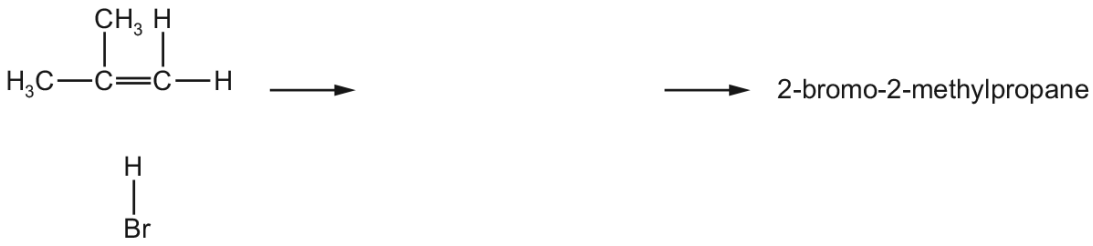
[3]

(d) The reaction of methylpropene, $(CH_3)_2CCH_2$, with hydrogen bromide, HBr, produces a mixture of two halogenoalkanes.

One of the halogenoalkanes, 2-bromo-2-methylpropane, is formed as the major product while 1-bromo-2-methylpropane is formed in small quantities.

(i) Complete the mechanism to show the reaction of methylpropene with HBr to form the **major** product.

Include the structure of the intermediate and all necessary charges, dipoles, lone pairs and curly arrows. The structure of 2-bromo-2-methylpropane is not required.



[4]

(ii) Explain why 2-bromo-2-methylpropane is the major product of this reaction.

.....

.....

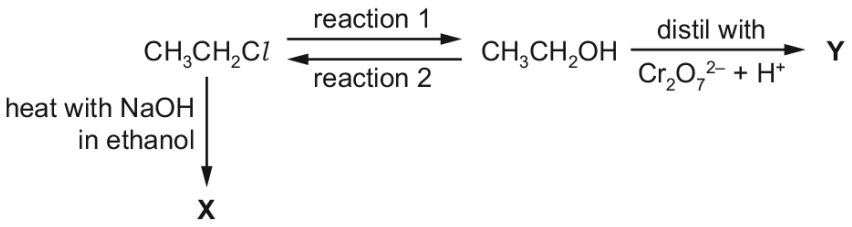
.....

..... [2]

[Total: 15]

132. 9701_w15_qp_21 Q: 4

Some reactions involving ethanol are shown.



(a) (i) Give an equation for reaction 2 including the reagent needed for the conversion.

..... [2]

(ii) State the reagent and conditions required for reaction 1.

..... [2]

(b) (i) Identify the organic product **X**.

..... [1]

(ii) Nitric acid is added to the products of reaction of CH_3CH_2Cl with NaOH in ethanol. Silver nitrate solution is then added to this mixture.

State what you would observe.

..... [1]

(iii) Write an ionic equation, including state symbols, for the reaction responsible for the observation in **(ii)**.

..... [1]

(c) (i) Identify the organic product **Y** which is distilled out of the reaction mixture.

..... [1]

(ii) Explain, in terms of the properties of and intermolecular forces in CH_3CH_2OH and **Y**, why the chosen conditions for the reaction ensure that **Y** is the product.

.....

.....

..... [3]

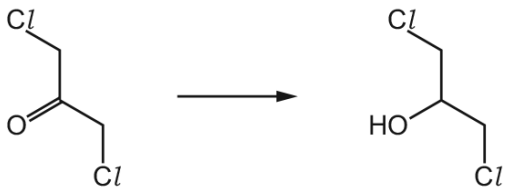
[Total: 11]

16.2 Phenol

133. 9701_s21_qp_23 Q: 4

(a) 1,3-dichloropropan-2-ol can be made by reacting **M**.

M → 1,3-dichloropropan-2-ol



(i) Give the systematic name of **M**.

..... [1]

(ii) Name the functional group present in **M** that changes during this reaction.

..... [1]

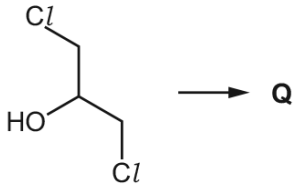
(iii) State a suitable reagent for this reaction.

..... [1]

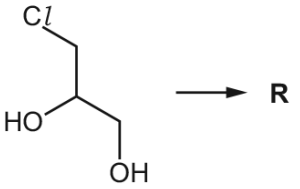
(b) Separate samples of 1,3-dichloropropan-2-ol and 3-chloropropane-1,2-diol are heated with excess acidified $Cr_2O_7^{2-}$ until there is no further reaction.

In each reaction, a different organic product, **Q** or **R**, is made.

1,3-dichloropropan-2-ol → **Q**



3-chloropropane-1,2-diol → **R**



Q and **R** are tested separately with 2,4-dinitrophenylhydrazine solution, 2,4-DNPH, and sodium carbonate solution, $Na_2CO_3(aq)$.

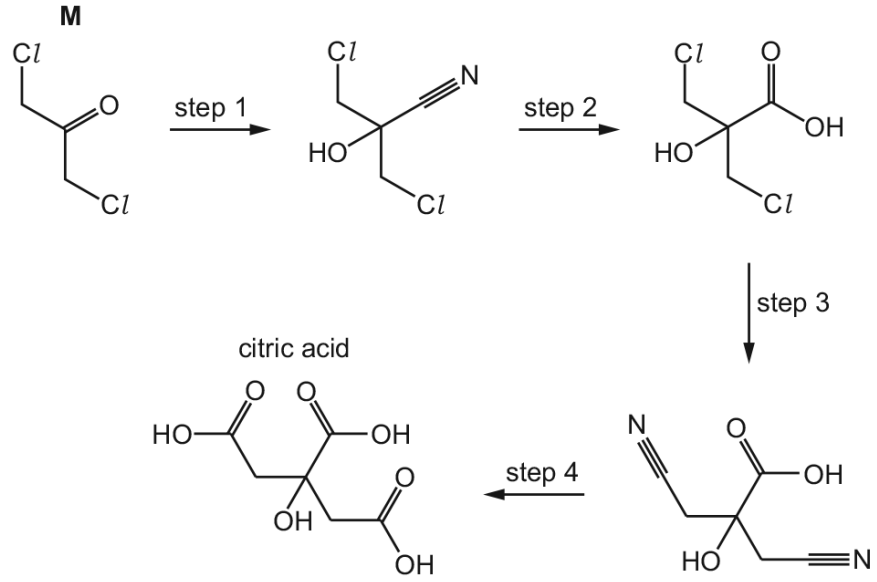
Complete the table to give any relevant observations.

