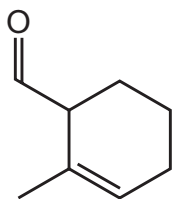
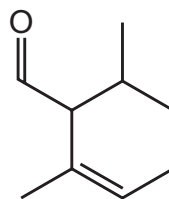


1. Question | 9701 May-June 2016 P1 V1 Q20

20 The diagrams show two different compounds.



1



2

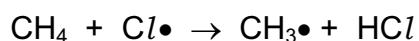
What is

- the total number of structural isomers, including compound 2, that could be formed by adding a second methyl group to the ring of compound 1,
- the number of π electrons in each compound?

	number of isomers	number of π electrons
A	3	2
B	3	4
C	5	2
D	5	4

2. Question | 9701 May-June 2016 P1 V1 Q23

23 The **first** propagation step in the reaction between methane and chlorine is shown.



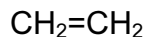
How many different **first** propagation steps are possible in the reaction between pentane and chlorine?

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

3. Question | 9701 May-June 2016 P1 V2 Q22

22 Oct-1-ene, $\text{CH}_3(\text{CH}_2)_5\text{CH}=\text{CH}_2$, can be thermally cracked.

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



W



X



Y



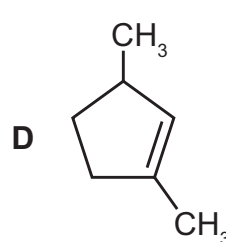
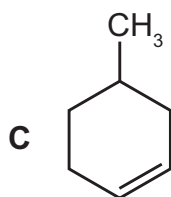
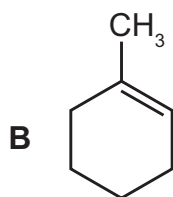
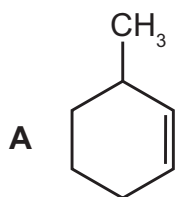
Z

- A** W, X, Y and Z
B W, X and Y only
C W, X and Z only
D W and X only

4. Question | 9701 May-June 2016 P1 V2 Q23

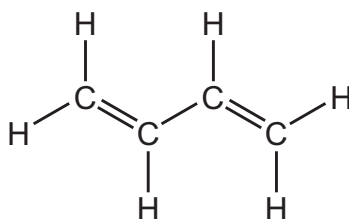
23 A cycloalkene with the molecular formula C_7H_{12} was oxidised by hot concentrated acidified MnO_4^- . The only organic product was 2-methylhexane-1,6-dioic acid.

What is the identity of the cycloalkene?



5. Question | 9701 May-June 2016 P1 V3 Q21

21 The diagram shows the structure of 1,3-butadiene.



1,3-butadiene

The addition reaction between 1,3-butadiene and two molecules of hydrogen bromide can produce three structurally isomeric products.

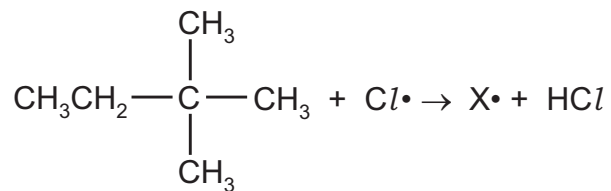
How many of these products have at least one chiral centre?

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

6. Question | 9701 May-June 2016 P1 V3 Q23

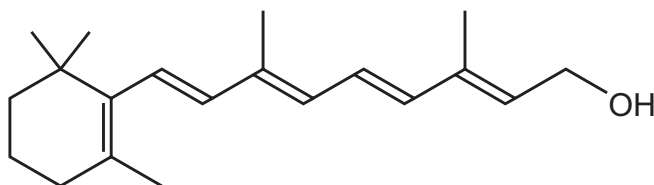
- 23** When heated with chlorine, the hydrocarbon 2,2-dimethylbutane undergoes free radical substitution.

In a propagation step a free radical $X\cdot$ is formed.



How many different structures of $X\cdot$ are possible?

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

24 Vitamin A contains retinol.

retinol

Under appropriate conditions, acidified $\text{KMnO}_4(\text{aq})$ can be used to break apart $\text{C}=\text{C}$ bonds.

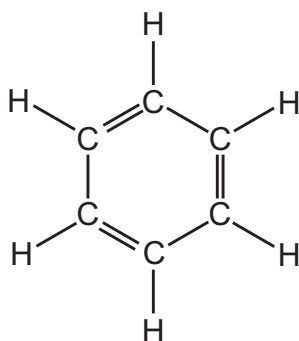
After these bonds have been broken, further oxidation of the fragments may occur.

Under which conditions is the acidified $\text{KMnO}_4(\text{aq})$ 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

8. Question | 9701 Oct-Nov 2016 P1 V1 Q20

- 20** In 1865 Kekulé suggested a ring structure for benzene, C_6H_6 , in which a hydrogen atom is attached to each carbon atom.



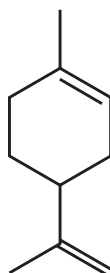
Kekulé structure

In this structure all of the bonds remain in the places shown. Assuming this is the structure of benzene, how many isomers of dichlorobenzene, $C_6H_4Cl_2$, would exist?

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

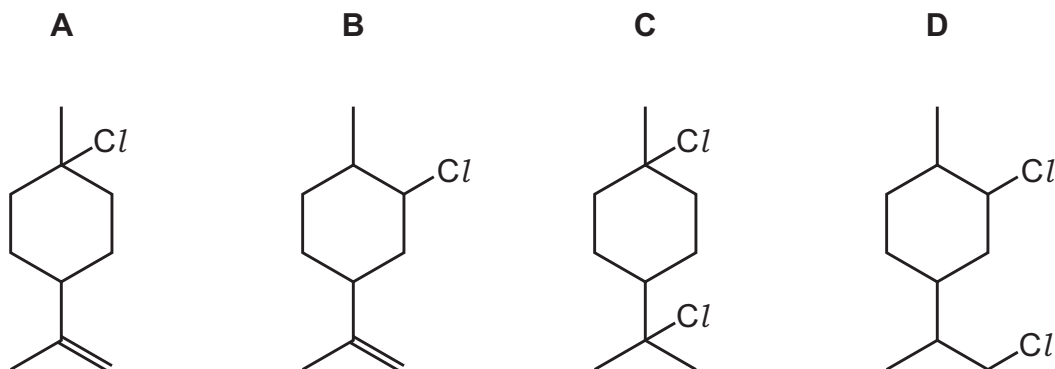
9. Question | 9701 Oct-Nov 2016 P1 V2 Q20

- 20** Limonene is found in lemon and orange oils.



limonene

What will be the major product when limonene is reacted with an excess of dry hydrogen chloride?

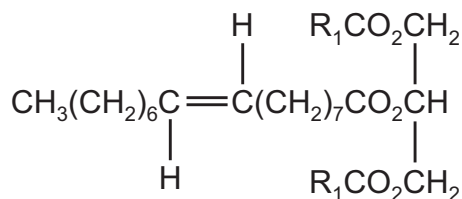


- 30** Some vegetable oils contain 'trans fats' that are associated with undesirable increases in the amount of cholesterol in the blood. In these oils the word 'trans' describes, in the usual way, the arrangement of groups at a C=C double bond.

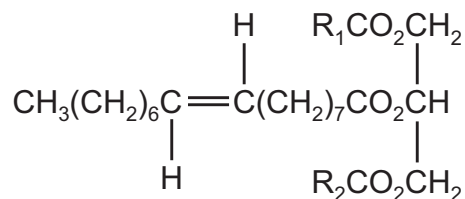
In the diagrams below, R_1 and R_2 are different unbranched hydrocarbon chains.

Which diagram correctly shows an optically active 'trans fat'?

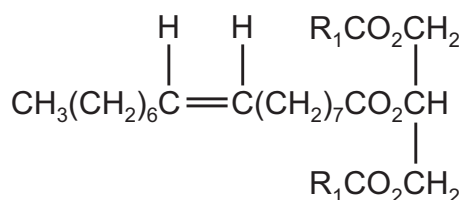
A



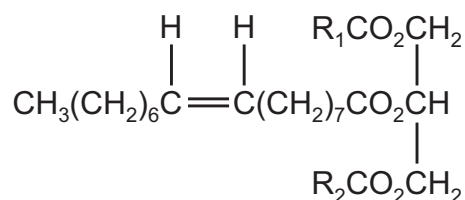
B



C



D



Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

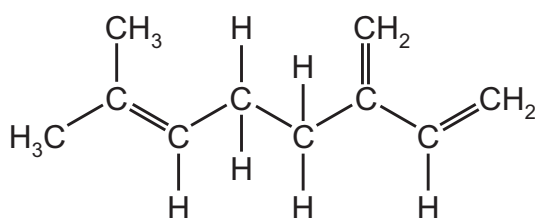
Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

37 A species of termite produces a chemical defence secretion which contains the molecule shown.



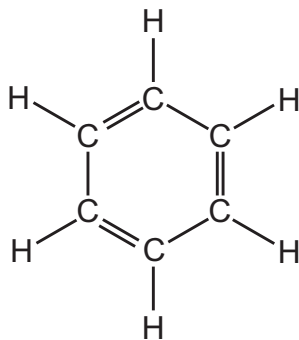
To help determine the structure of this compound, it is treated with hot, concentrated, acidified manganate(VII) ions.

Which compounds are produced in this reaction?

- 1** CO₂
- 2** CH₃COCH₃
- 3** CH₃CO₂H

12. Question | 9701 Oct-Nov 2016 P1 V3 Q20

- 20** In 1865 Kekulé suggested a ring structure for benzene, C_6H_6 , in which a hydrogen atom is attached to each carbon atom.

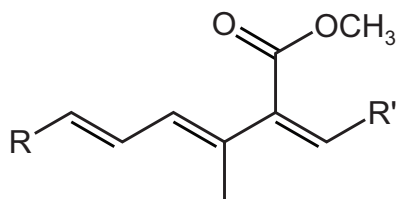


Kekulé structure

In this structure all of the bonds remain in the places shown. Assuming this is the structure of benzene, how many isomers of dichlorobenzene, $C_6H_4Cl_2$, would exist?

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

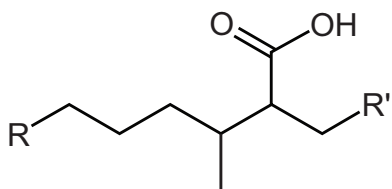
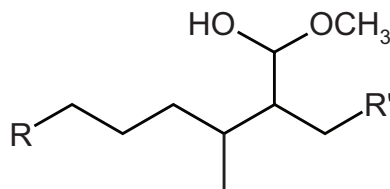
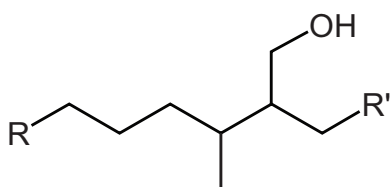
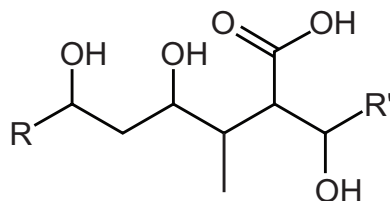
23 Part of the structure of a fungicide, strobilurin, is shown. R and R' are inert groups.



strobilurin

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

What could be the structure of compound Y?

A**B****C****D**

14. Question | 9701 Feb-March 2017 P1 V2 Q20

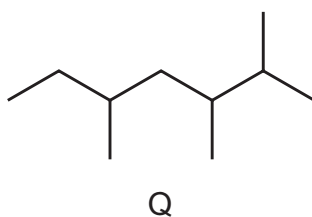
20 Structural isomerism and stereoisomerism should be considered when answering this question.

How many isomers with the formula C_4H_8 have structures that contain a π bond?

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

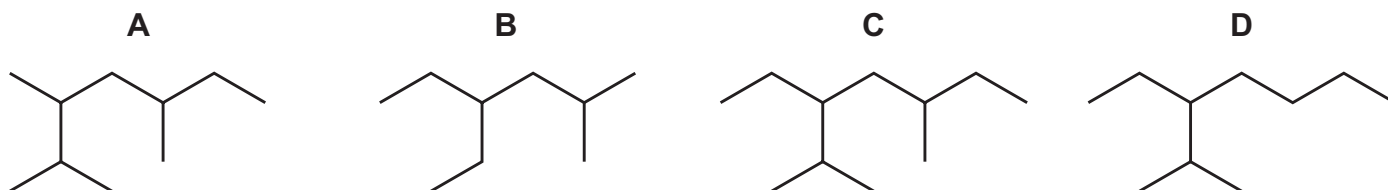
15. Question | 9701 Feb-March 2017 P1 V2 Q21

21 Kerosene is used as an aircraft fuel. Q is one of the molecules in kerosene and has the skeletal formula shown.



Other structural isomers of this molecule are also found in kerosene.

Which structure is a structural isomer of Q?



16. Question | 9701 Feb-March 2017 P1 V2 Q23

23 Propene undergoes a variety of reactions.

Which row is correct?

	reagent added to propene	products include
A	$\text{Br}_2(\text{aq})$	1-bromopropane
B	cold, dilute, acidified $\text{KMnO}_4(\text{aq})$	propanoic acid
C	$\text{HBr}(\text{g})$	2-bromopropane
D	hot, concentrated, acidified $\text{KMnO}_4(\text{aq})$	propanoic acid

17. Question part 1/2 | 9701 Feb-March 2017 P1 V2 Q37

37 Which compounds can be obtained from but-2-ene in a **single** reaction?

- 1** $\text{CH}_3\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_3$
- 2** $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$
- 3** $\text{CH}_3\text{CO}_2\text{H}$

17. Question part 2/2 | 9701 Feb-March 2017 P1 V2 Q37

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

9701 Chemistry Paper 1 - Hydrocarbons

Topical questions | 175 questions

18. Question | 9701 May-June 2017 P1 V1 Q22

- 22** An alkene is reacted with acidified manganate(VII) ions, MnO_4^- . The desired organic product has a relative molecular mass greater than that of the alkene by 34.

What conditions should be used?

- A** cold, concentrated MnO_4^-
- B** cold, dilute MnO_4^-
- C** hot, concentrated MnO_4^-
- D** hot, dilute MnO_4^-

19. Question | 9701 May-June 2017 P1 V2 Q22

- 22** Which equation represents the initiation step of the substitution reaction between methane and chlorine?

