

Name: _____

Class: _____

Organic Chemistry

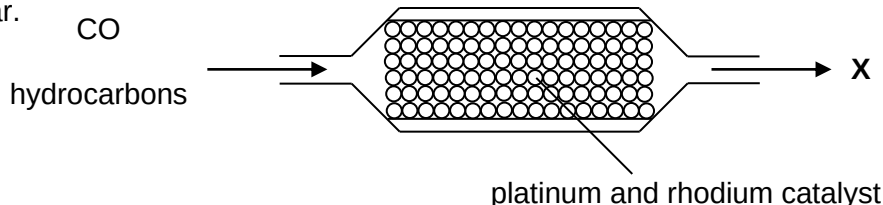
Revision Booklet

(MCQ)

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General properties of organic compounds

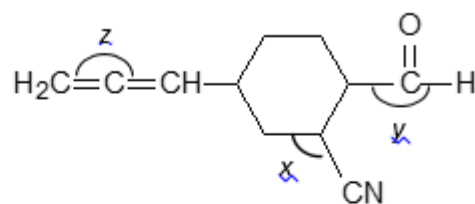
1. Which property of benzene may be directly attributed to the stability associated with its delocalized electrons?
- A** It does not conduct electricity.
B Its enthalpy change of formation is endothermic.
C It is susceptible to attack by nucleophiles.
D It tends to undergo substitution rather than addition reactions.
2. Which statement is true regarding the formation of chlorobenzene from benzene and chlorine?
- A** A catalyst is not required for the reaction to take place.
B The six carbon atoms in benzene remain sp^2 hybridised throughout the reaction.
C The relative molecular mass of the organic product is 35.5 greater than that of benzene.
D The reaction involves an intermediate which contains 4 delocalised electrons
3. Which of the following statements best explains why the boiling point of butanal (76 °C) is higher than that of pentane (36 °C)?
- A** There are permanent dipole-permanent dipole interactions between butanal molecules, but not between pentane molecules.
B There are hydrogen bonds between butanal molecules, but not between pentane molecules.
C The butanal molecule has a larger surface area than the pentane molecule.
D The covalent bonds in the butanal molecule are stronger than those in the pentane molecule.
4. Amino acids have comparatively high melting points when compared with other organic compounds of similar mass. Which of the following statements best explains this observation?
- A** In the solid state, amino acids are held together by strong hydrogen bonds.
B In order to melt an amino acid, strong covalent bonds are broken.
C Amino acids are held together by ionic bonding.
D Amino acids are held in fixed positions in a solid lattice.
5. The diagram below represents a section of a catalytic converter on the exhaust system of a car.



Which statement is **incorrect** regarding the processes that occur in the catalytic converter?

- A** Platinum and rhodium catalyse the redox reactions in the catalytic converter.
B Carbon monoxide and nitrogen oxide react together.
C Carbon monoxide and hydrocarbons react together.
D Mixture **X** contains carbon dioxide, nitrogen and water vapour.

6. Which of the following statements are correct about compound **U**?



compound **U**

- 1 The bond angles in compound **U** increase in the order $x < y < z$.
- 2 There is only one sp^2 hybridised carbon atom in compound **U**.
- 3 There are 26 σ and 5 π bonds.
- 4 Compound **U** is planar.