If no reaction occurs, write 'no visible change'.

reagent	observation with **Q**	observation with **R**
2,4-DNPH		
$Na_2CO_3(aq)$		

[4]

(c) Citric acid can be made from **M** in a four-step reaction.



Complete the table for each step of the reaction sequence to identify:

- the reagents and conditions required
- the type of reaction.

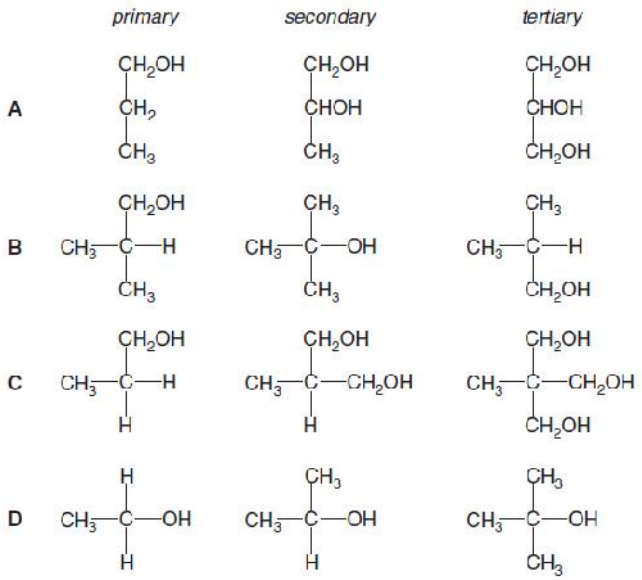
step	reagent and conditions	type of reaction
1		
2	dilute sulfuric acid	
3		
4	dilute sulfuric acid	

[5]

[Total: 12]

1.

Which set of alcohols correctly shows a primary, a secondary and a tertiary alcohol?



[2002 M/J (20)]

2.

An organic compound will decolorise dilute acidified aqueous potassium manganate(VII) on warming, but will not decolorise bromine water.

What could the organic compound be?

A butane

B ethanol

C ethene

D ethanoic acid

[2002 M/J (26)]

3.

Which alcohols on oxidation with acidified potassium dichromate(VI) give an organic product which causes an effervescence when reacted with sodium carbonate?

1 butan-1-ol

2 2-methylpropan-1-ol

3 2-methylpropan-2-ol

[2002 M/J (40)]

4.

The compound hex-3-en-1-ol, **P**, has a strong 'leafy' smell of newly cut grass and is used in perfumery.

$CH_3CH_2CH{=}CHCH_2CH_2OH$

P

What is produced when **P** is treated with an excess of hot concentrated acidic $KMnO_4$?

A $CH_3CH_2CH(OH)CH(OH)CH_2CH_2OH$

B $CH_3CH_2CH{=}CHCH_2CO_2H$

C CH_3CH_2CHO and $OCHCH_2CH_2OH$

D $CH_3CH_2CO_2H$ and $HO_2CCH_2CO_2H$

[2003 M/J (22)]

5.

In its reaction with sodium, 1 mol of a compound **X** gives 1 mol of $H_2(g)$.

Which compound might **X** be?

A $CH_3CH_2CH_2CH_2OH$

B $(CH_3)_3COH$

C $CH_3CH_2CH_2CO_2H$

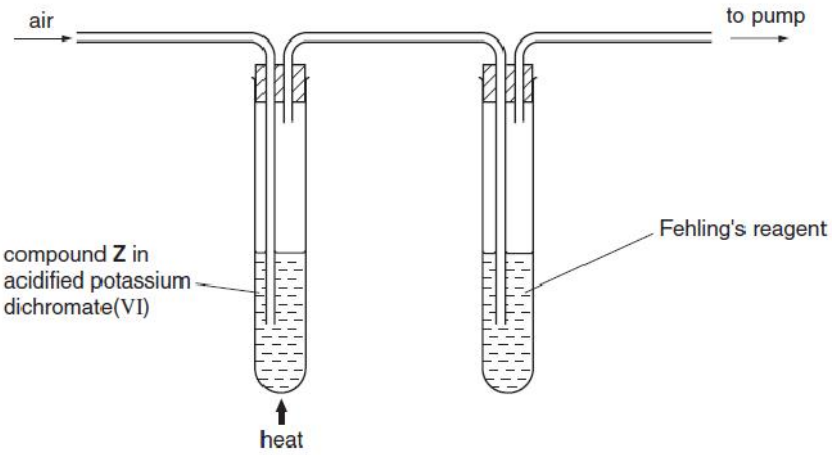
D $CH_3CH(OH)CO_2H$

[2003 M/J (28)]

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6.

When the apparatus below was used with compound **Z**, a brick-red precipitate formed in the right-hand tube.



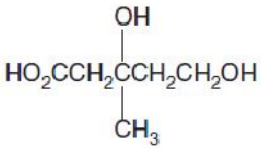
Which compound could be **Z**?

1 $CH_3CH(OH)CH_3$ **2** $CH_3CH_2CH_2OH$ **3** CH_3OH

[2003 M/J (39)]

7.

Mevalonic acid is an intermediate in the biosynthesis of cholesterol, and is shown below.



Which properties does mevalonic acid have?

1 It has only one chiral carbon atom.

2 It can be esterified both by ethanoic acid and by ethanol, in the presence of H^+ ions.

3 It contains both primary and secondary alcohol groups.

[2003 M/J (40)]

8.

Which alcohol gives only **one** 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

[2003 O/N (26)]

9.

What will react differently with the two isomeric pentanols, $(CH_3)_3CCH_2OH$ and $(CH_3)_2CHCH_2CH_2OH$?

A acidified aqueous potassium manganate(VII)

B concentrated sulphuric acid

C phosphorus pentachloride

D sodium

[2003 O/N (27)]

10.

