14. Hydrocarbons

14.2 Alkenes

Paper 1

Question Paper

1 Which statement about $H_2C=C(CH_3)CH_2CO_2CH_3$ is correct?

A It can be hydrolysed to a secondary alcohol.

B It can be made using ethanoic acid and a suitable alcohol.

C It gives a positive test with alkaline $I_2(aq)$.

D When treated with hot concentrated acidified $KMnO_4$ it gives CH_3COCH_2COOH as one

2 Ethene reacts with steam in the presence of sulfuric acid.

$$C_2H_4 + H_2O \rightarrow CH_3CH_2OH$$

Which type of reaction is this?

A acid–base

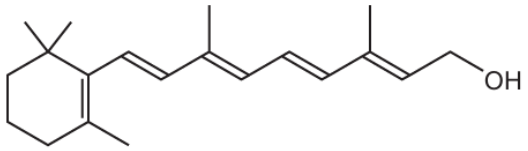
B addition

C hydrolysis

D substitution

3 Vitamin A contains retinol.

retinol



Under appropriate conditions, acidified $KMnO_4(aq)$ can be used to break C=C bonds.

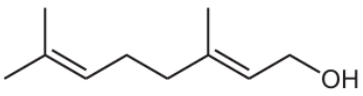
After these bonds have been broken, further oxidation of the fragments may occur.

Under which conditions is the acidified $KMnO_4(aq)$ used and what do the final oxidation products include?

	conditions	final oxidation products
A	cold, dilute	aldehydes and carboxylic acids
B	cold, dilute	ketones and carboxylic acids
C	hot, concentrated	aldehydes and carboxylic acids
D	hot, concentrated	ketones and carboxylic acids

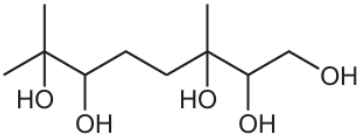
4 A molecule of geraniol is shown.

geraniol



What is formed when geraniol is reacted with an excess of cold dilute acidified MnO_4^-?

A



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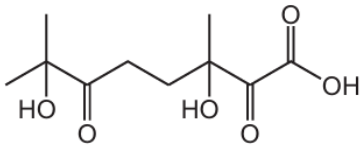

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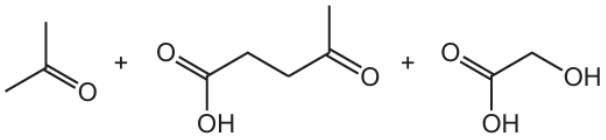

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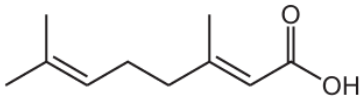


5 Z is a gaseous hydrocarbon which has a density of 3.50×10^{-3} g cm^{-3} under room conditions.

Z reacts with an excess of hot concentrated acidified $KMnO_4$. Only **one** type of carboxylic acid is formed in this reaction.

What is Z?

A but-2-ene

B 2,3-dimethylbut-2-ene

C hex-2-ene

D hex-3-ene

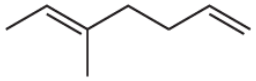
6 The molecule of limonene, $C_{10}H_{16}$, contains a 6-membered ring. This is the only cyclic component in its structure.

Which volume of hydrogen, at room conditions, is required to react completely with the C=C double bonds in **one** mole of limonene?

A 12 dm^3 **B** 24 dm^3 **C** 48 dm^3 **D** 72 dm^3

7 The structure of compound X is shown.

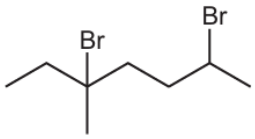
compound X



One mole of compound X reacts completely with two moles of hydrogen bromide.

What is the structure of the major product of this reaction?

A



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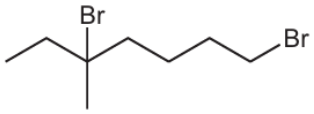

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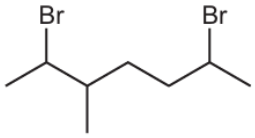

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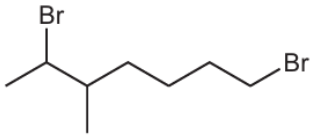


8 Alkynes are hydrocarbons that contain one triple C≡C bond.

Like alkenes, alkynes take part in addition reactions. A saturated compound can be formed.

For example, ethyne, H–C≡C–H, reacts with an excess of hydrogen to form ethane.

Propyne, C_3H_4, undergoes an addition reaction with an excess of hydrogen bromide in two stages. Markovnikov's rule applies to the addition of HBr at each stage.

What is the main product obtained when propyne reacts with an excess of hydrogen bromide?

A $CH_2BrCH_2CH_2Br$

B $CH_3CH_2CHBr_2$

C $CH_3CHBrCH_2Br$

D $CH_3CBr_2CH_3$

9 Bromine reacts with alkenes by an electrophilic addition mechanism in which a cation is formed as an intermediate.

Which mixture will produce the most stable intermediate cation?