- A** 1 and 2
B 1 and 3
C 1, 2 and 4 only
D 2, 3 and 4 only

7. The table shows the boiling point of some Halogenoalkanes.

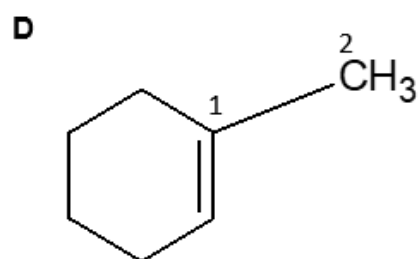
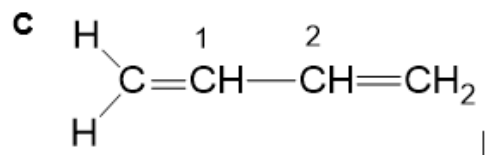
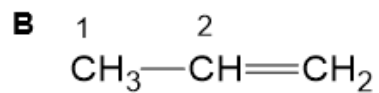
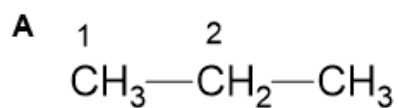
compound	boiling point/ °C
$\text{CH}_3\text{CH}_2\text{Cl}$	12.3
$\text{CH}_3\text{CH}_2\text{Br}$	34.8
$\text{CH}_3\text{CH}_2\text{I}$	70.0

Which of the following correctly explains the difference in the boiling point?

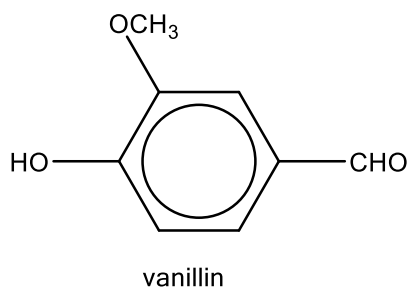
- 1 the electronegativity difference between the halogen and carbon increases from C-Cl to C-I
- 2 the strength of permanent dipole-permanent dipole attraction increases from C-Cl to C-I
- 3 the strength of instantaneous dipole-induced dipole attraction increases from $\text{CH}_3\text{CH}_2\text{Cl}$ to $\text{CH}_3\text{CH}_2\text{I}$
- 4 the bond energy of C-X bond decreases from C-Cl to C-I

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

8. Which of the following compounds has the shortest C1-C2 bond length?



9. Vanillin is the key flavour compound in vanilla, and its structure is shown.



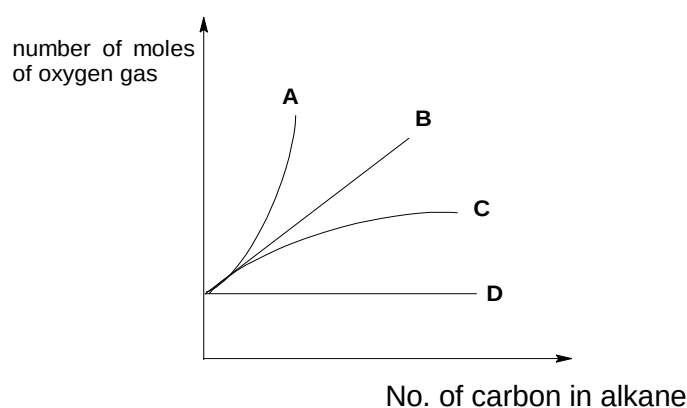
How many sp^2 hybridised carbons are there in a molecule of vanillin?

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

10. A non-cyclic organic compound has the molecular formula $C_3H_4O_2$. Which combination of functional groups **cannot** be present in this molecule?
- A** one alkene and one carboxylic acid group
B one alkene and one ester group
C one alkene and two alcohol groups
D one aldehyde and one ketone group

Combustion of organic molecules

11. Which line on the graph shows the relationship between the number of carbon atoms in an alkane and the number of moles of oxygen gas needed for complete combustion of the alkane?



12. When 15 cm^3 of a gaseous hydrocarbon **X** were burned in 100 cm^3 of oxygen, the final gaseous mixture contained 60 cm^3 of carbon dioxide and 10 cm^3 of unreacted oxygen. [All gaseous volumes measured under identical conditions.]