How many hydrogen atoms in a molecule of glycerol, $HOCH_2CH(OH)CH_2OH$, may be substituted by deuterium on dissolving it in an excess of D_2O?

A 2 **B** 3 **C** 5 **D** 8

[2003 O/N (28)]

11.

What can be produced when an aqueous solution of butan-1-ol is heated with dilute acidified potassium manganate(VII)?

1 butanal

2 butanoic acid

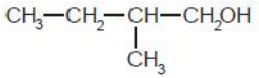
3 butanone

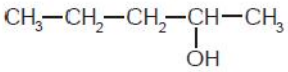
[2004 M/J (38)]

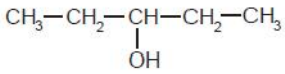
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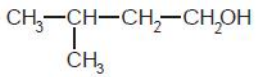
12.

Which isomer of $C_5H_{11}OH$ gives, on dehydration, the greatest number of different alkenes?

A 

B 

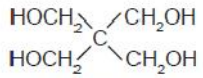
C 

D 

[2004 O/N (28)]

13.

Pentaerythritol is an intermediate in the manufacture of paint.



pentaerythritol

Which of the following statements about pentaerythritol are correct?

1 It reacts with metallic sodium.

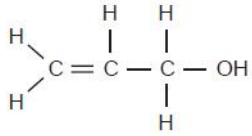
2 It is dehydrated by concentrated sulphuric acid to an alkene.

3 Its empirical formula is CH_3O.

[2004 O/N (39)]

14.

Prop-2-en-1-ol (allyl alcohol) has the following structure.



Which reagent would react with prop-2-en-1-ol to form a product that could exist as optical isomers?

A bromine

B hydrogen and nickel

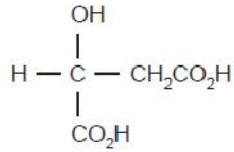
C phosphorus pentachloride

D sodium

[2005 M/J (20)]

15.

Malic acid occurs in apples.



malic acid

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

A ethanol in the presence of concentrated sulphuric acid

B potassium hydroxide

C sodium

D sodium carbonate

[2005 M/J (26)]

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16.

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

A Na

B Br_2 (in CCl_4)

C $KMnO_4(aq)$

D 2,4-dinitrophenylhydrazine

[2006 M/J (26)]

17.

Which compounds are able to react with concentrated sulphuric acid to give a product that will decolourise acidic potassium manganate(VII)?

1 $(CH_3)_3COH$

2 $CH_3CH_2CH(OH)CH_3$

3 CH_3CO_2H

[2006 O/N (39)]

18.

An alcohol with molecular formula $C_nH_{2n+1}OH$ has a chiral carbon atom but does not react with MnO_4^- / H^+.

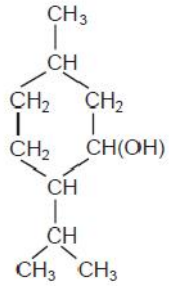
What is the least number of carbon atoms such an alcohol could possess?

A 5 **B** 6 **C** 7 **D** 8

[2007 M/J (26)]

19.

Menthol, from oil of mint, is used in soaps and perfumes.



menthol

Which statements about menthol are correct?

1 There is a total of two chiral centres present in the menthol molecule.

2 On reaction with concentrated sulphuric acid, menthol produces a mixture of two alkenes.

3 A solution of acidified potassium dichromate(VI), on warming with menthol, changes colour from orange to green.

[2007 M/J (39)]

20.

Which reaction will distinguish between a primary and a secondary alcohol?

A warming with H^+ / MnO_4^-

B warming with $H^+ / Cr_2O_7^{2-}$

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

D oxidation, followed by reaction with Fehling's (or Tollens') reagent

[2007 O/N (27)]

21.

Which structures show a primary alcohol that **cannot** be dehydrated to form an alkene?

1 CH_3OH

2 CH_3CH_2OH

3 $CH_3CH(OH)CH_3$

[2007 O/N (38)]

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22.

An alcohol of molecular formula $C_4H_{10}O_2$ contains two OH groups and has an unbranched carbon atom chain.

On reaction with an excess of hot MnO_4^-/ H^+ this alcohol is converted into a compound of molecular formula $C_4H_6O_4$.

To which two carbon atoms in the chain of the alcohol are the two OH groups attached?

A 1st and 2nd

B 1st and 3rd

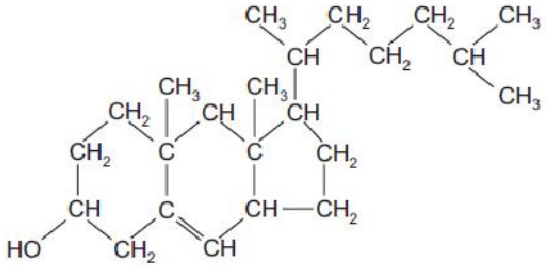
C 1st and 4th

D 2nd and 3rd

[2008 M/J (26)]

23.

The compound cholesterol has the following structure.



Which statements are correct?

1 Cholesterol reacts with a mixture of ethanoic acid and concentrated sulphuric acid.

2 Cholesterol reacts with bromine to form a compound which has two new chiral centres.

3 Cholesterol is oxidised by acidified sodium dichromate(VI) to form an aldehyde.

[2008 M/J (39)]

24.

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

$CH_3CH_2CH{=}CHCH_2CH_2OH$

leaf alcohol

Which two compounds will be formed when 'leaf alcohol' is oxidised using hot, concentrated manganate(VII) ions?

A CH_3CO_2H and $HOCH_2CH_2CH_2CO_2H$

B CH_3CO_2H and $HO_2CCH_2CH_2CO_2H$

C $CH_3CH_2CO_2H$ and $HO_2CCH_2CO_2H$

D $CH_3CH_2CO_2H$ and $HOCH_2CH_2CO_2H$

[2008 O/N (21)]

25.

The functional group in a primary alcohol is $-CH_2OH$.

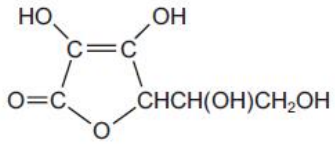
Which reagent reacts with a primary alcohol, under suitable conditions, to give an organic product with the same number of oxygen atoms as the alcohol?