- A** $\text{CH}_4 \rightarrow \text{CH}_3\cdot + \text{H}\cdot$
- B** $\text{CH}_4 \rightarrow \text{CH}_3^- + \text{H}^+$
- C** $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$
- D** $\text{Cl}_2 \rightarrow \text{Cl}^+ + \text{Cl}^-$

20. Question | 9701 May-June 2017 P1 V3 Q25

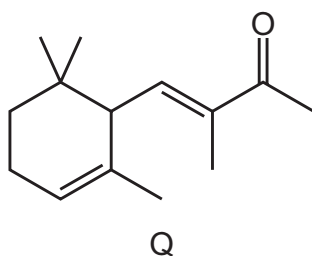
- 25** Bromine reacts with ethene in the dark.

Which description of the organic intermediate in this reaction is correct?

- A** It has a negative charge.
- B** It is a free radical.
- C** It is a nucleophile.
- D** It is an electrophile.

21. Question | 9701 Oct-Nov 2017 P1 V1 Q20

20 The structural formula of compound Q is shown.



How many stereoisomers exist with this structural formula?

- A** 1 **B** 2 **C** 4 **D** 8

22. Question | 9701 Oct-Nov 2017 P1 V1 Q22

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

Which reaction occurs quickly at room temperature, 20 °C?

- A** $\text{C}_2\text{H}_4 + \text{Br}_2 \rightarrow \text{C}_2\text{H}_4\text{Br}_2$
B $\text{C}_2\text{H}_4 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}_2\text{OH}$
C $\text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{C}_2\text{H}_4 + \text{H}_2\text{O}$
D $\text{CH}_3\text{CH}_2\text{OH} + \text{HBr} \rightarrow \text{CH}_3\text{CH}_2\text{Br} + \text{H}_2\text{O}$

23. Question | 9701 Oct-Nov 2017 P1 V1 Q29

- 29** Ethene is reacted with steam in the presence of concentrated H_3PO_4 . The product of this reaction is added to acidified potassium dichromate(VI) and heated under reflux for one hour. The final organic product is collected and labelled X.

But-2-ene is treated with hot, concentrated, acidified potassium manganate(VII). The final organic product is collected and labelled Y.

Which statement is correct?

- A** One molecule of X has more carbon atoms than one molecule of Y.
- B** One molecule of Y has more carbon atoms than one molecule of X.
- C** X and Y have different functional groups.
- D** X is the same compound as Y.

24. Question part 1/2 | 9701 Oct-Nov 2017 P1 V1 Q37

- 37** In which molecules do all the carbon atoms lie in the same plane?

- 1** 2,3-dimethylbut-2-ene
- 2** propane
- 3** cyclohexane

24. Question part 2/2 | 9701 Oct-Nov 2017 P1 V1 Q37

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

9701 Chemistry Paper 1 - Hydrocarbons

Topical questions | 175 questions

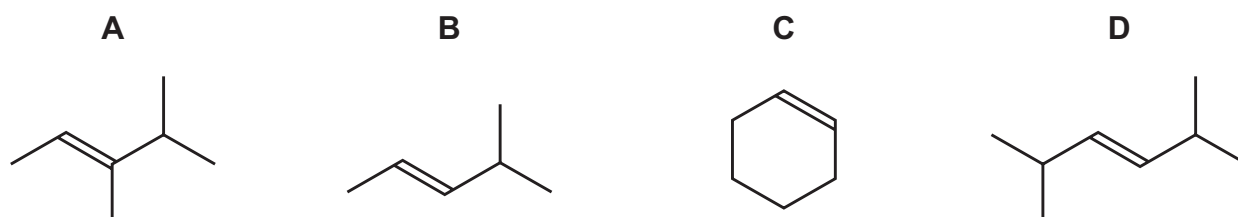
25. Question | 9701 Oct-Nov 2017 P1 V2 Q20

20 Which compound does **not** exhibit stereoisomerism?

- A** $\text{CH}_3\text{CHClCH}_2\text{CHO}$
- B** $\text{CH}_3\text{CHCHCH}_3$
- C** $\text{CH}_2\text{ClCH}_2\text{CCl}_2\text{H}$
- D** CHClCHCl

26. Question | 9701 Oct-Nov 2017 P1 V2 Q22

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



27. Question | 9701 Oct-Nov 2017 P1 V2 Q24

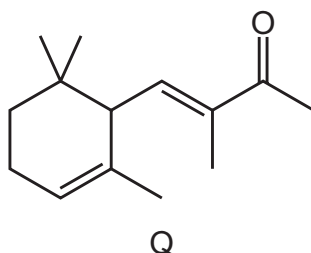
24 2,3-dimethylpent-2-ene, $(\text{CH}_3)_2\text{C}=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_3$, is treated with cold, dilute KMnO_4 . The product of this reaction is treated with an excess of concentrated H_2SO_4 at 180°C , giving a mixture of isomeric hydrocarbons with molecular formula C_7H_{12} .

What is the name of one of the isomeric hydrocarbons?

- A** 2,3-dimethylpenta-1,2-diene
- B** cis-2,3-dimethylpenta-1,3-diene
- C** 2,3-dimethylpenta-1,4-diene
- D** 3,4-dimethylpenta-1,3-diene

28. Question | 9701 Oct-Nov 2017 P1 V3 Q20

20 The structural formula of compound Q is shown.



How many stereoisomers exist with this structural formula?

- A** 1
- B** 2
- C** 4
- D** 8

29. Question | 9701 Oct-Nov 2017 P1 V3 Q22

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

Which reaction occurs quickly at room temperature, 20 °C?

- A** $\text{C}_2\text{H}_4 + \text{Br}_2 \rightarrow \text{C}_2\text{H}_4\text{Br}_2$
- B** $\text{C}_2\text{H}_4 + \text{H}_2\text{O} \rightarrow \text{CH}_3\text{CH}_2\text{OH}$
- C** $\text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{C}_2\text{H}_4 + \text{H}_2\text{O}$
- D** $\text{CH}_3\text{CH}_2\text{OH} + \text{HBr} \rightarrow \text{CH}_3\text{CH}_2\text{Br} + \text{H}_2\text{O}$

30. Question | 9701 Oct-Nov 2017 P1 V3 Q29

29 Ethene is reacted with steam in the presence of concentrated H_3PO_4 . The product of this reaction is added to acidified potassium dichromate(VI) and heated under reflux for one hour. The final organic product is collected and labelled X.

But-2-ene is treated with hot, concentrated, acidified potassium manganate(VII). The final organic product is collected and labelled Y.

Which statement is correct?

- A** One molecule of X has more carbon atoms than one molecule of Y.
- B** One molecule of Y has more carbon atoms than one molecule of X.
- C** X and Y have different functional groups.
- D** X is the same compound as Y.

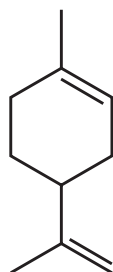
31. Question | 9701 Feb-March 2018 P1 V2 Q20

20 Which types of stereoisomerism are shown by 2,4-dimethylhex-2-ene?

- A** both cis-trans isomerism and optical isomerism
- B** cis-trans isomerism only
- C** neither cis-trans isomerism nor optical isomerism
- D** optical isomerism only

32. Question | 9701 May-June 2018 P1 V1 Q38

38 Limonene is found in lemons.



limonene

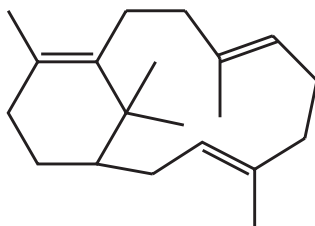
Limonene is heated with concentrated acidified potassium manganate(VII).

Which compounds are produced?

- 1** $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}(\text{CH}_2\text{CO}_2\text{H})_2$
- 2** CO_2
- 3** $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}(\text{COCH}_3)\text{CH}_2\text{CO}_2\text{H}$

33. Question | 9701 May-June 2018 P1 V2 Q20

- 20** Compound Y is treated with an excess of hydrogen gas in the presence of a nickel catalyst. The product is fully saturated.



compound Y

What is the number of chiral carbon atoms in the product?

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

34. Question | 9701 May-June 2018 P1 V2 Q21

- 21** Which equation represents a valid propagation step in the chlorination of ethane?

- A** $\text{C}_2\text{H}_6 + \text{Cl}\bullet \rightarrow \text{C}_2\text{H}_5\text{Cl} + \text{H}\bullet$
B $\text{C}_2\text{H}_5\text{Cl} + \text{Cl}\bullet \rightarrow \text{C}_2\text{H}_4\text{Cl}\bullet + \text{HCl}$
C $\text{C}_2\text{H}_5\text{Cl} + \text{H}\bullet \rightarrow \text{C}_2\text{H}_5\bullet + \text{HCl}$
D $\text{C}_2\text{H}_5\bullet + \text{Cl}\bullet \rightarrow \text{C}_2\text{H}_5\text{Cl}$

35. Question | 9701 May-June 2018 P1 V2 Q22

- 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 $\text{HO}_2\text{CCH}=\text{CHCO}_2\text{H}$.

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

- A** $\text{HO}_2\text{CCH}(\text{OH})\text{CH}(\text{OH})\text{CO}_2\text{H}$
B $\text{HO}_2\text{CCO}_2\text{H}$
C $\text{HO}_2\text{CCH}_2\text{CH}(\text{OH})\text{CO}_2\text{H}$
D $\text{HO}_2\text{CCOCOCO}_2\text{H}$

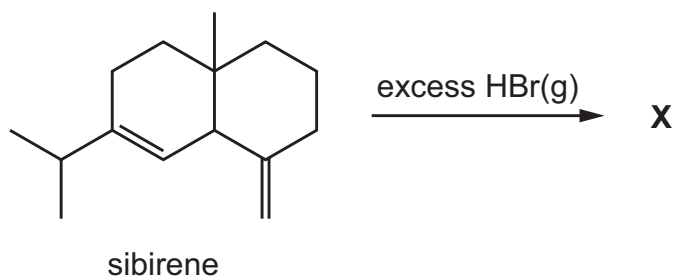
36. Question | 9701 May-June 2018 P1 V2 Q37

- 37** Which compounds show geometrical (cis-trans) isomerism?

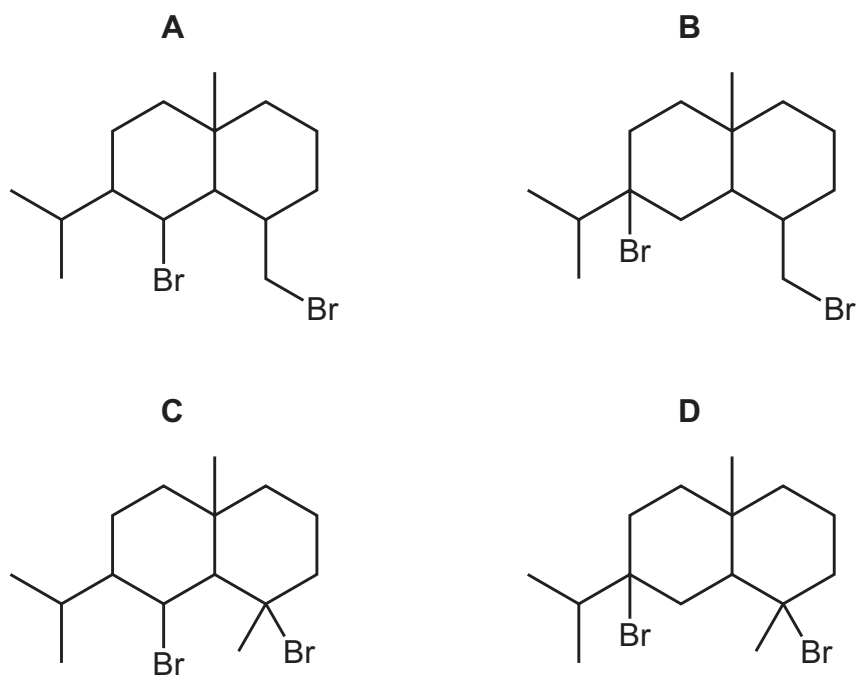
- 1** $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)\text{C}_2\text{H}_5$
2 $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}_2\text{CH}_3$
3 $\text{C}_2\text{H}_5\text{CH}=\text{CHC}_2\text{H}_5$

37. Question | 9701 May-June 2018 P1 V3 Q21

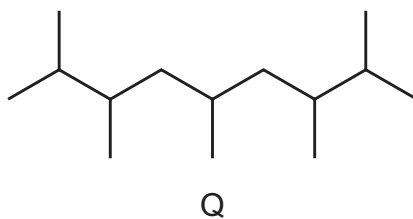
21 Sibirene, $C_{15}H_{24}$, is reacted with an excess of $HBr(g)$. The major product is **X**.



What is the skeletal formula of **X**?

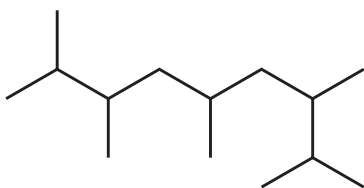


22 A new jet fuel has been produced that is a mixture of different structural isomers of compound Q.

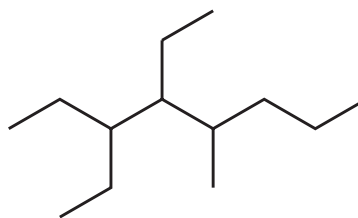


Which skeletal formula represents a **structural isomer** of Q?

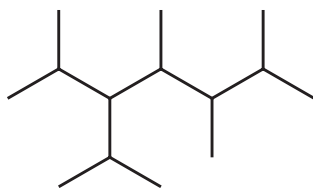
A



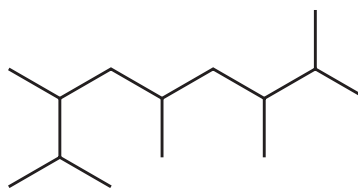
B

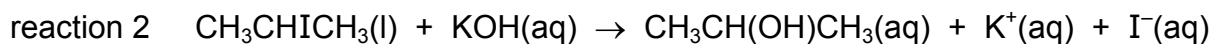


C



D

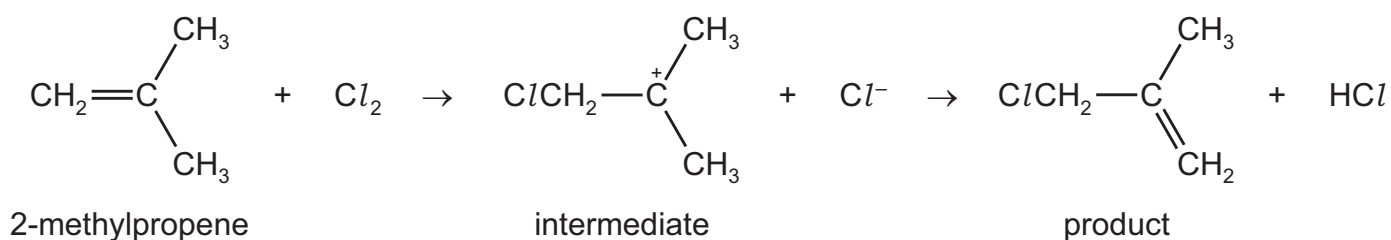




How can these two reactions be described?