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

- A.** C_3H_6 **B.** C_4H_{10}
C. C_3H_8 **D.** C_4H_8
13. What volume of CO_2 will be formed when $y\text{ cm}^3$ of a 50:50 mixture of methane and propane is completely burnt?
- A.** $2y\text{ cm}^3$
B. $5y/2\text{ cm}^3$
C. 4 cm^3
D. 5 cm^3
14. When 100 cm^3 of a hydrocarbon were completely burnt in an excess of oxygen, 200 cm^3 of carbon dioxide and 0.225 g of water were formed. All volumes were measured at room temperature and pressure. What is the molecular formula of the hydrocarbon?
- A.** C_2H_4 **B.** C_4H_6
C. C_2H_6 **D.** C_4H_{12}

15. When an unknown organic compound is burned completely in excess oxygen, 90 cm^3 of gaseous products is collected. When cooled to room temperature, the gaseous volume decreased to 50 cm^3 . A further decrease of 40 cm^3 in the gaseous volume was observed when the gaseous mixture is passed through aqueous potassium hydroxide.

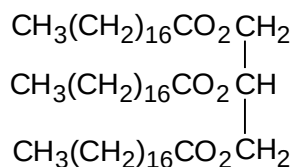
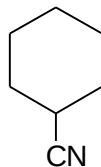
What is the possible identity of the organic compound?

- 1 CH_2CH_2
- 2 $\text{CH}_3\text{CO}_2\text{H}$
- 3 $\text{CH}_3\text{CH}_2\text{CH}_3$
- 4 $\text{CH}_2\text{CHCH}_2\text{OH}$

- A** 1 and 3 only
- B** 1 and 4 only
- C** 1, 2 and 4 only
- D** 2 and 4 only

Calculations involving Organic Molecules

16. Experiments are carried out on three compounds **X**, **Y**, and **Z**.

**X****Y****Z**

A sample of 0.01 mol of each compound is heated under reflux with 50 cm³ of 1 mol dm⁻³ NaOH (in excess) until hydrolysis is complete and any ammonia produced is expelled from solution. The excess NaOH is then titrated in each case and is found to require 20 cm³, 30 cm³ and 40 cm³ of 1 mol dm⁻³ HCl for neutralisation.

Which sequence of compounds matches these results?

	20 cm ³	30 cm ³	40 cm ³
A	X	Y	Z
B	X	Z	Y
C	Y	Z	X
D	Z	Y	X

17. When 0.05 mol of an organic compound **M** was completely combusted in excess oxygen, it produced 0.20 mol of carbon dioxide and 0.20 mol of water. When **M** is heated with a few drops of acidified potassium dichromate, the solution remained orange in colour. Which of the following could be **M**?

- A** CH₃CH₂CH₂CH₃
B CH₃CH₂CH₂CH₂OH
C CH₃CH₂CH₂CHO
D CH₃CH₂CH₂COOH

18. An alkene, with a general formula of C_nH_{2n}, reacts with hot acidified potassium manganate(VII). The products of this reaction gave the following observations:

<i>test</i>	<i>observations</i>
2,4-dinitrophenylhydrazine	Orange ppt observed
Limewater	No white ppt observed

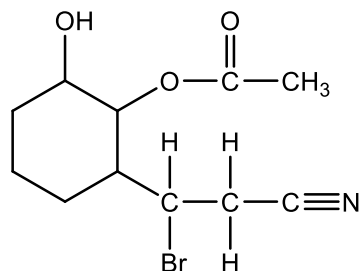
What is the **least** number of *n* for such an alkene?

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

19. In the hydrogenation of CH₂=CHCH₂CN using platinum catalyst, the volume of hydrogen (measured at s.t.p.) that reacts with 1 mole of the compound could be

- A** 22.7 dm³ **B** 24.0 dm³ **C** 45.4 dm³ **D** 68.1 dm³

20. 0.01 mol of compound **R** is refluxed with 50 cm³ of 1 mol dm⁻³ aqueous NaOH and all ammonia gas evolved is expelled. The resulting solution is subsequently titrated with 1 mol dm⁻³ H₂SO₄ solution.

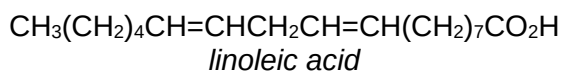
Compound **R**

What is the volume of H₂SO₄ required for complete neutralisation of the resulting solution?