A Al_2O_3 **B** CH_3CO_2H **C** HBr **D** Na

[2008 O/N (25)]

26.

The structure of the antioxidant vitamin C is shown in the diagram.



On the basis of this structure, which properties is vitamin C likely to have?

1 It is soluble in water.

2 It decolourises aqueous bromine rapidly.

3 It reduces Fehling's reagent.

[2008 O/N (40)]

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27.

Glycol, used in anti-freeze, has the formula $HOCH_2CH_2OH$. It can be oxidised to give a number of products.

What is the molecular formula of an oxidation product of glycol that will **not** react with sodium?

A $C_2H_2O_2$ **B** $C_2H_2O_3$ **C** $C_2H_2O_4$ **D** $C_2H_4O_2$

[2009 M/J (26)]

28.

A compound **Y** has the following properties.

- It is a liquid at room temperature and atmospheric pressure.
- It does not mix completely with water.
- It does not decolourise acidified potassium manganate(VII).

What could **Y** be?

A ethane

B ethanoic acid

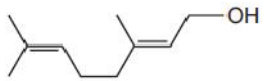
C ethanol

D ethyl ethanoate

[2009 M/J (30)]

29.

Geraniol is one of several compounds produced by the scent glands of honey bees to help them mark nectar-bearing flowers and locate the entrances to their hives.



geraniol

Which reactions will geraniol undergo?

1 reaction with hot concentrated acidic $KMnO_4$ to give propanone

2 addition of halogens

3 reaction with aqueous $NaHCO_3$ to give CO_2

[2009 M/J (38)]

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Hydroxyl Compounds – 2021 AS

1. Nov/2021/Paper_12/No.26

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

2. Nov/2021/Paper_12/No.27

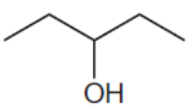
Structural and stereoisomerism should be taken into account when answering this question.

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

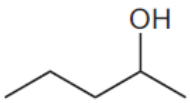
Only **two** organic products are formed.

What could be X?

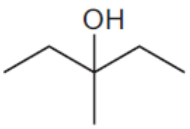
A



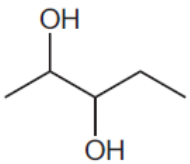
B



C



D



3. Nov/2021/Paper_13/No.25

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 $CH_2(OH)CH_2CH(OH)CH_2CH_3$

4. Nov/2021/Paper_13/No.26

$CH_3CH_2COCH_2CH_3$ reacts with hydrogen cyanide to form an organic product called a cyanohydrin.

Which statement is correct?

A The cyanohydrin product has one chiral centre.

B The cyanohydrin product is formed by electrophilic addition.

C The cyanohydrin product is formed via an intermediate which contains a C–OH group.

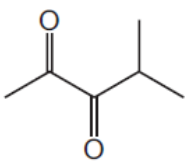
D The formation of the cyanohydrin product requires the use of cyanide ions as a catalyst.

5. Nov/2021/Paper_13/No.27

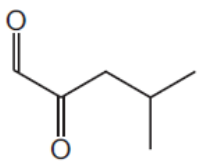
Reduction of compound R with $LiAlH_4$ gives the compound 4-methylpentane-2,3-diol.

What could be the identity of compound R?

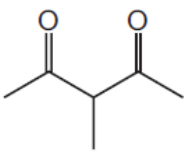
A



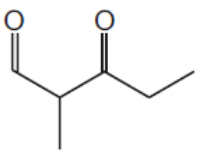
B



C



D



6. Nov/2021/Paper_13/No.40

Which reactions of propan-1-ol have water as one of the products?

1 passing propan-1-ol vapour over hot Al_2O_3

2 mixing propan-1-ol with warm ethanoic acid and a few drops of concentrated sulfuric acid

3 warming propan-1-ol with HBr

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7. March/2021/Paper_12/No.21

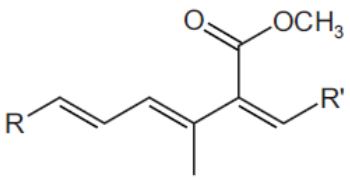
How many tertiary alcohols have the molecular formula $C_6H_{14}O$?

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

8. March/2021/Paper_12/No.23

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

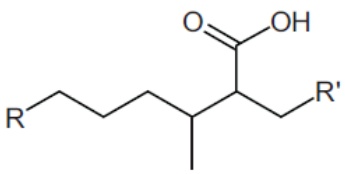
strobilurin



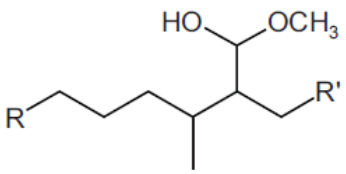
Strobilurin is warmed with aqueous sulfuric acid producing compound X. Compound X is then treated with hydrogen in the presence of a nickel catalyst producing compound Y.

What could be the structure of compound Y?

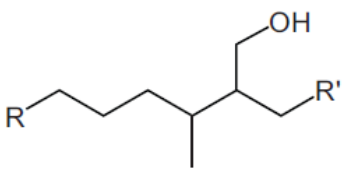
A



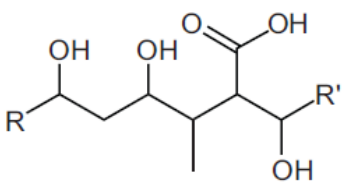
B



C



D



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9. March/2021/Paper_12/No.28

Ethanedioic acid has the formula HO_2CCO_2H.

What is the formula of aluminium ethanedioate?

A AlC_2O_4 **B** $Al(C_2O_4)_3$ **C** $Al_2C_2O_4$ **D** $Al_2(C_2O_4)_3$

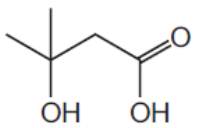
10. March/2021/Paper_12/No.38

An excess of P reacts with Q, in the presence of concentrated sulfuric acid, to form R.

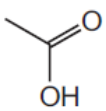
Effervescence is seen when a piece of sodium is added to pure R.

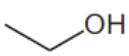
The structure of P is shown.

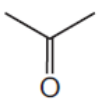
P



Which organic compounds could be compound Q?