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

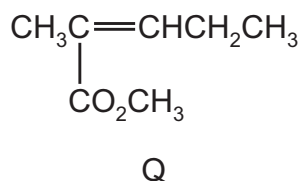
One of the reactions follows the pathway shown.



Which statements about this mechanism are correct?

- 1 The intermediate has all carbon atoms in the same plane.
- 2 There is an electrophilic attack on the double bond.
- 3 It is a free radical mechanism.

24 Which statement about compound Q is correct?



- A** It could be polymerised to give a polymer with the repeat unit $\begin{array}{c} \text{H} \qquad \text{CH}_3 \\ | \qquad | \\ -\text{C}-\text{C}- \\ | \qquad | \\ \text{CO}_2\text{CH}_3 \quad \text{CH}_2\text{CH}_3 \end{array}$.
- B** It reacts with chlorine by a free radical mechanism to give $\begin{array}{c} \text{Cl} \quad \text{Cl} \\ | \quad | \\ \text{CH}_3\text{CH}-\text{C}-\text{CH}-\text{CH}_3 \\ | \quad | \\ \text{CO}_2\text{CH}_3 \quad \text{H} \end{array}$.
- C** It reacts with cold, dilute acidified manganate(VII) to give $\begin{array}{c} \text{OH} \quad \text{OH} \\ | \quad | \\ \text{CH}_3\text{C}-\text{C}-\text{CH}_2\text{CH}_3 \\ | \quad | \\ \text{CO}_2\text{CH}_3 \quad \text{H} \end{array}$.
- D** It reacts with bromine via a free radical mechanism to give $\begin{array}{c} \text{Br} \quad \text{Br} \\ | \quad | \\ \text{CH}_3-\text{C}-\text{C}-\text{CH}_2\text{CH}_3 \\ | \quad | \\ \text{CO}_2\text{CH}_3 \quad \text{H} \end{array}$.

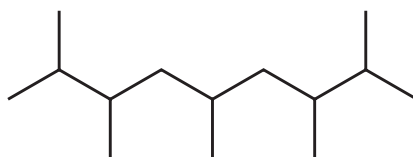
42. Question | 9701 Oct-Nov 2018 P1 V3 Q21

- 21** X has the molecular formula $\text{C}_5\text{H}_{12}\text{O}$. X has a branched carbon skeleton and a secondary alcohol functional group.

How many **structural** isomers fit this description of X?

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

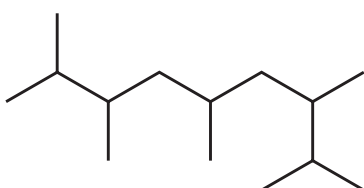
22 A new jet fuel has been produced that is a mixture of different structural isomers of compound Q.



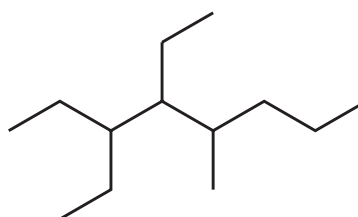
Q

Which skeletal formula represents a **structural isomer** of Q?

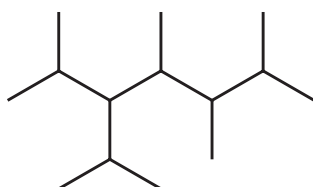
A



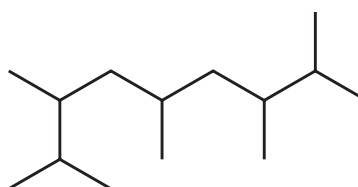
B

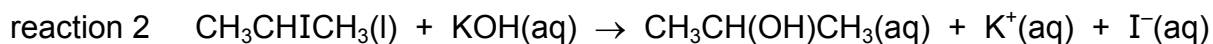


C



D

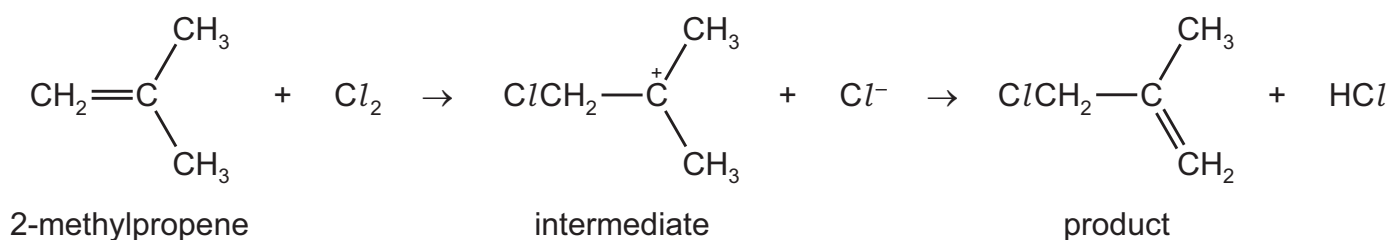




How can these two reactions be described?

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

One of the reactions follows the pathway shown.

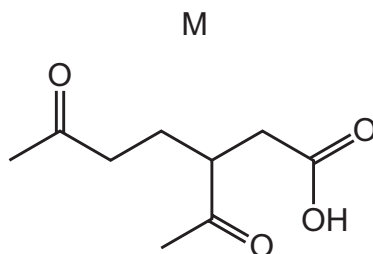


Which statements about this mechanism are correct?

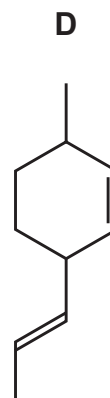
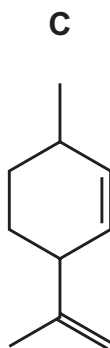
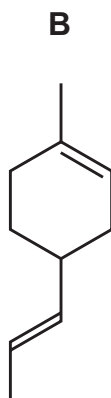
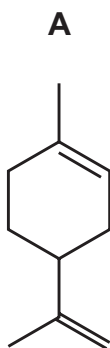
- 1 The intermediate has all carbon atoms in the same plane.
- 2 There is an electrophilic attack on the double bond.
- 3 It is a free radical mechanism.

21 Compound L has the molecular formula $C_{10}H_{16}$.

A sample of L reacted with an excess of hot, concentrated, acidified potassium manganate(VII). Compound M is produced.

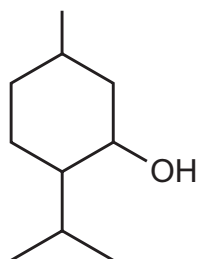


What could be the structure of compound L?



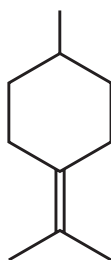
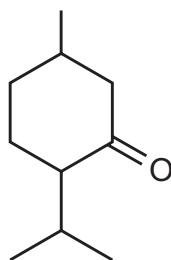
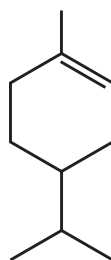
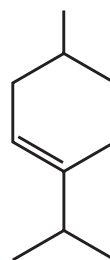
26 Menthol is a naturally occurring alcohol.

menthol



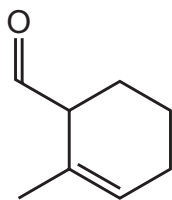
When menthol is heated with concentrated sulfuric acid it reacts. The products formed include compound T.

What could be the structure of compound T?

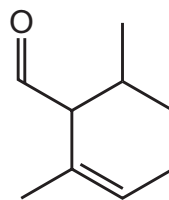
A**B****C****D**

48. Question | 9701 May-June 2019 P1 V1 Q20

20 The diagrams show two different compounds.



1



2

What is

- the total number of structural isomers, including compound 2, that could be formed by adding a second methyl group to the ring of compound 1,
- the number of π electrons in each compound?

	number of isomers	number of π electrons
A	3	2
B	3	4
C	5	2
D	5	4

49. Question | 9701 May-June 2019 P1 V1 Q22

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

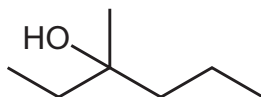
- A** $\text{CH}_2\text{BrCH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
- B** $(\text{CH}_3)_2\text{CBrCH}_2\text{CH}_3$
- C** $(\text{CH}_3)_2\text{CHCHBrCH}_3$
- D** $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{Br}$

50. Question | 9701 May-June 2019 P1 V1 Q26

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

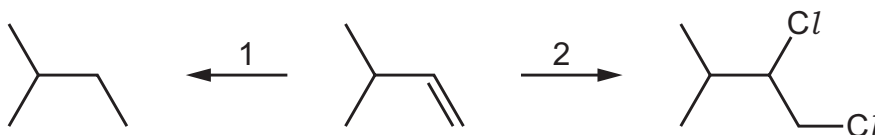


How many isomeric compounds could be formed in this reaction?

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

51. Question | 9701 May-June 2019 P1 V2 Q20

20 3-methylbut-1-ene can undergo different types of reaction.



Which row correctly identifies the reaction types?

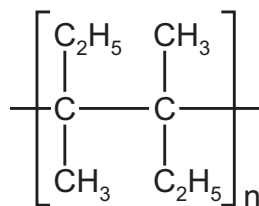
	reaction 1	reaction 2
A	oxidation	electrophilic addition
B	oxidation	nucleophilic addition
C	reduction	electrophilic addition
D	reduction	nucleophilic addition

21 Compound X does **not** show cis-trans isomerism.

What could be the identity of compound X?

- A** 1,1,2-trichloropropene
- B** 1,2,3-trichloropropene
- C** 1-chlorobut-1-ene
- D** 1-chlorobut-2-ene

22 The diagram shows the repeat unit of an addition polymer.

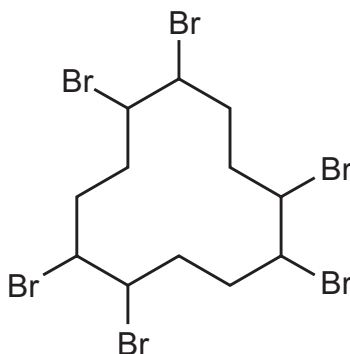


What is the correct name for the monomer that would form this polymer?

- A** cis-1,2-diethyl-1,2-dimethylethene
- B** cis-2-ethyl-3-methylpent-2-ene
- C** trans-2-ethyl-3-methylpent-2-ene
- D** trans-3,4-dimethylhex-3-ene

54. Question part 1/2 | 9701 May-June 2019 P1 V2 Q37

37 The diagram shows a compound used as a flame retardant.



Which statements about this structure are correct?

- 1** The empirical formula is C_2H_3Br .
- 2** The C_{12} ring is not planar.
- 3** There are six chiral carbon atoms.

54. Question part 2/2 | 9701 May-June 2019 P1 V2 Q37

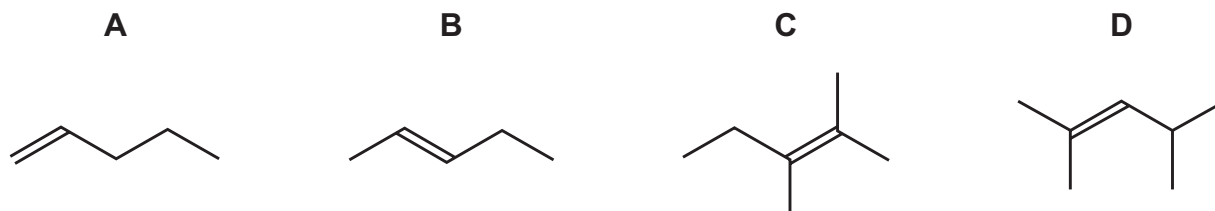
The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

55. Question | 9701 May-June 2019 P1 V3 Q23

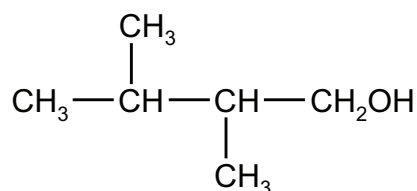
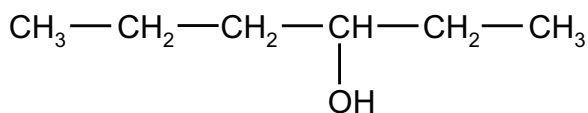
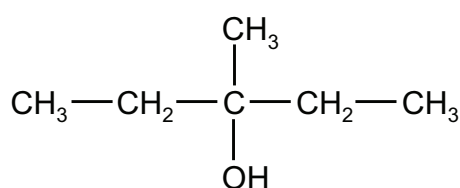
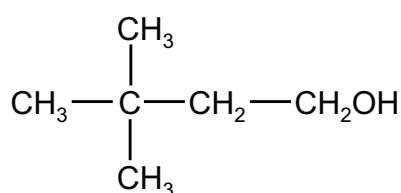
23 Which compound would produce a carboxylic acid and a ketone when treated with hot, concentrated acidified manganate(VII) ions?



56. Question | 9701 May-June 2019 P1 V3 Q26

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**

57. Question | 9701 May-June 2019 P1 V3 Q38

38 Bromine reacts with ethene in an addition reaction.

Which statements about this reaction are correct?

- 1** It is the basis of a test for unsaturation in alkenes.
- 2** It leads to an increase in each of the $\text{H}-\text{C}-\text{H}$ bond angles.
- 3** A nucleophile attacks the $\text{C}=\text{C}$ bond in ethene.

58. Question | 9701 Oct-Nov 2019 P1 V1 Q21

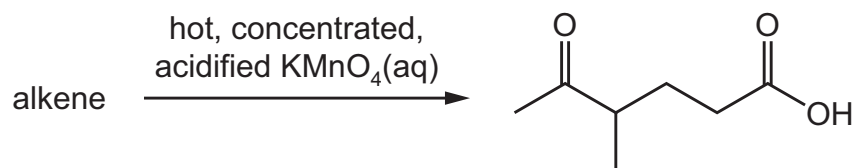
21 Alkanes are saturated hydrocarbons.

Which type of reaction are alkanes most likely to undergo?