- A.** 10 cm³ **B.** 20 cm³ **C.** 30 cm³ **D.** 40 cm³

Isomerism

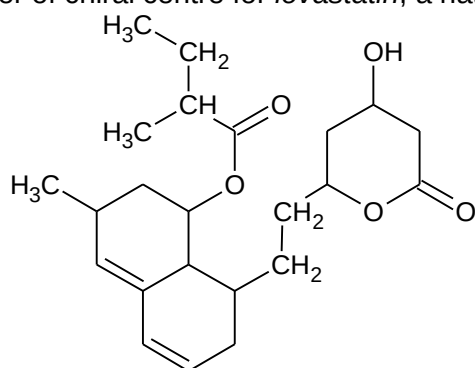
21. Low fat sunflower butter spreads are high in polyunsaturates, such as *linoleic acid* as shown below.



On the lid of a brand of spread, it is claimed that the spread contains virtually no *trans* fatty acids. Which isomer does **not** contain a *trans* linkage and could be present in the spread?

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

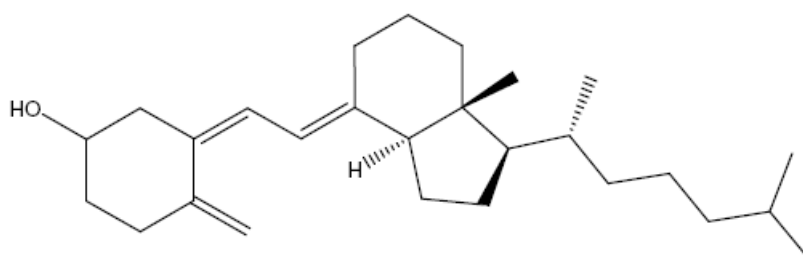
22. What is the total number of chiral centre for *lovastatin*, a naturally occurring compound?



lovastatin

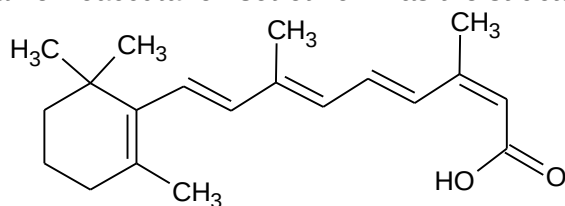
- A** 5 **B** 6 **C** 7 **D** 8

23. Cholecalciferol, Vitamin D3 has the structure shown below. It is generated in the skin when light energy is absorbed. How many stereoisomers does the molecule have?



- A** 2^5 **B** 2^6 **C** 2^7 **D** 2^8

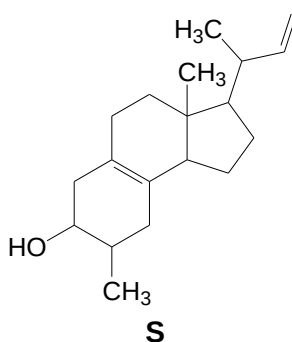
24. *Isotretinoin* is a medication commonly used in the treatment of severe acne and is marketed under the trade name *Roaccutane*. *Isotretinoin* has the structure shown below:



What is the total number of stereoisomers for *Isotretinoin*?

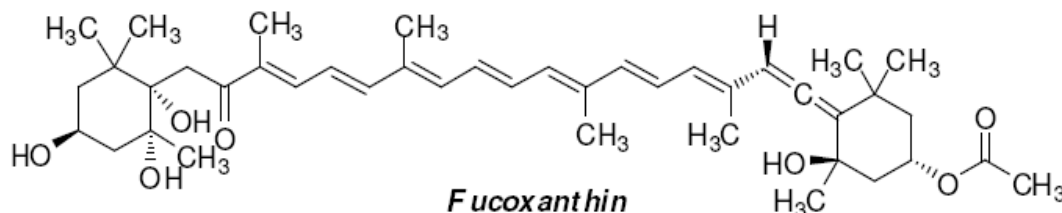
- A** 2^2 **B** 2^3 **C** 2^4 **D** 2^5

25. How many chiral centres are present in the **major** product formed when compound **S** undergoes a reaction with KBr and concentrated H_2SO_4 at high temperature?