1 

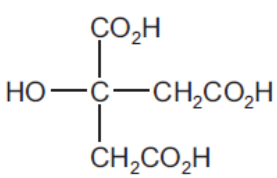
2 

3 

11. June/2021/Paper_11/No.27

How many moles of hydrogen, H_2, are evolved when an excess of sodium metal is added to one mole of citric acid?

citric acid

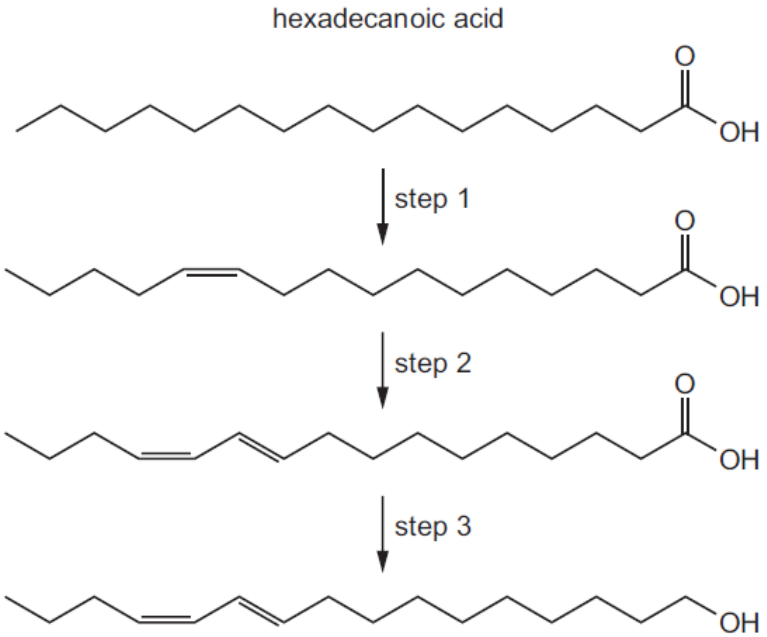


A 0.5 **B** 1.5 **C** 2 **D** 4

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12. June/2021/Paper_12/No.21

Hexadeca-10,12-dien-1-ol is produced by silk moths from hexadecanoic acid in a three-step enzymic process.



Which row contains correct descriptions of the three steps?

	step 1	step 2	step 3
A	elimination	elimination	dehydration
B	elimination	reduction	reduction
C	oxidation	elimination	oxidation
D	oxidation	oxidation	reduction

13. June/2021/Paper_12/No.26

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

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14. June/2021/Paper_12/No.27

Which reaction will form a strong organic base?

A ethanol and acidified sodium dichromate

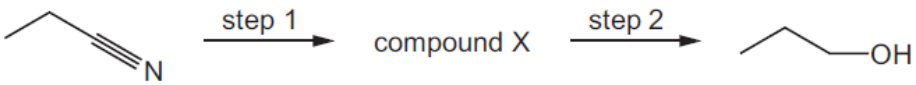
B ethanol and hot aluminium oxide

C ethanol and sodium

D ethanol and hydrogen chloride

15. June/2021/Paper_12/No.29

The synthesis shown may be used for the production of propan-1-ol.



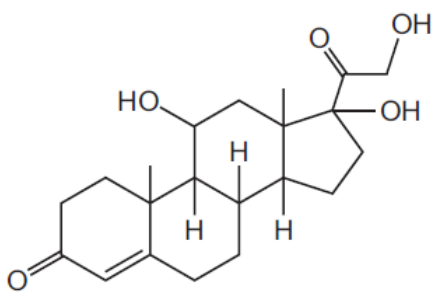
Which row gives the correct reagents for steps 1 and 2?

	step 1	step 2
A	HC*l*(aq)	H_2 + Ni
B	HC*l*(aq)	LiA*l*H_4
C	NaOH(aq)	H_2 + Ni
D	NaOH(aq)	$NaBH_4$

16. June/2021/Paper_12/No.37

Cortisone is a synthetic hormone.

cortisone



Which classes of alcohol does this molecule contain?

1 primary alcohol

2 secondary alcohol

3 tertiary alcohol

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17. June/2021/Paper_13/No.25

Two reactions are shown. Only one product is identified in each reaction.

ethanol + acidified $Cr_2O_7^{2-}$ → ethanal

ethanol + sodium → sodium ethoxide

Which statement about these reactions is correct?

A The formations of both ethanal and sodium ethoxide are redox reactions.

B The formations of both ethanal and sodium ethoxide result in colour changes.

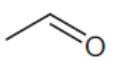
C The formation of ethanal is catalysed by potassium dichromate.

D The formation of sodium ethoxide is a dehydration reaction.

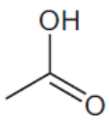
18. June/2021/Paper_13/No.26

The skeletal formulae of three compounds are shown.

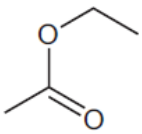
R



S



T



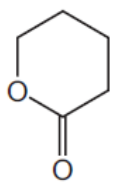
Which compounds will give a positive test with 2,4-dinitrophenylhydrazine reagent?

A R only **B** R and S only **C** S and T only **D** R, S and T

19. June/2021/Paper_13/No.40

5-hydroxypentanoic acid is readily converted into the cyclic compound L.

L



Which statements about this reaction are correct?

1 Acidified sodium dichromate(VI) is used as a reagent.

2 A water molecule is produced in the reaction.

3 The reaction can be catalysed by concentrated H_2SO_4.

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20. June/2021/Paper_22/No.4(c)

(c) A sample of propan-1-ol reacts with concentrated sulfuric acid to form propene.

Identify the role of concentrated sulfuric acid in this reaction.

..... [1]

21. June/2021/Paper_22/No.5

S is a secondary alcohol with molecular formula $C_4H_{10}O$.

(a) Draw the displayed formula of **S**.

[1]

(b) **S** is converted to **V** in a three-step reaction sequence.



In step 1, the secondary alcohol **S** reacts with PBr_3 to produce **T**, which has molecular formula C_4H_9Br.

(i) Give the systematic name of **T**.

..... [1]

(ii) Name the type of reaction that occurs in step 1.

..... [1]

(iii) State the reagent(s) and conditions for step 2.

.....