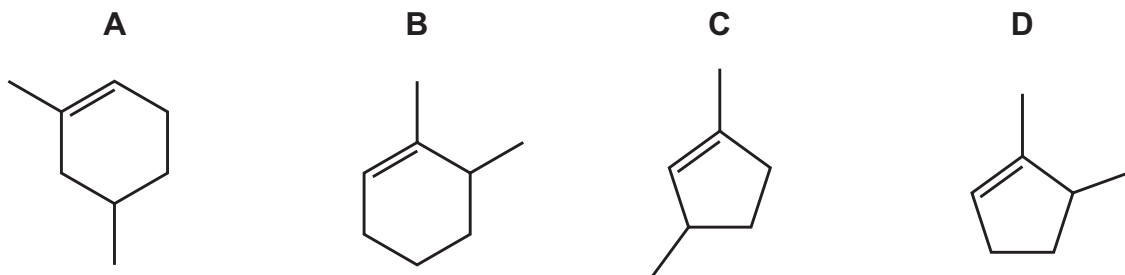
- A** electrophilic addition
- B** electrophilic substitution
- C** free radical substitution
- D** nucleophilic addition

59. Question | 9701 Oct-Nov 2019 P1 V1 Q22

- 22** 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?



60. Question | 9701 Oct-Nov 2019 P1 V2 Q20

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

How many isomers with the formula C_5H_{10} have structures that involve π bonding?

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

61. Question | 9701 Oct-Nov 2019 P1 V2 Q22

- 22** 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** $\text{CH}_2\text{C}(\text{CH}_3)_2$
B $\text{CH}_3\text{CHCHCH}_3$
C $\text{CH}_2\text{CHCH}_2\text{CH}_3$
D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$

62. Question | 9701 Oct-Nov 2019 P1 V2 Q37

37 Following fractional distillation of crude oil, which processes can be used to produce propene from larger hydrocarbon molecules?

- 1 cracking
- 2 reduction
- 3 polymerisation

63. Question | 9701 Oct-Nov 2019 P1 V3 Q21

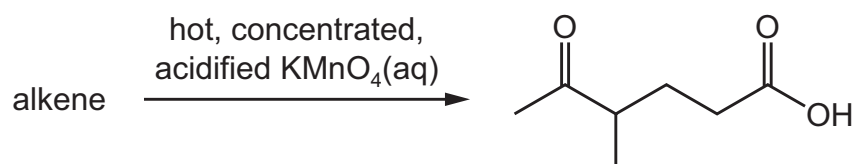
21 Alkanes are saturated hydrocarbons.

Which type of reaction are alkanes most likely to undergo?

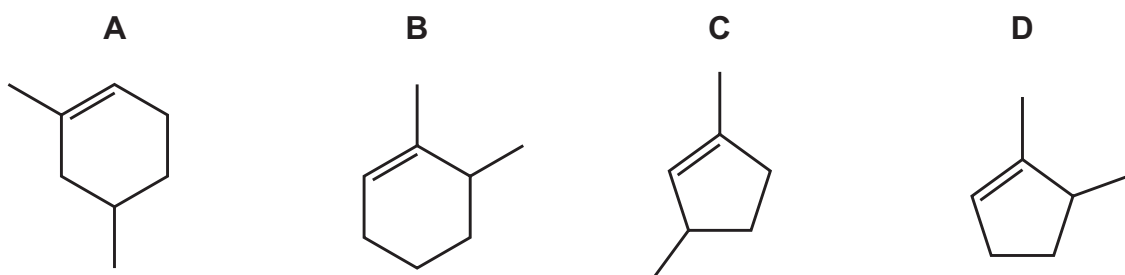
- A electrophilic addition
- B electrophilic substitution
- C free radical substitution
- D nucleophilic addition

64. Question | 9701 Oct-Nov 2019 P1 V3 Q22

22 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?



9701 Chemistry Paper 1 - Hydrocarbons

Topical questions | 175 questions

65. Question | 9701 Feb-March 2020 P1 V2 Q25

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

How many non-cyclic isomers have the molecular formula C_5H_{10} ?

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

66. Question | 9701 Feb-March 2020 P1 V2 Q39

39 Which statements apply to tetrafluoromethane?

- 1** It is rapidly decomposed by ultraviolet radiation.
- 2** It is less harmful to the ozone layer than dichlorodifluoromethane.
- 3** It is a non-polar molecule.

67. Question | 9701 Feb-March 2020 P1 V2 Q40

40 Which statements comparing ethene and ethane are correct?

- 1** The bond angles in ethene are larger than the bond angles in ethane.
- 2** Ethene reacts much more quickly with bromine in the dark than ethane does.
- 3** Complete combustion of 0.01 mol of ethene or ethane produces the same volume of gas measured at room temperature and pressure.

68. Question | 9701 May-June 2020 P1 V1 Q22

22 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

69. Question | 9701 May-June 2020 P1 V2 Q25

25 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

70. Question | 9701 May-June 2020 P1 V2 Q28

28 Ethene reacts with aqueous bromine to give two products, $\text{CH}_2\text{BrCH}_2\text{Br}$ and $\text{CH}_2\text{BrCH}_2\text{OH}$.

Which statement about these products is correct?

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

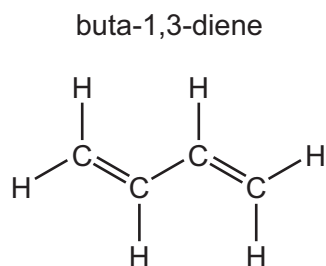
B Both products are obtained in this reaction by nucleophilic addition.

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

D Both products can form hydrogen bonds with water.

71. Question part 1/2 | 9701 May-June 2020 P1 V2 Q30

30 The diagram shows the structure of buta-1,3-diene.



The addition reaction between buta-1,3-diene and two molecules of hydrogen bromide can produce three structurally isomeric products.

How many of these products have at least one chiral centre?

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

71. Question part 2/2 | 9701 May-June 2020 P1 V2 Q30

Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

Use of the *Data Booklet* may be appropriate for some questions.

72. Question | 9701 May-June 2020 P1 V3 Q20

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

When *trans*-pent-2-ene reacts with HBr, how many different products can form?

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

73. Question | 9701 May-June 2020 P1 V3 Q27

27 1,2-dibromopropane can be made from 1-bromopropane in two steps.

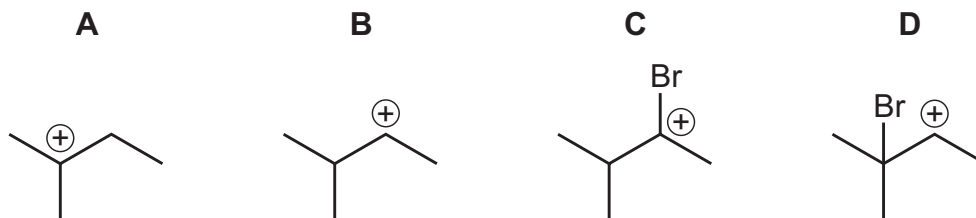
Which row is correct?

	step 1	step 2
A	addition	substitution
B	elimination	addition
C	hydrolysis	elimination
D	substitution	hydrolysis

74. Question | 9701 May-June 2020 P1 V3 Q28

- 28** 2-methylbut-2-ene reacts with HBr(g) to form two isomeric products. During the reaction two positively charged intermediates can be made.

Which diagram shows the more stable of the two positively charged intermediates?



75. Question | 9701 Oct-Nov 2020 P1 V1 Q21

- 21** 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

76. Question | 9701 Oct-Nov 2020 P1 V1 Q38

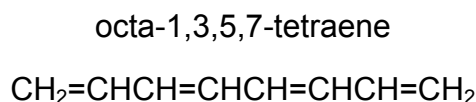
- 38** During the bromination of methane, the free radical $\text{CH}_3\cdot$ is generated. A possible termination step of this reaction is the formation of C_2H_6 by the combination of two free radicals.

What could be produced in a termination step during the bromination of **propane**?

- 1** $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
- 2** $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)_2$
- 3** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$

77. Question | 9701 Oct-Nov 2020 P1 V2 Q20

- 20** The unsaturated hydrocarbon octa-1,3,5,7-tetraene, C_8H_{10} , can display geometric isomerism.



How many isomers exist?

- A** 2 **B** 3 **C** 4 **D** 8

78. Question | 9701 Oct-Nov 2020 P1 V2 Q28

- 28** Which statement about the use of alkane fuels in internal combustion engines is correct?
- A** C_8H_{18} is used as fuel in internal combustion engines and reacts with oxygen and nitrogen from the air.
 - B** In limited oxygen, CO is produced which oxidises SO_2 to SO_3 in the atmosphere.
 - C** The catalytic converter removes polluting gases including NO_2 and CO_2 .
 - D** Unburnt hydrocarbons and NO_2 can react in sunlight to produce photochemical smog.

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79. Question | 9701 Oct-Nov 2020 P1 V2 Q38

38 Which free radicals can be generated during a free-radical substitution reaction between chlorine and ethane?

- 1** $\text{CH}_3\cdot$
- 2** $\text{CH}_2\text{ClCH}_2\cdot$
- 3** $\text{CH}_3\text{CCl}_2\cdot$

80. Question | 9701 Oct-Nov 2020 P1 V3 Q21

21 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

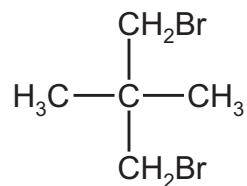
- 38** During the bromination of methane, the free radical $\text{CH}_3\cdot$ is generated. A possible termination step of this reaction is the formation of C_2H_6 by the combination of two free radicals.

What could be produced in a termination step during the bromination of **propane**?

- 1** $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$
- 2** $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)_2$
- 3** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)_2$

82. Question | 9701 Feb-March 2021 P1 V2 Q22

- 22** The diagram shows the structure of a bromo compound that may be formed by the reaction of bromine with a hydrocarbon.

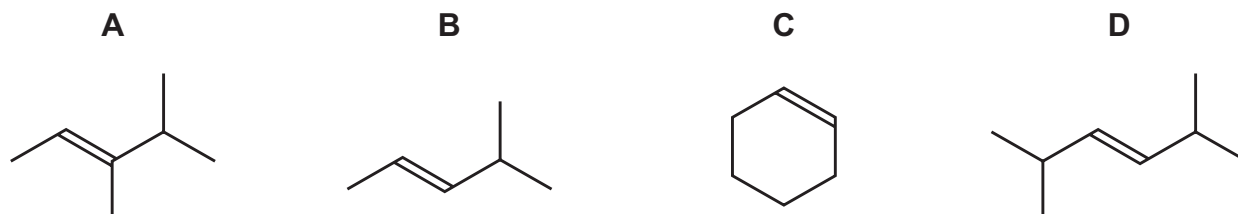


Which row is correct?

	type of reaction	mechanism
A	addition	electrophilic
B	addition	nucleophilic
C	substitution	nucleophilic
D	substitution	free-radical

83. Question | 9701 May-June 2021 P1 V1 Q21

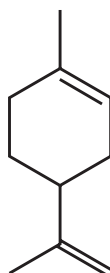
- 21** Which compound would produce two different carboxylic acids when treated with hot, concentrated, acidified manganate(VII) ions?



84. Question | 9701 May-June 2021 P1 V1 Q23

23 Limonene is a hydrocarbon found in the rind of citrus fruits.

limonene



What is the molecular formula of limonene?

- A** $C_{10}H_{12}$ **B** $C_{10}H_{14}$ **C** $C_{10}H_{16}$ **D** $C_{10}H_{18}$

85. Question | 9701 May-June 2021 P1 V1 Q29

29 The table describes four reactions of propene.

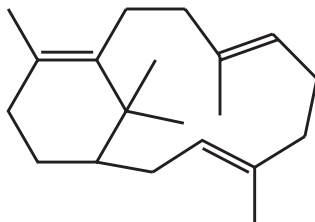
Which row is correct?

	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

86. Question | 9701 May-June 2021 P1 V2 Q20

- 20** Compound P is treated with an excess of hydrogen gas in the presence of a nickel catalyst. The product Q is fully saturated.

compound P



What is the number of chiral carbon atoms in the product Q?

- A** 4 **B** 5 **C** 6 **D** 7

87. Question | 9701 May-June 2021 P1 V2 Q23

- 23** Methane and bromine react by free radical substitution.

P and Q are involved in the reaction mechanism.

P and Q:

- are **both** involved in propagation steps as reactants
- are **both** involved in termination steps as reactants.

What could be P and Q?