A 6 **B** 7 **C** 8 **D** 9

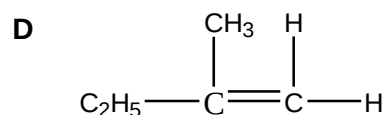
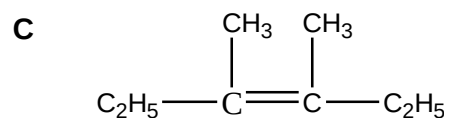
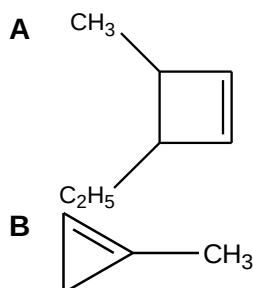
26. *Fucoxanthin* is a carotenoid which is found as an accessory pigment in the chloroplasts of brown algae and most other heterokonts, giving them a brown or olive-green color.



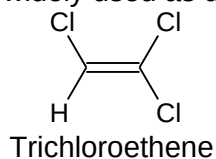
How many **new** chiral centers will be formed when fucoxanthin is *completely* hydrogenated over a palladium catalyst?

A 5 **B** 6 **C** 10 **D** 12

27. Compound **W** exhibits geometric isomerism. Upon reaction with hot acidified KMnO_4 , one of the products formed is butanone. Which of the following compounds could be Compound **W**?



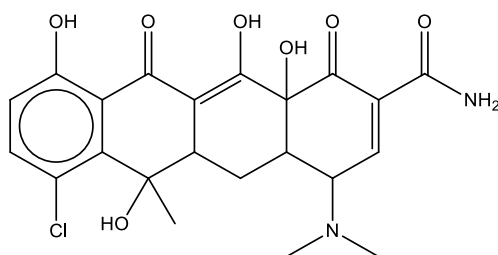
28. Trichloroethene is widely used as dry-cleaning agent.



Which of the following does trichloroethene react with to give a chiral product?

- A** Br_2
B HCl
C NaOH
D NaCN
29. Which one of the following alcohols on dehydration with hot concentrated sulfuric acid produces only one alkene that also displays *cis-trans* isomerism?
- A** pentan-1-ol
B pentan-2-ol
C pentan-3-ol
D butan-2-ol
30. Molecule Y contains only carbon, hydrogen and a single oxygen atom.
If Y is an aldehyde, what is the smallest number of carbon atoms needed for it to be chiral?
- | | | | |
|----------|---|----------|---|
| A | 4 | C | 6 |
| B | 5 | D | 9 |
31. Which of the following reagents would react with hydrogen cyanide to give an organic compound with a chiral centre?
- | | | | |
|----------|---|----------|---|
| A | $(\text{CH}_3)_2\text{CHCO}_2\text{CH}_3$ | C | CH_3COCH_3 |
| B | $(\text{CH}_3)_2\text{CHCHO}$ | D | $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$ |

32. *Aureomycin* is a powerful oral antibiotics that is effective against a wide range of infections.

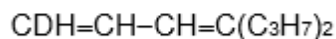


Aureomycin

Which row correctly indicates the number of chiral centres and sp^2 hybridised carbon in a molecule of *aureomycin*?

	Number of chiral centres	Number of sp^2 hybridised C
A	4	10
B	4	13
C	5	10
D	5	13

33. Deuterium (D or ^2H) is a heavy isotope of hydrogen. A deuterio-hydrocarbon has the part structural formula shown below.



What is the total number of isomers with the above part-structural formula?

- A** 2
- B** 4
- C** 8
- D** 10

34. Norcarane undergoes free radical substitution with limited bromine in the presence of ultraviolet light to form mono-brominated compound **Y**.