..... [2]

(iv) Step 3 involves heating C_4H_9CN with dilute acid to form **V**.

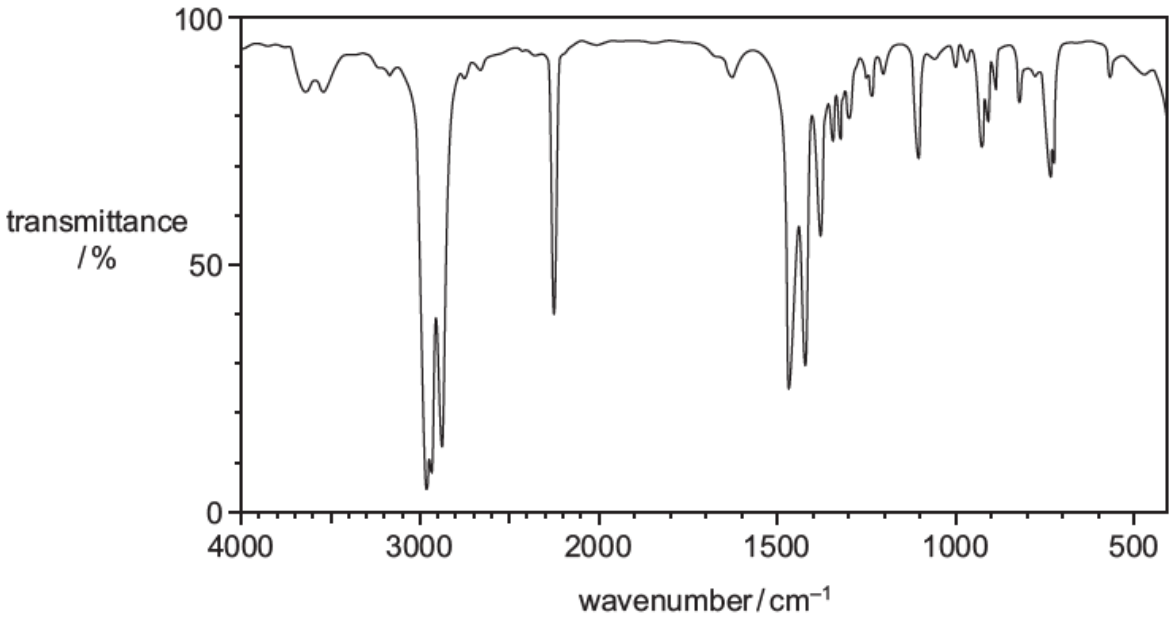
Complete the equation for this reaction.

$$.....C_4H_9CN + ...H^+ + ...H_2O \rightarrow .....$$ [2]

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(v) An unlabelled sample contains either **S**, **T** or **U**.

The sample produces the infrared spectrum shown.



Explain how this spectrum confirms that the unknown sample contains **U**.

In your answer identify **one** relevant absorption in the infrared spectrum and the bond that corresponds to this absorption in the region above 1500 cm^{-1}.

.....

..... [1]

[Total: 8]

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22. June/2021/Paper_23/No.4

(a) 1,3-dichloropropan-2-ol can be made by reacting **M**.

M → 1,3-dichloropropan-2-ol



(i) Give the systematic name of **M**.

..... [1]

(ii) Name the functional group present in **M** that changes during this reaction.

..... [1]

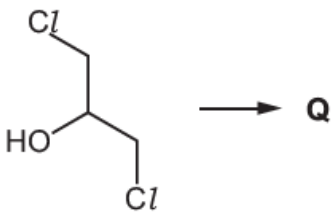
(iii) State a suitable reagent for this reaction.

..... [1]

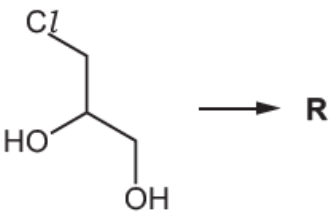
(b) Separate samples of 1,3-dichloropropan-2-ol and 3-chloropropane-1,2-diol are heated with excess acidified $Cr_2O_7^{2-}$ until there is no further reaction.

In each reaction, a different organic product, **Q** or **R**, is made.

1,3-dichloropropan-2-ol → **Q**



3-chloropropane-1,2-diol → **R**



Q and **R** are tested separately with 2,4-dinitrophenylhydrazine solution, 2,4-DNPH, and sodium carbonate solution, $Na_2CO_3(aq)$.

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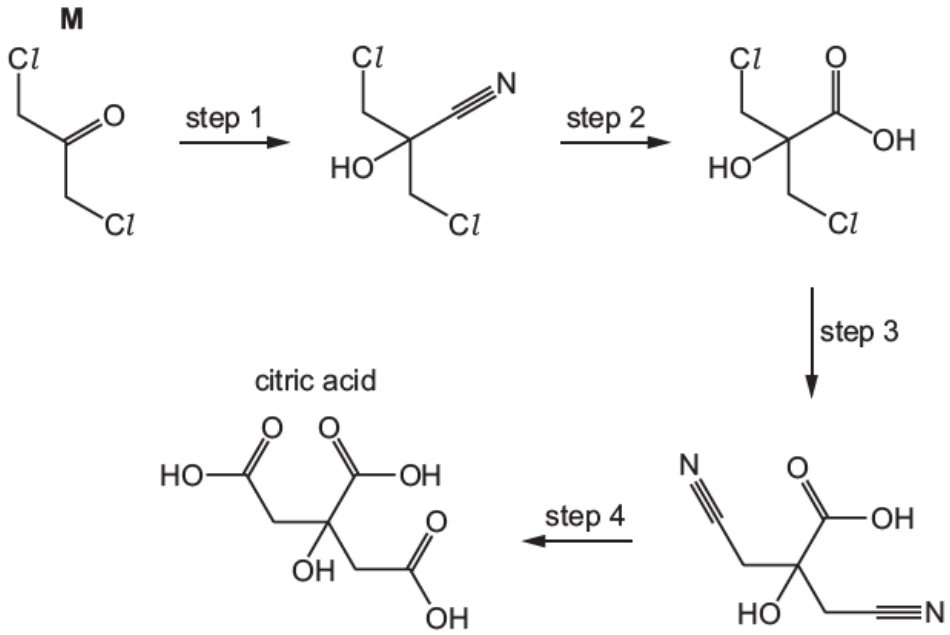
Complete the table to give any relevant observations.