- A** Br and H **B** Br and CH₃ **C** Br and C₂H₆ **D** CH₃ and CH₃Br

88. Question | 9701 May-June 2021 P1 V2 Q26

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

89. Question | 9701 May-June 2021 P1 V3 Q20

20 Which compound shows stereoisomerism?

- A** 2-methylbut-2-ene
- B** 2-chloropropan-1-ol
- C** difluorochlorobromomethane
- D** pent-1-ene

90. Question | 9701 May-June 2021 P1 V3 Q21

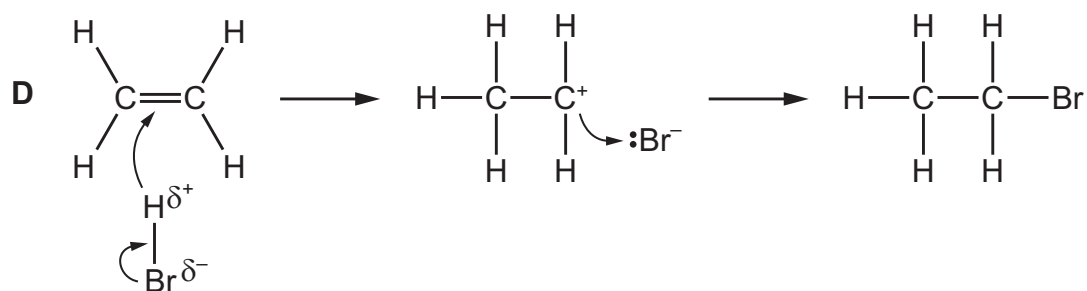
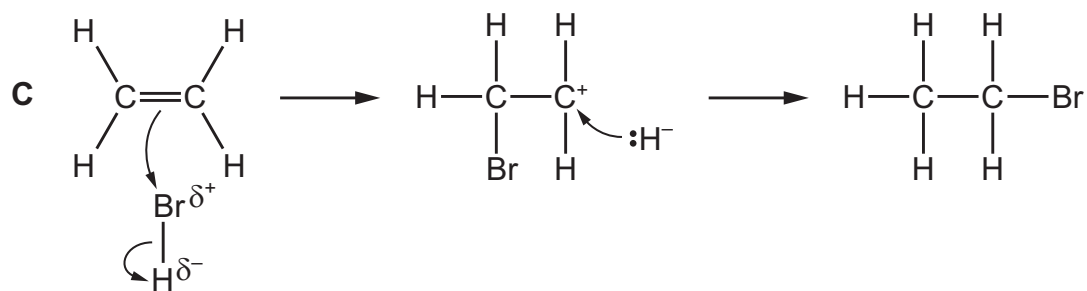
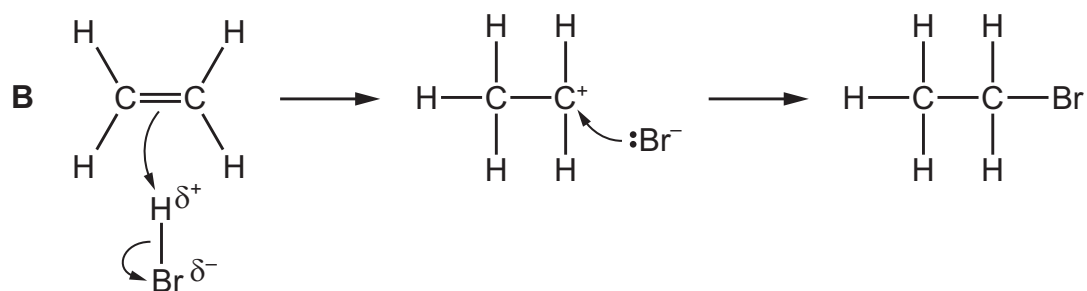
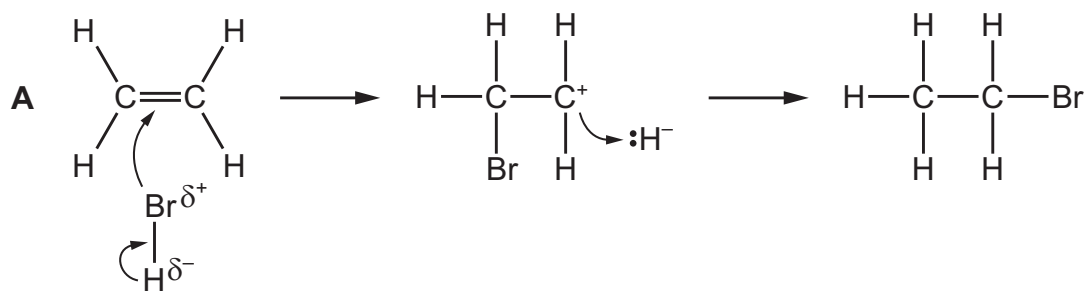
21 Two carbon-containing products result from the reaction of alkene Z with a hot, concentrated, acidified solution of potassium manganate(VII).

One product forms an orange precipitate with 2,4-dinitrophenylhydrazine reagent. The other product is a gas which gives a white precipitate with aqueous calcium hydroxide.

Which alkene could be alkene Z?

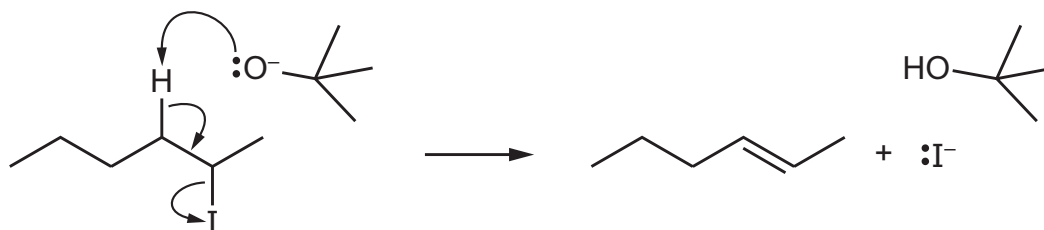
- A** but-2-ene
- B** 2-methylpropene
- C** 2-methylbut-2-ene
- D** propene

22 What is the correct mechanism for the addition of hydrogen bromide to ethene?



92. Question | 9701 Oct-Nov 2021 P1 V1 Q20

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



Which statement about this reaction is correct?

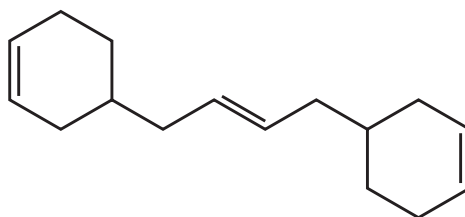
- A** $(\text{CH}_3)_3\text{CO}^-$ is behaving as a Brønsted-Lowry base.
- B** $(\text{CH}_3)_3\text{CO}^-$ is behaving as an oxidising agent.
- C** The C–I bond breaks via homolytic fission.
- D** This is a hydrolysis reaction.

93. Question | 9701 Oct-Nov 2021 P1 V1 Q21

21 Structural isomerism **only** should be considered when answering this question.

Molecule X contains three C=C double bonds. One mole of X is reacted with three moles of HBr. The carbon skeleton is unchanged.

molecule X

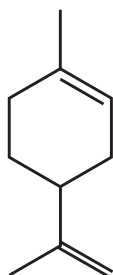


How many different products are formed?

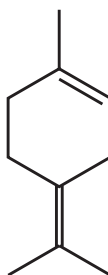
- A** 3
- B** 4
- C** 6
- D** 8

37 A diketo acid is a compound with two ketone groups and one carboxylic acid group.

limonene



terpinolene



Which statements about the reactions of limonene and terpinolene are correct?

- 1 When reacted with an excess of hydrogen and a nickel catalyst, limonene and terpinolene produce the same compound.
- 2 An excess of hot concentrated acidified KMnO_4 reacts with limonene and with terpinolene to form different diketo acids.
- 3 The reactions of limonene and terpinolene with an excess of Br_2 produce positional isomers with the same number of chiral carbon atoms.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

9701 Chemistry Paper 1 - Hydrocarbons

Topical questions | 175 questions

95. Question | 9701 Oct-Nov 2021 P1 V1 Q38

38 One molecule of dodecane, $C_{12}H_{26}$, is cracked, producing three product molecules, X, Y and Z.

X is a straight chain alkane. Y and Z are straight chain alkenes with different M_r values.

Which statements about X, Y and Z are correct?

- 1** If Y and Z are but-1-ene and ethene respectively, X will be hexane.
- 2** If X is butane, then Y and Z could both show *cis-trans* isomerism.
- 3** X could be octane.

96. Question | 9701 Oct-Nov 2021 P1 V2 Q22

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

Y is a gaseous hydrocarbon which decolourises aqueous bromine. It contains no rings.

10.0 g of Y occupies a volume of 3.43 dm^3 under room conditions.

How many isomeric structures are possible for Y?

- A** 4 **B** 5 **C** 6 **D** 7

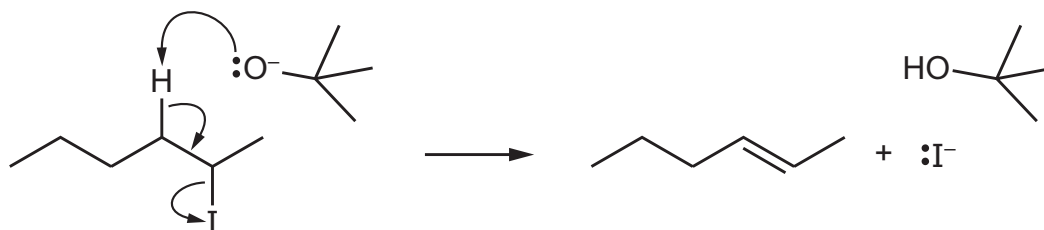
97. Question | 9701 Oct-Nov 2021 P1 V2 Q23

23 Which equation represents a valid propagation step in the chlorination of ethane?

- A** $C_2H_5Cl + Cl\cdot \rightarrow C_2H_4Cl\cdot + HCl$
- B** $C_2H_6 + Cl\cdot \rightarrow C_2H_5Cl + H\cdot$
- C** $C_2H_5Cl + H\cdot \rightarrow C_2H_5\cdot + HCl$
- D** $C_2H_5\cdot + Cl\cdot \rightarrow C_2H_5Cl$

98. Question | 9701 Oct-Nov 2021 P1 V3 Q20

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



Which statement about this reaction is correct?

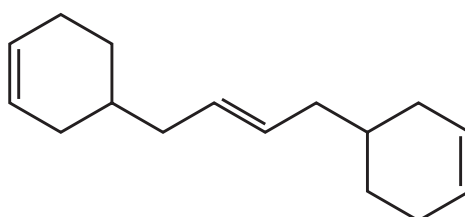
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- B** $(\text{CH}_3)_3\text{CO}^-$ is behaving as an oxidising agent.
- C** The C–I bond breaks via homolytic fission.
- D** This is a hydrolysis reaction.

99. Question | 9701 Oct-Nov 2021 P1 V3 Q21

21 Structural isomerism **only** should be considered when answering this question.

Molecule X contains three C=C double bonds. One mole of X is reacted with three moles of HBr. The carbon skeleton is unchanged.

molecule X

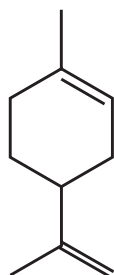


How many different products are formed?

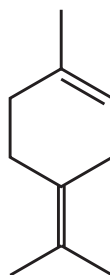
- A** 3
- B** 4
- C** 6
- D** 8

37 A diketo acid is a compound with two ketone groups and one carboxylic acid group.

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terpinolene



Which statements about the reactions of limonene and terpinolene are correct?

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- 2 An excess of hot concentrated acidified KMnO_4 reacts with limonene and with terpinolene to form different diketo acids.
- 3 The reactions of limonene and terpinolene with an excess of Br_2 produce positional isomers with the same number of chiral carbon atoms.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

No other combination of statements is used as a correct response.

9701 Chemistry Paper 1 - Hydrocarbons

Topical questions | 175 questions

101. Question | 9701 Oct-Nov 2021 P1 V3 Q38

38 One molecule of dodecane, $C_{12}H_{26}$, is cracked, producing three product molecules, X, Y and Z.

X is a straight chain alkane. Y and Z are straight chain alkenes with different M_r values.

Which statements about X, Y and Z are correct?

- 1** If Y and Z are but-1-ene and ethene respectively, X will be hexane.
- 2** If X is butane, then Y and Z could both show *cis-trans* isomerism.
- 3** X could be octane.

102. Question | 9701 Feb-March 2022 P1 V2 Q26

26 In this question, alkenes and cyclic alkanes should be considered.

How many **structural** isomers of C_4H_8 are there?

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

103. Question | 9701 Feb-March 2022 P1 V2 Q27

27 Which compound will decolourise $Br_2(aq)$?

- A** $CH_3CH_2CH_2CH_2CH_2CO_2H$
- B** $CH_3CH_2CH_2CH_2CH_2CHO$
- C** $CH_3CHCHCH_2CH_2CH_2OH$
- D** $CH_3CH_2CH_2CO_2CH_2CH_3$

9701 Chemistry Paper 1 - Hydrocarbons

Topical questions | 175 questions

104. Question | 9701 Feb-March 2022 P1 V2 Q28

- 28** Alkenes react with aqueous hydrogen bromide. The reaction proceeds via an intermediate carbocation. The more stable the intermediate, the faster the reaction.

Which sequence correctly shows an **increase** in the speed of reaction of the alkenes with hydrogen bromide?

- A** ethene, propene, 2-methylpropene
- B** 2-methylpropene, ethene, propene
- C** propene, ethene, 2-methylpropene
- D** propene, 2-methylpropene, ethene

105. Question | 9701 Feb-March 2022 P1 V2 Q29

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

Which row is correct?

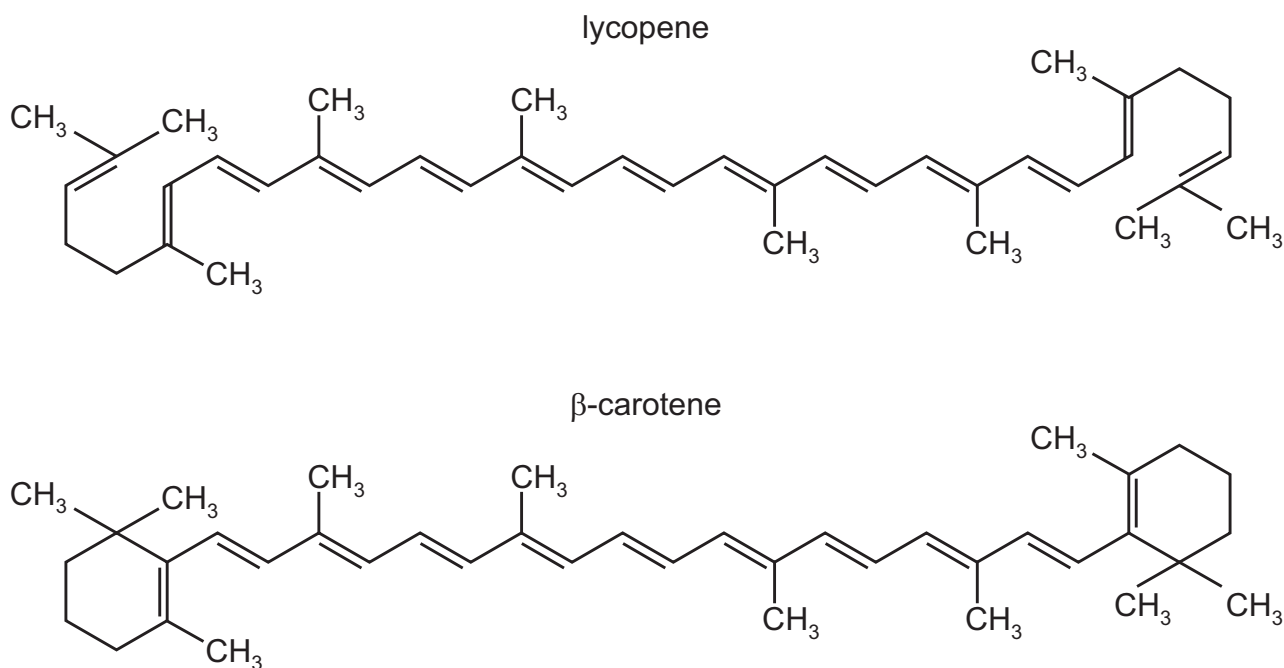
	type of reaction	name of product
A	elimination	propan-1-ol
B	elimination	propene
C	substitution	propan-1-ol
D	substitution	propene

106. Question | 9701 Feb-March 2022 P1 V2 Q36

- 36** What is the least number of carbon atoms in a non-cyclic alkane molecule that has a chiral centre?