A 3,3-dimethylpent-1-ene + bromine

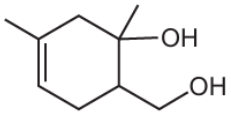
B ethene + bromine

C methylpropene + bromine

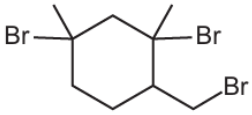
D propene + bromine

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

R



A



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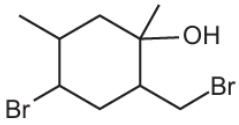

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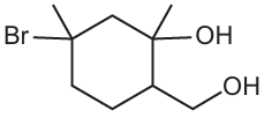

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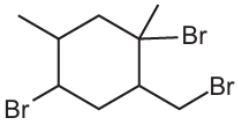


11 *cis*-but-2-ene reacts with cold dilute acidified potassium manganate(VII) solution to give product X.

cis-but-2-ene reacts with hot concentrated acidified potassium manganate(VII) solution to give product Y.

Which row describing the reactions of X and Y is correct?

	when sodium metal is added to separate samples of X and Y	when sodium hydroxide solution is added to separate samples of X and Y
A	both X and Y will react	neither X nor Y will react
B	both X and Y will react	only one of X and Y will react
C	only one of X and Y will react	neither X nor Y will react
D	only one of X and Y will react	only one of X and Y will react

12 Oct-1-ene, $CH_3(CH_2)_5CH=CH_2$, can be thermally cracked.

Which of the compounds W, X, Y and Z can be obtained by thermally cracking oct-1-ene?

W	X	Y	Z
$CH_2=CH_2$	$CH_3CH=CH_2$	$CH_3CH_2CH_3$	$CH_2=CHCH=CH_2$

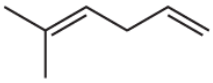
A W, X, Y and Z

B W, X and Y only

C W, X and Z only

D W and X only

13 The alkene shown reacts with an excess of HBr via an electrophilic addition reaction.



What is the **major** product formed?

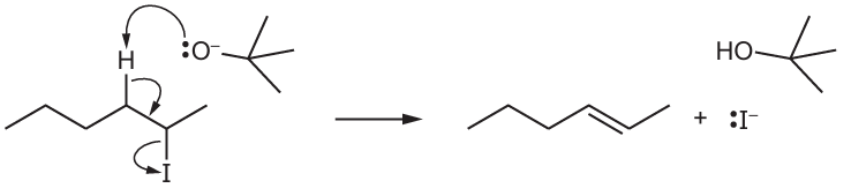
A 3,5-dibromo-2-methylhexane

B 2,5-dibromo-2-methylhexane

C 2,6-dibromo-2-methylhexane

D 3,6-dibromo-2-methylhexane

14 Hex-2-ene can be made by the reaction shown.



Which statement about this reaction is correct?

A $(CH_3)_3CO^-$ is behaving as a Brønsted-Lowry base.

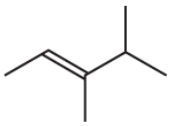
B $(CH_3)_3CO^-$ is behaving as an oxidising agent.

C The C–I bond breaks via homolytic fission.

D This is a hydrolysis reaction.

15 Which compound would produce two different carboxylic acids when treated with hot, concentrated, acidified manganate(VII) ions?

A



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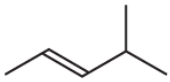
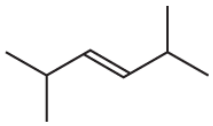


C

D



16 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

17 Two students each make a statement about 2-methylbut-1-ene.

Student 1 states that 2-methylbut-1-ene has geometrical isomers.

Student 2 states that 2-methylbut-1-ene reacts with HBr in an addition reaction to give 1-bromo-2-methylbutane as the main product.

Which students are correct?

A both 1 and 2

B 1 only

C 2 only

D neither 1 nor 2

18 But-1-ene and but-2-ene are treated separately with cold, dilute acidified manganate(VII) ions.

Four students, W, X, Y and Z, make statements about these alkenes and the diols formed from them.

W One diol contains two primary alcohol groups.

X One diol contains a primary and a secondary alcohol group.

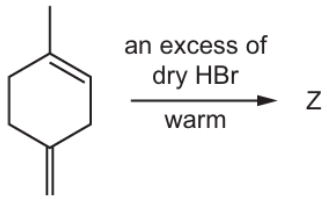
Y One diol contains two secondary alcohol groups.

Z Both alkenes exhibit *cis-trans* isomerism.

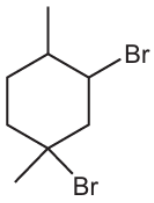
Which two students are correct?

A W and Y **B** W and Z **C** X and Y **D** X and Z

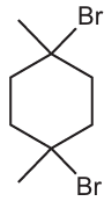
19 What is the major product Z of the following reaction?