If no reaction occurs, write 'no visible change'.

reagent	observation with **Q**	observation with **R**
2,4-DNPH		
$Na_2CO_3(aq)$		

[4]

(c) Citric acid can be made from **M** in a four-step reaction.



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Complete the table for each step of the reaction sequence to identify:

- the reagents and conditions required
- the type of reaction.

step	reagent and conditions	type of reaction
1		
2	dilute sulfuric acid	
3		
4	dilute sulfuric acid	

[5]

[Total: 12]

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Hydroxyl compounds – 2022 June AS Chemistry 9701

1. June/2022/Paper_11/No.26

Ethanol can be used to make propanenitrile in two steps.

$$CH_3CH_2OH \xrightarrow{X} CH_3CH_2Br \xrightarrow{Y} CH_3CH_2CN$$

What types of reaction are X and Y?

	X	Y
A	free-radical substitution	electrophilic substitution
B	free-radical substitution	nucleophilic substitution
C	nucleophilic substitution	nucleophilic substitution
D	nucleophilic substitution	electrophilic substitution

2. June/2022/Paper_11/No.33

17.6 g of pentan-1-ol is completely combusted.

Which volume of gaseous products is formed when measured at s.t.p.?

A $22.4\,dm^3$ **B** $24.0\,dm^3$ **C** $49.3\,dm^3$ **D** $52.8\,dm^3$

3. June/2022/Paper_11/No.34

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	$CH_3CH{=}CHCH_2Cl$

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4. June/2022/Paper_12/No.33

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

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Hydroxyl compounds – 2022 Nov AS Chemistry 9701

1. Nov/2022/Paper_11/No.26

Which pair of alcohols are isomers of each other?

A butan-1-ol and 2,2-dimethylpropan-1-ol

B butan-2-ol and 2-methylpropan-2-ol

C pentan-1-ol and 2-methylpropan-2-ol

D propan-2-ol and 2-methylpropan-2-ol

2. Nov/2022/Paper_11/No.27

How many chiral carbon atoms are there in one molecule of 2,2,4,5-tetramethylhexan-3-ol?

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

3. Nov/2022/Paper_11/No.37

2-bromopropane reacts with hot ethanolic sodium hydroxide.

Which substance is the major product of this reaction?

A propan-1-ol

B propan-2-ol

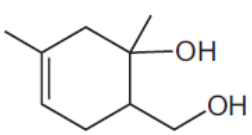
C 2-hydroxypropene

D propene

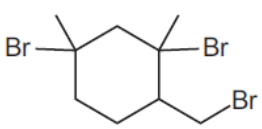
4. Nov/2022/Paper_12/No.29

What is the major product formed when compound R is warmed with an excess of HBr?

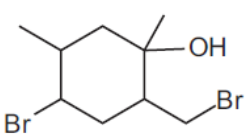
R



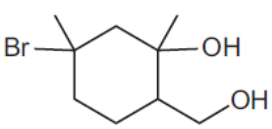
A



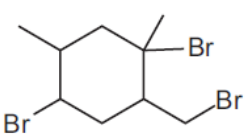
B



C



D

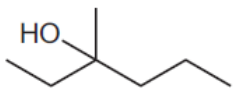


5. Nov/2022/Paper_12/No.34

Structural isomerism and stereoisomerism should be considered when answering this question.

3-methylhexan-3-ol reacts with hot concentrated sulfuric acid to form several isomeric compounds with the molecular formula C_7H_{14}.

3-methylhexan-3-ol



How many isomeric compounds could be formed in this reaction?

A 3 **B** 4 **C** 5 **D** 6

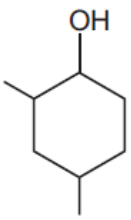
Hydroxyl compounds – 2023 AS Chemistry 9701

1. Nov/2023/Paper_ 9701/11/No.33

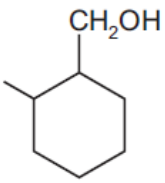
Alcohol X gives a yellow precipitate with alkaline $I_2(aq)$.

What is the structure of X?

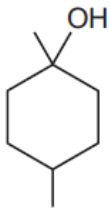
A



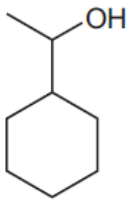
B



C



D



2. Nov/2023/Paper_ 9701/11/No.34

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.

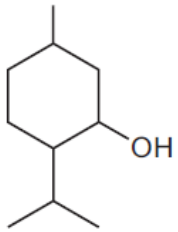
C The negative charge on the oxygen in an ethoxide ion is delocalised.

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

3. Nov/2023/Paper_ 9701/11/No.35

Menthol is a naturally occurring alcohol.

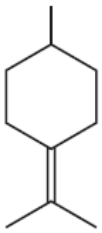
menthol



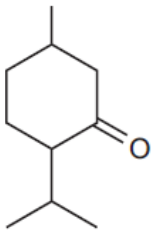
When menthol is heated with concentrated sulfuric acid it reacts. The products formed include compound T.

What is the structure of compound T?

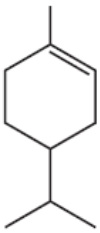
A



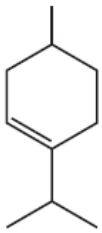
B



C



D



4. Nov/2023/Paper_ 9701/12/No.34

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

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(e) The structure of glucose, $C_6H_{12}O_6$, is shown in Fig. 3.2.

glucose

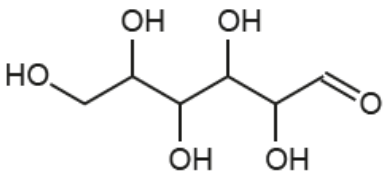


Fig. 3.2

(i) Complete Table 3.1 to identify the number of primary, secondary and tertiary alcohol groups present in the structure shown in Fig. 3.2.

Table 3.1

type of alcohol group	primary	secondary	tertiary
number of groups			

[1]

(ii) Separate samples of aqueous glucose are tested with the reagents shown in Table 3.2.

Complete Table 3.2 with the observation for each reaction.