- A** 7 **B** 8 **C** 9 **D** 10

39 The diagrams show the structures of lycopene and β -carotene.



When lycopene is converted into β -carotene, what is the gain or loss of hydrogen atoms per molecule?

- A** 4 gained
- B** 2 gained
- C** no change
- D** 2 lost

108. Question | 9701 May-June 2022 P1 V1 Q30

30 Oct-1-ene, $\text{CH}_3(\text{CH}_2)_5\text{CH}=\text{CH}_2$, 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
$\text{CH}_2=\text{CH}_2$	$\text{CH}_3\text{CH}=\text{CH}_2$	$\text{CH}_3\text{CH}_2\text{CH}_3$	$\text{CH}_2=\text{CHCH}=\text{CH}_2$

- A** W, X, Y and Z
B W, X and Y only
C W, X and Z only
D W and X only

109. Question | 9701 May-June 2022 P1 V2 Q29

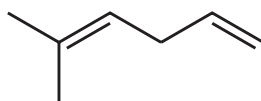
29 The free-radical substitution reaction between methane and chlorine involves initiation, propagation and termination stages.

Which row is correct?

	involved in initiation stage	radical produced in a propagation stage
A	homolytic fission	$\text{H}\cdot$
B	homolytic fission	$\text{CH}_3\cdot$
C	heterolytic fission	$\text{H}\cdot$
D	heterolytic fission	$\text{CH}_3\cdot$

110. Question | 9701 May-June 2022 P1 V2 Q30

30 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

111. Question | 9701 May-June 2022 P1 V3 Q29

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

Y is a gaseous hydrocarbon which decolourises aqueous bromine.

10.0 g of Y occupies a volume of 3.43 dm³ under room conditions.

How many isomeric structures are possible for Y?

- A** 4 **B** 5 **C** 6 **D** 7

112. Question | 9701 Oct-Nov 2022 P1 V1 Q28

28 Which pair of reagents react together in a redox reaction?

- A** $\text{CH}_3\text{CHCH}_2 + \text{Br}_2$
- B** $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} + \text{concentrated H}_3\text{PO}_4$
- C** $\text{CH}_3\text{COCH}_3 + \text{HCN}$
- D** $\text{HCO}_2\text{C}_2\text{H}_5 + \text{dilute H}_2\text{SO}_4$

113. Question | 9701 Oct-Nov 2022 P1 V2 Q28

28 Which pair includes a hydrocarbon without a chiral centre?

- | | | |
|----------|---|---|
| A | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$ | $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$ |
| B | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_2\text{CH}_3)\text{CH}_3$ | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$ |
| C | $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_3$ | $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}(\text{CH}_3)_2$ |
| D | $\text{CH}_3\text{CH}(\text{CH}_2\text{CH}_3)\text{CH}(\text{CH}_3)\text{CH}_3$ | $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}(\text{CH}_3)_2$ |

114. Question | 9701 Oct-Nov 2022 P1 V2 Q30

- 30** *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?

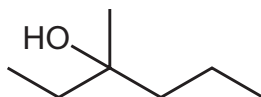
	when sodium metal is added to separate samples of X and Y	when sodium hydroxide solution is added to separate samples of X and Y
A	both X and Y will react	neither X nor Y will react
B	both X and Y will react	only one of X and Y will react
C	only one of X and Y will react	neither X nor Y will react
D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

115. Question | 9701 Oct-Nov 2022 P1 V2 Q34

- 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

116. Question | 9701 Specimen 2022 P1 Q27

- 27** An alkene is reacted with acidified manganate(VII) ions, MnO_4^- . The organic product has a relative molecular mass greater than that of the alkene by 34.

What conditions should be used?

- A** cold, concentrated MnO_4^-
B cold, dilute MnO_4^-
C hot, concentrated MnO_4^-
D hot, dilute MnO_4^-

117. Question | 9701 Specimen 2022 P1 Q36

36 P and Q are alkenes. They are geometric isomers of each other.

Which statement is correct?

- A** P and Q give different products with hot, concentrated, acidified potassium manganate(VII).
- B** P and Q have different empirical formulae.
- C** P and Q have different functional groups.
- D** P and Q have different skeletal formulae.

118. Question | 9701 Feb-March 2023 P1 V2 Q29

29 Cyclohexene, C_6H_{10} , is a hydrocarbon with a six-membered ring of carbon atoms.

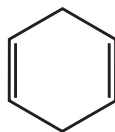
It has several structural isomers that are straight-chain alkenes. The number of double bonds in each of these molecules is P.

What is the shape of the cyclohexene molecule and what is the value of P?

	shape	P
A	planar	1
B	planar	2
C	non-planar	1
D	non-planar	2

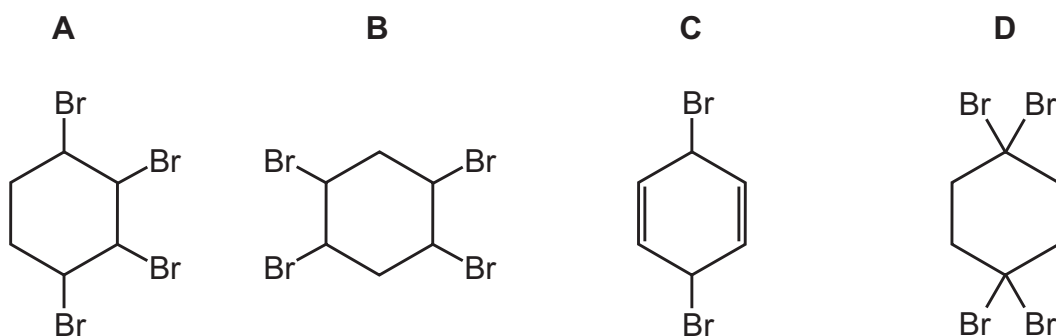
119. Question | 9701 Feb-March 2023 P1 V2 Q39

39 Cyclohexa-1,4-diene is treated with a solution of bromine in tetrachloromethane in the dark.



cyclohexa-1,4-diene

Which product is formed?



120. Question | 9701 May-June 2023 P1 V1 Q24

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

If a molecule contains two non-identical chiral carbon atoms, four optical isomers exist.

How many isomers are there with:

- molecular formula $C_7H_{14}O$ **and**
- a five-membered ring **and**
- a tertiary alcohol group?

A 4

B 5

C 9

D 13

9701 Chemistry Paper 1 - Hydrocarbons

Topical questions | 175 questions

121. Question | 9701 May-June 2023 P1 V1 Q27

27 Which equation represents a reaction that proceeds through initiation, propagation and termination steps?

- A** $\text{C}_4\text{H}_{10} + \text{Cl}_2 \rightarrow \text{C}_4\text{H}_9\text{Cl} + \text{HCl}$
- B** $\text{C}_5\text{H}_{11}\text{Br} + \text{NaOH} \rightarrow \text{C}_5\text{H}_{11}\text{OH} + \text{NaBr}$
- C** $\text{C}_6\text{H}_{12} + \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{13}\text{OH}$
- D** $\text{C}_6\text{H}_{13}\text{CHO} + \text{HCN} \rightarrow \text{C}_6\text{H}_{13}\text{CH}(\text{OH})\text{CN}$

122. Question | 9701 May-June 2023 P1 V1 Q28

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

A set of isomeric hydrocarbons:

- all contain 14.3% by mass of hydrogen
- all react with bromine by addition, 0.280 g of each hydrocarbon reacting with 0.799 g of bromine.

What is the maximum number of isomeric compounds in the set?

- A** 1 **B** 3 **C** 4 **D** 5

9701 Chemistry Paper 1 - Hydrocarbons

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123. Question | 9701 May-June 2023 P1 V2 Q30

30 Alkynes are hydrocarbons that contain one triple $\text{C}\equiv\text{C}$ bond.

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

For example, ethyne, $\text{H}-\text{C}\equiv\text{C}-\text{H}$, 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** $\text{CH}_2\text{BrCH}_2\text{CH}_2\text{Br}$
- B** $\text{CH}_3\text{CH}_2\text{CHBr}_2$
- C** $\text{CH}_3\text{CHBrCH}_2\text{Br}$
- D** $\text{CH}_3\text{CBr}_2\text{CH}_3$

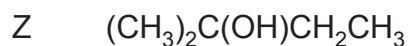
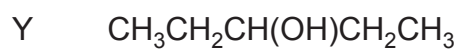
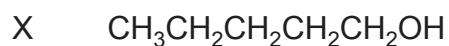
124. Question | 9701 May-June 2023 P1 V2 Q31

31 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

33 X, Y and Z are three isomeric alcohols.



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

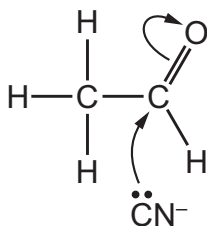
One of these alcohols, when dehydrated, will give a pair of cis-trans isomers with molecular formula C_5H_{10} .

Which row is correct?

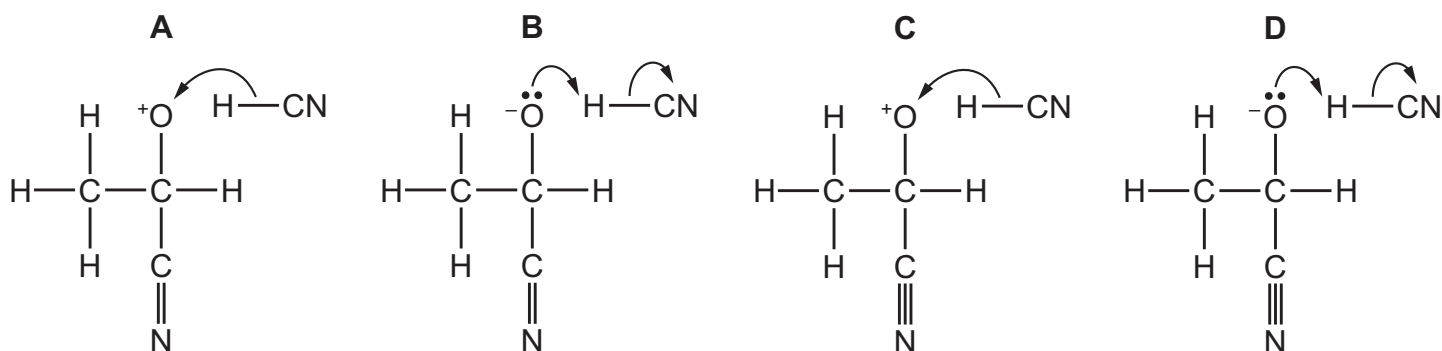
	reacts with mild oxidising reagents	gives cis/trans isomers
A	X, Y and Z	Y only
B	X, Y and Z	Z only
C	X and Y only	Y only
D	X and Y only	Z only

126. Question | 9701 May-June 2023 P1 V2 Q35

35 The mechanism for the reaction between ethanal and hydrogen cyanide starts with the step shown.



What is the correct structure of the intermediate ion formed, and what is the next step in this mechanism?



127. Question | 9701 May-June 2023 P1 V3 Q29

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.

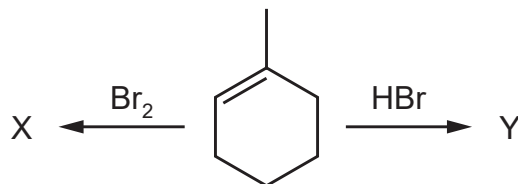
Which reagent would be needed to complete the second stage?

- A** cold dilute acidified manganate(VII) ions
- B** hot concentrated acidified manganate(VII) ions
- C** steam with phosphoric acid
- D** aqueous sodium hydroxide

128. Question | 9701 May-June 2023 P1 V3 Q32

32 When 1-methylcyclohexene reacts with Br_2 the product is X.

When 1-methylcyclohexene reacts with HBr the **major** product is Y.



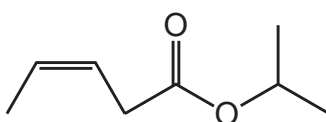
Which statement is correct?

- A** X is a mixture of two stereoisomers; Y does **not** have stereoisomers.
- B** X is a mixture of two stereoisomers; Y is a mixture of four stereoisomers.
- C** X is a mixture of four stereoisomers; Y does **not** have stereoisomers.
- D** X is a mixture of four stereoisomers; Y is a mixture of four stereoisomers.

129. Question | 9701 May-June 2023 P1 V3 Q37

37 An unsaturated carboxylic acid reacts with alcohol X to form an ester.

The structure of the ester is shown.



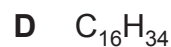
Which geometrical isomer is shown in this ester and to which class of alcohol does X belong?

	geometrical isomer	class of alcohol X
A	<i>cis</i>	secondary
B	<i>cis</i>	tertiary
C	<i>trans</i>	secondary
D	<i>trans</i>	tertiary

130. Question | 9701 Oct-Nov 2023 P1 V1 Q28

28 The hydrocarbon $C_{17}H_{36}$ can be cracked.

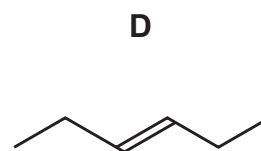
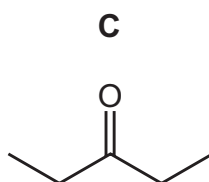
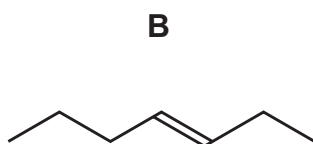
Which compound is the **least** likely to be produced in this reaction?



131. Question | 9701 Oct-Nov 2023 P1 V1 Q29

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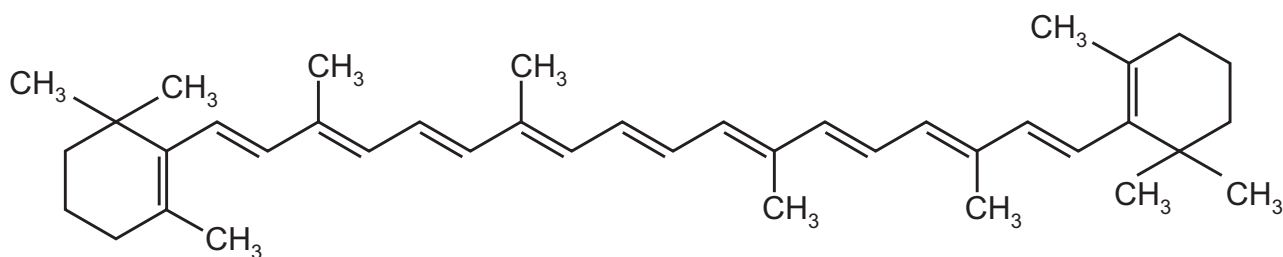
29 Which compound has an M_r of 84 and will react with HBr to give a product with an M_r of 164.9?