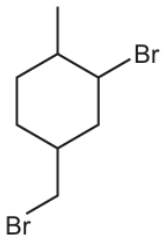
A



B



C



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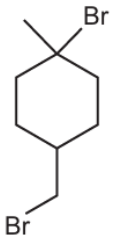


20 Which substance forms propanoic acid as one of the products when it reacts with hot concentrated acidified potassium manganate(VII)?

A but-1-ene

B but-2-ene

C 2-methylpropene

D 2-methylbut-1-ene

21 Ethene reacts with aqueous bromine to give two products, CH_2BrCH_2Br and CH_2BrCH_2OH.

Which statement about these products is correct?

A Both products are obtained in this reaction by nucleophilic substitution.

B Both products are obtained in this reaction by nucleophilic addition.

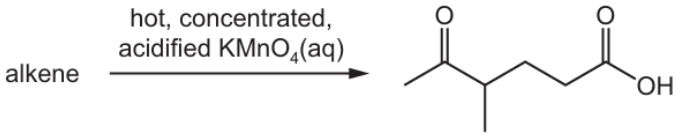
C Both products can be hydrolysed to form the same organic compound.

D Both products can form hydrogen bonds with water.

22 Which substance reacts with trichloroethene to give a chiral product?

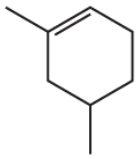
A Br_2 **B** HCl **C** NaCN **D** NaOH

23 An alkene reacts with hot, concentrated, acidified potassium manganate(VII) to produce a single organic product as shown.



What is the structure of the alkene?

A



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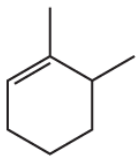

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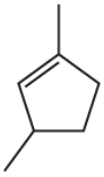

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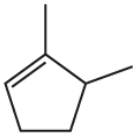


24 An organic compound X reacts with hot, concentrated acidified potassium manganate(VII) solution to give a single carbon-containing product.

What could be X?

A $CH_2C(CH_3)_2$

B $CH_3CHCHCH_3$

C $CH_2CHCH_2CH_3$

D $CH_3CH_2CH_2CH_3$

25 What is the structural formula of the major product when hydrogen bromide reacts with 2-methylbut-2-ene?

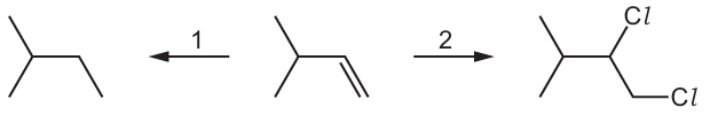
A $CH_2BrCH(CH_3)CH_2CH_3$

B $(CH_3)_2CBrCH_2CH_3$

C $(CH_3)_2CHCHBrCH_3$

D $(CH_3)_2CHCH_2CH_2Br$

26 3-methylbut-1-ene can undergo different types of reaction.



Which row correctly identifies the reaction types?

	reaction 1	reaction 2
A	oxidation	electrophilic addition
B	oxidation	nucleophilic addition
C	reduction	electrophilic addition
D	reduction	nucleophilic addition

27 Propene, bromine and hydrogen bromide are mixed in the dark.

A number of products are formed, some in very small quantities.

Which substance will **not** be present in the mixture of products?

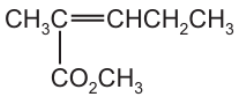
A 1-bromopropane

B 2-bromopropane

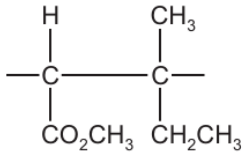
C 1,1-dibromopropane

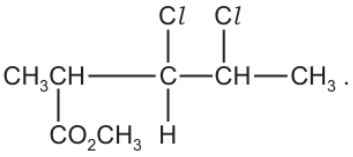
D 1,2-dibromopropane

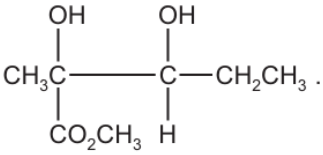
28 Which statement about compound Q is correct?

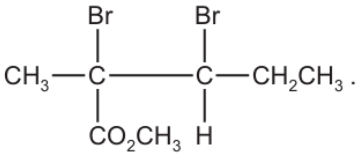


Q

A It could be polymerised to give a polymer with the repeat unit  .

B It reacts with chlorine by a free radical mechanism to give  .

C It reacts with cold, dilute acidified manganate(VII) to give  .

D It reacts with bromine via a free radical mechanism to give  .

29 Which reagent could be used to carry out the following reaction?

A a solution containing acidified dichromate(VI) ions

B a solution containing dilute, acidified manganate(VII) ions

C a solution containing hot, concentrated, acidified manganate(VII) ions

D concentrated sulfuric acid

30 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 $HO_2CCOCOCO_2H$