Write "no reaction" if applicable.

Table 3.2

reagent and conditions	observation with glucose
acidified $KMnO_4(aq)$ and warm	
Fehling's reagent and warm	
alkaline $I_2(aq)$ and warm	

[3]

(iii) There are many structural isomers of $C_6H_{12}O_6$.

Define structural isomers.

.....

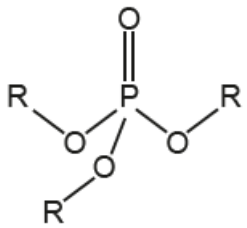
..... [1]

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6. Nov/2023/Paper_ 9701/22/No.3(d)

(d) H_3PO_4 also reacts with alcohols to form organophosphates.

Organophosphates are compounds similar to esters. They have the general structure shown in Fig. 3.2.



R = alkyl group

Fig. 3.2

(i) Complete the equation to suggest the products of the reaction of H_3PO_4 with methanol, CH_3OH.

$H_3PO_4 + 3CH_3OH \longrightarrow$ ..... [1]

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(ii) Compound **T** is a simple organophosphate.

The mass spectrum of **T** shows a molecular ion peak at m/e = 182. This peak has a relative intensity of 12.7.

The relative intensity of the M+1 peak is 0.84.

Deduce the number of carbon atoms in **T**.
Hence suggest the molecular formula of **T**.

Assume that phosphorus and oxygen exist as single isotopes.

Show your working.

number of carbon atoms in **T** = ...

molecular formula of **T** = ...
[3]

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7. June/2023/Paper_9701/11/No.25

Which reagent will react with pentan-3-ol to give a mixture of stereoisomers?

A acidified potassium dichromate

B concentrated sulfuric acid

C ethanoic acid in the presence of a little concentrated H_2SO_4

D hydrogen chloride

8. June/2023/Paper_9701/11/No.30

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

9. June/2023/Paper_9701/11/No.32

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

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

10. June/2023/Paper_9701/12/No.26

The general formula for a non-cyclic alcohol is $C_nH_{2n+1}OH$.

How many different structural isomers are there for $n = 3$ and $n = 4$?

	$n = 3$	$n = 4$
A	2	2
B	2	4
C	3	4
D	3	8

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11. June/2023/Paper_9701/12/No.27

Compound X, $C_5H_{10}O_3$, has one chiral carbon atom per molecule. Compound X produces bubbles with Na but **not** with Na_2CO_3.

Which formula could represent compound X?

A $(CH_3)_2C(OH)CO_2CH_3$

B $HOCH_2CH(CH_3)CO_2CH_3$

C $CH_3CH_2C(CH_3)(OH)CO_2H$

D $CH_3CH(OH)CH(CH_3)CO_2H$

12. June/2023/Paper_9701/12/No.33

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}.

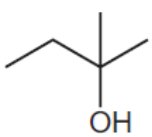
Which row is correct?

	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

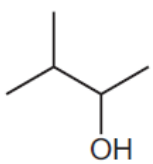
13. June/2023/Paper_9701/13/No.28

Which compound is a secondary alcohol that can be dehydrated to form an alkene with $M_r = 70$?

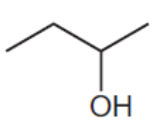
A



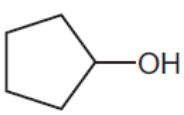
B



C



D



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14. June/2023/Paper_9701/13/No.29

The conversion of propan-1-ol into propan-2-ol can be completed in a two-stage synthesis.

The first stage is to heat the propan-1-ol with concentrated sulfuric acid.

Which reagent would be needed to complete the second stage?

A cold dilute acidified manganate(VII) ions

B hot concentrated acidified manganate(VII) ions

C steam with phosphoric acid

D aqueous sodium hydroxide

15. June/2023/Paper_9701/13/No.38

Which two-step process converts cyclohexanol into cyclohexane-1,2-diol?

cyclohexanol → cyclohexane-1,2-diol

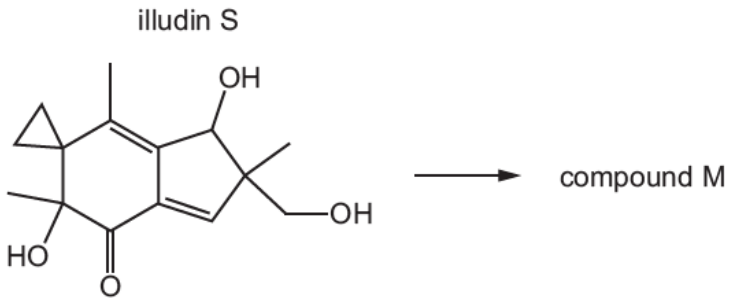


	step 1	step 2
A	heat strongly with Al_2O_3	add cold dilute $KMnO_4$ and H_2SO_4
B	heat strongly with Al_2O_3	heat with steam and H_2SO_4
C	reflux with ethanolic NaOH	add cold dilute $KMnO_4$ and H_2SO_4
D	reflux with ethanolic NaOH	heat with steam and H_2SO_4

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16. March/2023/Paper_9701/12/No.28

When illudin S is heated under reflux with an excess of acidified potassium dichromate(VI), compound M is formed.



What is the molecular formula of compound M?

A $C_{15}H_{16}O_4$ **B** $C_{15}H_{16}O_5$ **C** $C_{15}H_{18}O_4$ **D** $C_{15}H_{18}O_5$

17. March/2023/Paper_9701/12/No.35

Two isomeric alcohols, W and X, have molecular formula C_4H_9OH.

W is oxidised to carbonyl compound Y which gives a red precipitate with Fehling's solution.

X is oxidised to carbonyl compound Z which does **not** give a red precipitate with Fehling's solution.

Which of W and X gives a yellow precipitate with alkaline $I_2(aq)$?

A insufficient data is given to answer this question

B W only

C X only

D neither W nor X

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18. March/2023/Paper_9701/22/No.3(c)

(c) When propene reacts with CO and an excess of H_2, an alkane and a mixture of alcohols are formed instead. The alcohols are isomers of each other.

Suggest the molecular formulae of the alkane and the alcohols that are formed under these conditions.

molecular formula of alkane .....

molecular formula of alcohols .....

[2]

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