132. Question | 9701 Oct-Nov 2023 P1 V1 Q30

30 β -carotene is responsible for the orange colour of carrots.

β -carotene



β -carotene is oxidised by hot, concentrated, acidified $KMnO_4$.

When an individual molecule of β -carotene is oxidised in this way, many product molecules are formed.

How many of these product molecules contain a ketone functional group?



133. Question | 9701 Oct-Nov 2023 P1 V2 Q29

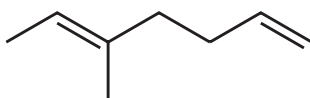
29 How many geometrical (cis/trans) isomers are there of hex-2,4-diene, $\text{CH}_3\text{CH}=\text{CHCH}=\text{CHCH}_3$?

- A** none; hex-2,4-diene does **not** show geometric isomerism
- B** 2
- C** 3
- D** 4

134. Question | 9701 Oct-Nov 2023 P1 V2 Q30

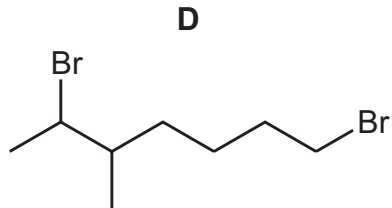
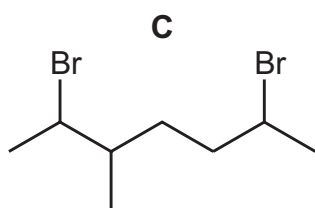
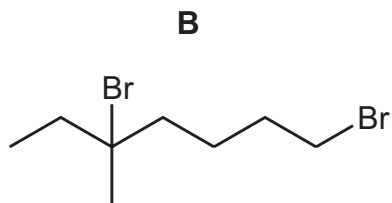
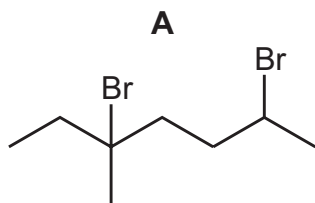
30 The structure of compound X is shown.

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?



135. Question | 9701 Oct-Nov 2023 P1 V2 Q32

32 Which list contains a compound that is **not** made during the free radical substitution of methane with chlorine?

- A** CH_3Cl , CCl_4 , C_2H_6
B Cl_2 , CH_2Cl_2 , CCl_4
C CH_3Cl , CH_2Cl_2 , CHCl_3
D CH_3Cl , CHCl_3 , $\text{C}_2\text{H}_2\text{Cl}_2$

136. Question | 9701 Oct-Nov 2023 P1 V3 Q28

28 The hydrocarbon $\text{C}_{17}\text{H}_{36}$ can be cracked.

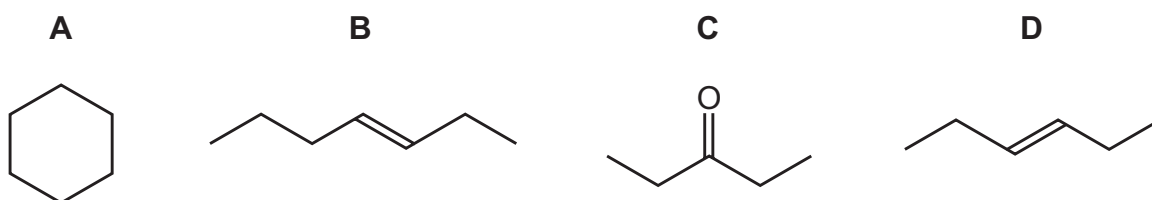
Which compound is the **least** likely to be produced in this reaction?

- A** C_3H_8 **B** C_4H_8 **C** C_8H_{16} **D** $\text{C}_{16}\text{H}_{34}$

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137. Question | 9701 Oct-Nov 2023 P1 V3 Q29

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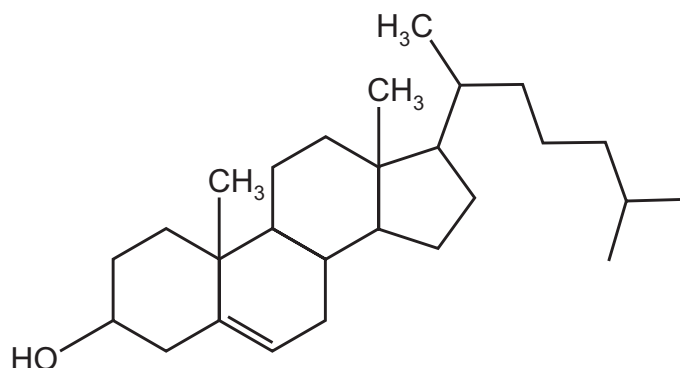
29 Which compound has an M_r of 84 and will react with HBr to give a product with an M_r of 164.9?



138. Question | 9701 Feb-March 2024 P1 V2 Q25

- 25** The diagram shows the structure of the naturally occurring molecule cholesterol.

cholesterol



Student X stated that the 17 carbon atoms in the 4 rings all lie in the same plane.

Student Y stated that this molecule displays cis/trans isomerism at the C=C double bond.

Which students are correct?

- A** both student X and student Y
- B** neither student X nor student Y
- C** student X only
- D** student Y only

139. Question | 9701 Feb-March 2024 P1 V2 Q27

- 27** But-2-ene reacts with cold dilute acidified KMnO₄ to give product X.

But-2-ene reacts with hot concentrated acidified KMnO₄ to give product Y.

Which statement about product X and product Y is correct?

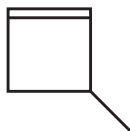
- A** Both product X and product Y will react with 2,4-dinitrophenylhydrazine.
- B** Neither product X nor product Y will react with 2,4-dinitrophenylhydrazine.
- C** Product X will react with 2,4-dinitrophenylhydrazine, product Y will not.
- D** Product Y will react with 2,4-dinitrophenylhydrazine, product X will not.

140. Question | 9701 May-June 2024 P1 V1 Q25

- 25** Structural isomerism and stereoisomerism should be taken into account when answering this question.

The structure of 3-methylcyclobutene is shown.

3-methylcyclobutene



A mixture containing all stereoisomers of 3-methylcyclobutene is treated with HBr. This produces a mixture of isomeric bromomethylcyclobutanes.

How many stereoisomers does 3-methylcyclobutene have, and how many isomeric bromomethylcyclobutanes are present in the product mixture?

	3-methylcyclobutene	bromomethylcyclobutanes
A	2	4
B	2	6
C	4	4
D	4	8

141. Question | 9701 May-June 2024 P1 V1 Q28

- 28** Which reaction occurs when ethane and chlorine are mixed in diffused sunlight?

- A** a free-radical substitution with hydrogen given off
- B** a free-radical substitution with hydrogen chloride given off
- C** a free-radical substitution with no gas given off
- D** a nucleophilic substitution with hydrogen chloride given off

9701 Chemistry Paper 1 - Hydrocarbons

Topical questions | 175 questions

142. Question | 9701 May-June 2024 P1 V2 Q26

26 Z is a gaseous hydrocarbon which has a density of $3.50 \times 10^{-3} \text{ g cm}^{-3}$ 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

143. Question | 9701 May-June 2024 P1 V2 Q34

34 The molecule of limonene, $\text{C}_{10}\text{H}_{16}$, 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 $\text{C}=\text{C}$ double bonds in **one** mole of limonene?

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

144. Question | 9701 May-June 2024 P1 V3 Q25

25 Which alkene shows geometric isomerism?

- A** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$
- B** $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_3$
- C** $\begin{array}{c} \text{CH}_3\text{CH}_2\text{C}=\text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$
- D** $\begin{array}{c} \text{CH}_3\text{CH}=\text{CCH}_3 \\ | \\ \text{CH}_3 \end{array}$

9701 Chemistry Paper 1 - Hydrocarbons

Topical questions | 175 questions

145. Question | 9701 May-June 2024 P1 V3 Q26

26 What is the correct name of the major product of the reaction of HBr with 3-ethylhex-3-ene?

- A** 3-bromo-3-ethylhexane
- B** 3-bromo-4-ethylhexane
- C** 4-bromo-3-ethylhexane
- D** 4-bromo-4-ethylhexane

146. Question | 9701 May-June 2024 P1 V3 Q29

29 But-2-ene reacts with cold dilute acidified KMnO_4 to give product X.

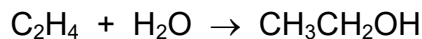
But-2-ene reacts with an excess of hot concentrated acidified KMnO_4 to give product Y.

Which statement about X and Y is correct?

- A** Only one of X and Y reacts with 2,4-dinitrophenylhydrazine.
- B** X and Y both react with sodium hydroxide.
- C** X and Y both react with sodium metal.
- D** Y reacts with LiAlH_4 to give X.

147. Question | 9701 Oct-Nov 2024 P1 V1 Q25

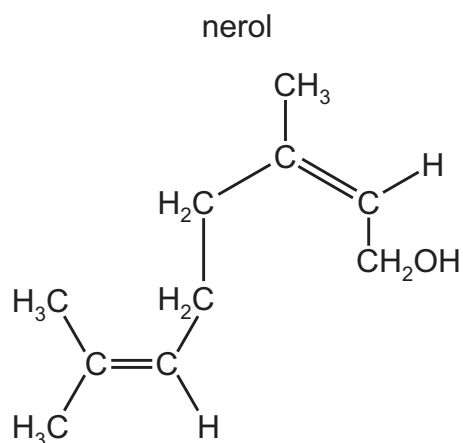
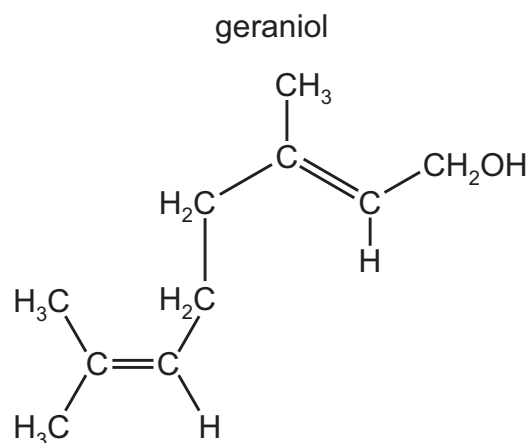
25 Ethene reacts with steam in the presence of sulfuric acid.



Which type of reaction is this?

- A** acid–base
- B** addition
- C** hydrolysis
- D** substitution

27 Geraniol and nerol are isomers of each other.



Which type of isomerism is shown here?

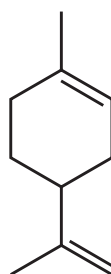
- A** chain
- B** geometrical (cis/trans)
- C** optical
- D** positional

28 Which compound has the greatest number of stereoisomers?

- A** 2-methylhex-2-ene
- B** 3-methylhex-2-ene
- C** 4-methylhex-2-ene
- D** 5-methylhex-2-ene

30 The structure of limonene is shown.

limonene



What are the number of moles of carbon dioxide and water produced when a sample of limonene is completely combusted in oxygen?

	number of moles of carbon dioxide	number of moles of water
A	4	3
B	5	4
C	5	8
D	9	7

31 The reaction of chlorine with methane is carried out in the presence of light.

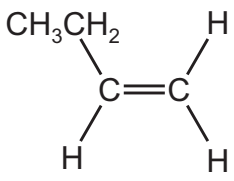
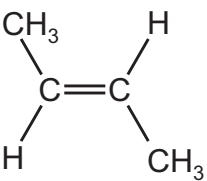
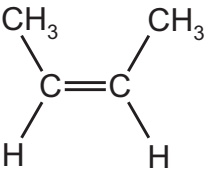
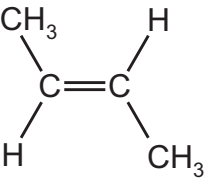
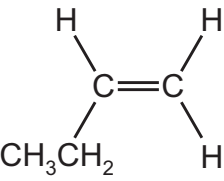
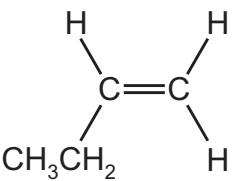
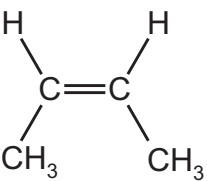
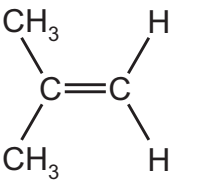
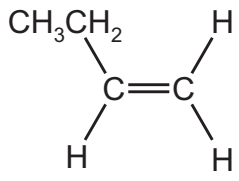
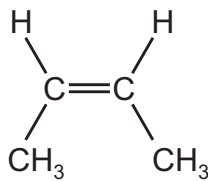
What is the function of the light?

- A** to break the C–H bonds in methane
- B** to break the chlorine molecules into atoms
- C** to break the chlorine molecules into ions
- D** to heat the mixture

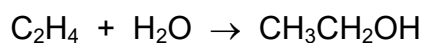
CC(C)C=CC(C)=CC#CC(C)C

A 3 **B** 4 **C** 7 **D** 10

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

A	 
B	  
C	 
D	  

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



Which type of reaction is this?

- A** acid–base
- B** addition
- C** hydrolysis
- D** substitution

155. Question | 9701 Oct-Nov 2024 P1 V3 Q28

28 Which compound has the greatest number of stereoisomers?

- A** 2-methylhex-2-ene
- B** 3-methylhex-2-ene
- C** 4-methylhex-2-ene
- D** 5-methylhex-2-ene

156. Question | 9701 Oct-Nov 2024 P1 V3 Q31

31 The reaction of chlorine with methane is carried out in the presence of light.

What is the function of the light?

- A** to break the C–H bonds in methane
- B** to break the chlorine molecules into atoms
- C** to break the chlorine molecules into ions
- D** to heat the mixture

157. Question | 9701 Feb-March 2025 P1 V2 Q28

28 Which compound may be synthesised from an alkene, with formula C_4H_8 , by an addition reaction?

- A** 1,1-dibromobutane
- B** 1,2-dibromobutane
- C** 1,3-dibromobutane
- D** 1,3-dibromomethylpropane

158. Question | 9701 Feb-March 2025 P1 V2 Q37

37 A molecule of hexane can be cracked in a number of different ways.

Three compounds are listed.

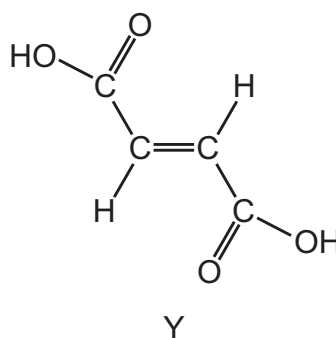
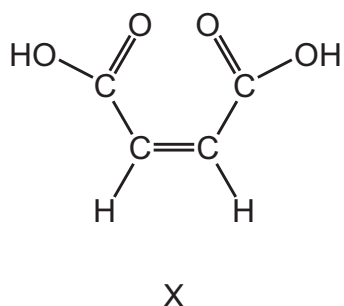
- 1 C_3H_8
- 2 C_4H_8
- 3 C_5H_{12}

Which compounds are found in the mixture of products from the cracking of hexane molecules?

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

159. Question | 9701 Feb-March 2025 P1 V2 Q38

38 The diagrams show the structures of two isomeric dicarboxylic acids, X and Y.



X can be reduced to compound P with empirical formula C_2H_5O .

Y can be reduced to compound Q, also with empirical formula C_2H_5O .

Which statement is correct?

- A** X is a cis isomer; compound P and compound Q are identical.
- B** X is a cis isomer; compound P and compound Q are isomers of each other.
- C** X is a trans isomer; compound P and compound Q are identical.
- D** X is a trans isomer; compound P and compound Q are isomers of each other.

160. Question | 9701 May-June 2025 P1 V1 Q30

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

2,5-dibromohexane is heated under reflux with ethanolic KOH.

How many isomeric compounds are formed with molecular formula C_6H_{10} ?

- A** 3 **B** 5 **C** 6 **D** 7

161. Question | 9701 May-June 2025 P1 V1 Q36

36 An alkene P reacts with an excess of hot concentrated acidified $KMnO_4(aq)$.

Methylpropanoic acid is the only organic product.

What is alkene P?

- A** 2,5-dimethylhex-3-ene
B 2-methylbut-2-ene
C methylpropene
D oct-4-ene, C_8H_{16}

162. Question | 9701 May-June 2025 P1 V1 Q37

37 Three substances are listed.

- 1 butane
- 2 hydrogen
- 3 hydrogen bromide

Which substances are possible products of the free-radical substitution reaction between ethane and bromine?

- A** 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

163. Question | 9701 May-June 2025 P1 V2 Q35

35 Samples of the gases CH_3Cl and Cl_2 are mixed together and irradiated with ultraviolet light.

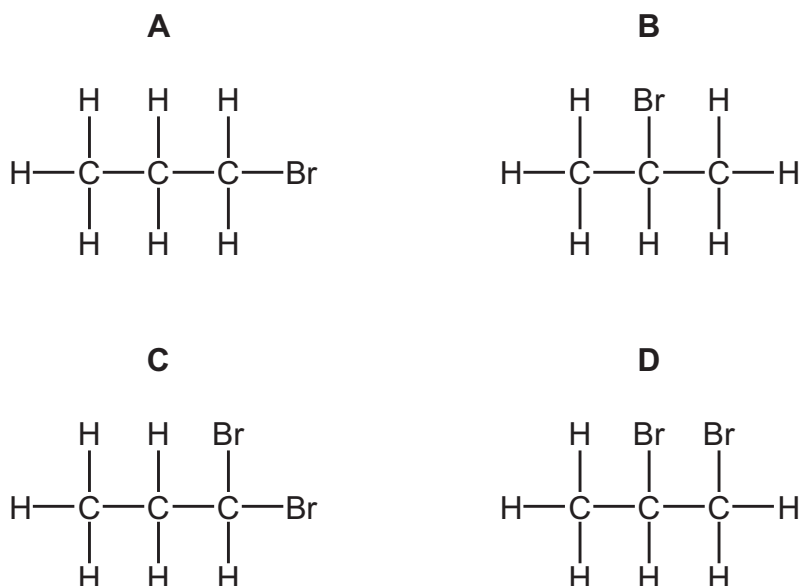
Which compound is produced by a termination step in the reaction?

- A** HCl **B** $\text{CH}_2=\text{CH}_2$ **C** $\text{CH}_2\text{ClCH}_2\text{Cl}$ **D** H_2

164. Question | 9701 May-June 2025 P1 V2 Q36

- 36** Propan-1-ol, $\text{C}_3\text{H}_7\text{OH}$, is dehydrated by passing its vapour over hot aluminium oxide to give a hydrocarbon.

Which structural formula represents the product obtained when the hydrocarbon reacts with bromine?



165. Question | 9701 May-June 2025 P1 V2 Q37

- 37** Alkane S has molecular formula C_4H_{10} .

S reacts with $\text{Cl}_2(\text{g})$ in the presence of sunlight to produce only two different monochloroalkanes, $\text{C}_4\text{H}_9\text{Cl}$. Both of these monochloroalkanes are treated with hot ethanolic KOH. They both produce the same alkene T, and no other organic products.

What is produced when T is treated with hot concentrated acidified KMnO_4 ?

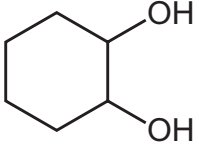
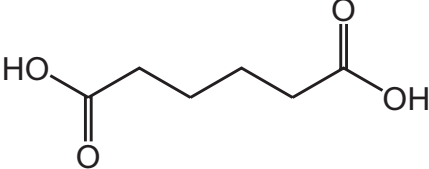
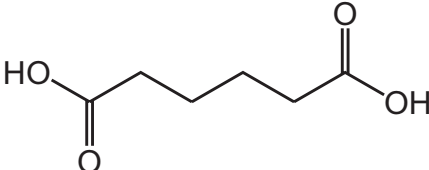
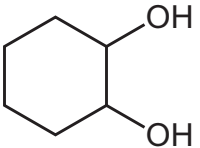
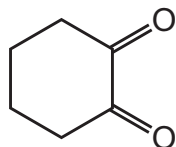
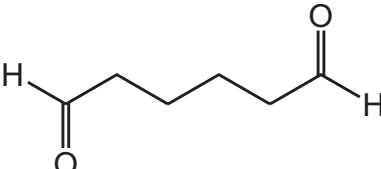
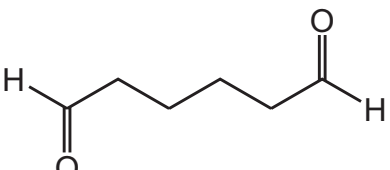
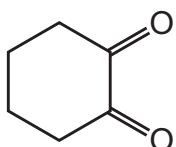
- A** CO_2 and $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$
B CO_2 and CH_3COCH_3
C HCO_2H and CH_3COCH_3
D $\text{CH}_3\text{CO}_2\text{H}$ only

166. Question | 9701 May-June 2025 P1 V2 Q38

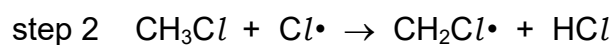
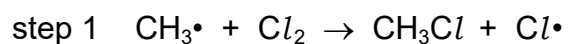
- 38** Including structural isomers and stereoisomers, how many isomers are there of $\text{C}_2\text{H}_2\text{Br}_2$?

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

35 Which row shows the products formed when cyclohexene reacts with acidified KMnO_4 under different conditions?

	product formed on reaction with cold, dilute acidified KMnO_4	product formed on reaction with hot, concentrated acidified KMnO_4
A		
B		
C		
D		

36 Two steps in the free-radical substitution reaction between methane and chlorine are shown.

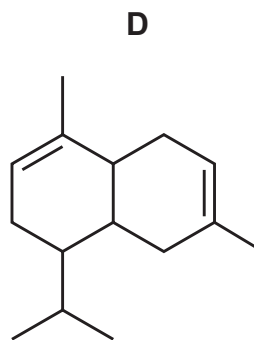
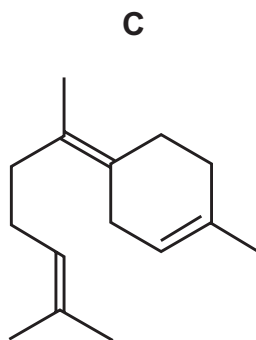
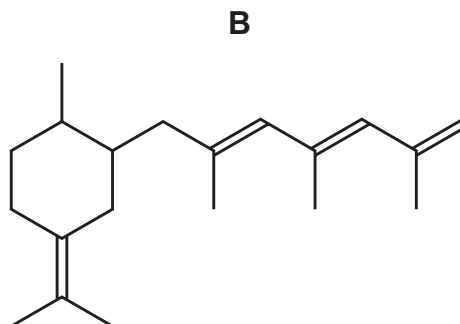
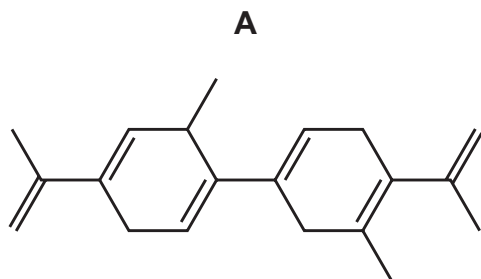


Which statement is correct?

- A** Step 1 is initiation and step 2 is propagation.
- B** Step 1 is propagation and step 2 is termination.
- C** Step 1 is initiation and step 2 is termination.
- D** Both steps are propagation.

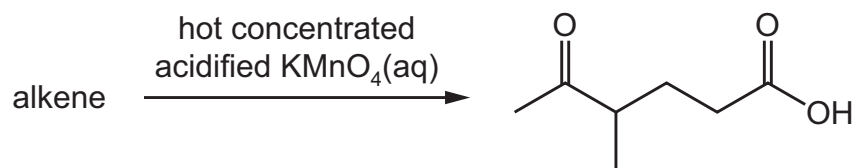
- 29** When 0.010 mol of a hydrocarbon X reacts with 720 cm³ of hydrogen at room conditions, an alkane is formed.

What is hydrocarbon X?

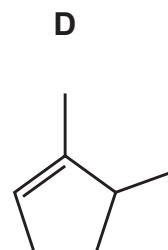
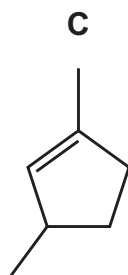
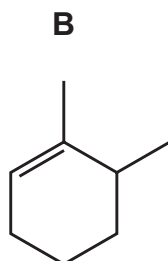
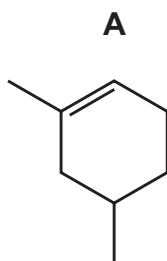


170. Question | 9701 May-June 2025 P1 V4 Q30

- 30** An alkene reacts with hot concentrated acidified KMnO_4 to produce a single organic product as shown.



What is the structure of the alkene?



171. Question | 9701 Oct-Nov 2025 P1 V1 Q27

- 27** Which intermediate ion forms in the greatest amount during the addition of HBr to propene?

- A** $\text{CH}_3\text{CH}^+\text{CH}_3$
B $\text{CH}_3\text{CH}_2\text{CH}_2^+$
C $\text{CH}_3\text{CH}^-\text{CH}_2\text{Br}$
D $\text{CH}_3\text{CHBrCH}_2^-$

172. Question | 9701 Oct-Nov 2025 P1 V2 Q27

27 What is the major product when 2-methylpent-2-ene reacts with hydrogen bromide?

- A** 1-bromo-2-methylpentane
- B** 2-bromo-2-methylpentane
- C** 3-bromo-2-methylpentane
- D** 4-bromo-2-methylpentane

173. Question | 9701 Oct-Nov 2025 P1 V2 Q28

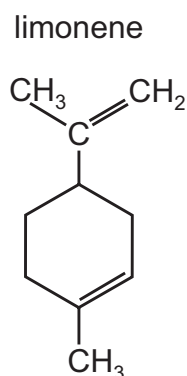
28 Pent-2-ene is reacted with cold, dilute, acidified manganate(VII) ions.

What is the major product?

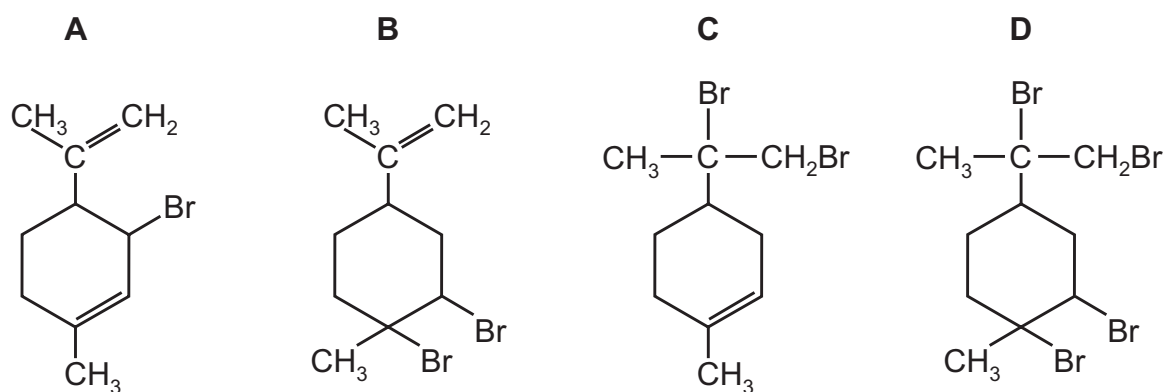
- A** $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}(\text{OH})\text{CH}_3$
- B** $\text{CH}_3\text{CH}_2\text{COCOCH}_3$
- C** a mixture of $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
- D** $\text{CH}_3\text{CH}_2\text{COOH}$ and CH_3COOH

174. Question | 9701 Oct-Nov 2025 P1 V2 Q29

29 Limonene is an oil formed in the peel of citrus fruits.



Which product is formed when an excess of bromine, $\text{Br}_2(\text{l})$, reacts with limonene at room temperature in the dark?



175. Question | 9701 Oct-Nov 2025 P1 V3 Q27

27 Which intermediate ion forms in the greatest amount during the addition of HBr to propene?

- A** $\text{CH}_3\text{CH}^+\text{CH}_3$
- B** $\text{CH}_3\text{CH}_2\text{CH}_2^+$
- C** $\text{CH}_3\text{CH}^-\text{CH}_2\text{Br}$
- D** $\text{CH}_3\text{CHBrCH}_2^-$