Norcarane

How many isomers of **Y** (including stereoisomers) will be formed at the end of the reaction?

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

35. An alcohol **M** with molecular formula $C_4H_{10}O$ is oxidised by acidified potassium dichromate(VI) under certain conditions to give **N**.

- **N** does not produce a yellow precipitate with aqueous alkaline iodine
- **N** gives a reddish brown precipitate when reacted with Fehling's solution

How many isomers of alcohol **M** could result in the observations for **N**?

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

Organic Reactions/Synthesis

36. Which of the following compounds:

- is unaffected by hot alkaline potassium manganate(VII) and
- gives hydrogen when treated with sodium?

- A $(CH_3)_2CHCOCH_3$
- B $(CH_3)_3COH$
- C $(CH_3)_2CHCH_2OH$
- D $CH_3CH_2CH(OH)CH_3$

37. Which of the following sets of starting materials may be used for the preparation of phenyl benzoate in the laboratory?

- A C_6H_5OH , C_6H_5COOH , $H_2SO_4(l)$
- B C_6H_5Cl , C_6H_5COCl
- C C_6H_5OH , C_6H_5COCl , $NaOH(aq)$
- D C_6H_5Cl , C_6H_5COCl , $NaOH(aq)$

38. A compound **R**, with molecular formula $C_9H_{10}O_2$, is heated under reflux with aqueous sodium hydroxide and the resulting mixture then cooled and acidified with dilute sulfuric acid. The final products include a compound that turns blue litmus solution red, and another which gives a purple colouration when tested with neutral aqueous iron(III) chloride. What could **R** be?

- A $C_6H_5OCOCH_2CH_3$
- B $C_6H_5CH_2OCOCH_3$
- C $C_6H_5OCH_2COCH_3$
- D $C_6H_5CH_2CH_2COOH$

39. Butanone, $\text{CH}_3\text{CH}_2\text{COCH}_3$, may be used as the starting point for synthesizing Compound **Z**, $\text{CH}_3\text{CH}=\text{C}(\text{COOH})\text{CH}_3$. Which is best process for producing compound **Z**?

- A** $\text{CH}_3\text{CH}_2\text{COCH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{C}(\text{OH})_2\text{CH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{C}(\text{OH})(\text{CN})\text{CH}_3 \rightarrow \text{Z}$
B $\text{CH}_3\text{CH}_2\text{COCH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{C}(\text{OH})(\text{CN})\text{CH}_3 \rightarrow \text{CH}_3\text{CH}=\text{C}(\text{CN})\text{CH}_3 \rightarrow \text{Z}$
C $\text{CH}_3\text{CH}_2\text{COCH}_3 \rightarrow \text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3 \rightarrow \text{CH}_3\text{CH}=\text{C}(\text{CN})\text{CH}_3 \rightarrow \text{Z}$
D $\text{CH}_3\text{CH}_2\text{COCH}_3 \rightarrow \text{CH}_3\text{CH}=\text{C}(\text{OH})\text{CH}_3 \rightarrow \text{CH}_3\text{CH}=\text{C}(\text{CN})\text{CH}_3 \rightarrow \text{Z}$

40. An alcohol with molecular formula $C_nH_{2n+1}OH$ has a chiral carbon atom but does not react with MnO_4^- / H^+ . What is the least number of carbon atoms such an alcohol could possess?

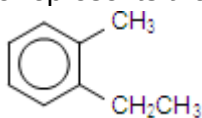
- | | | | |
|----------|---|----------|---|
| A | 5 | C | 7 |
| B | 6 | D | 8 |

41. An ester **Y** is boiled with aqueous hydrochloric acid and the resulting mixture is cooled. The final products include a compound $C_4H_8O_2$ which gives a pale yellow precipitate with alkaline aqueous iodine.

Which formula could represent Y?

- A** $\text{CH}_3\text{OCOCH}_2\text{CH}_2\text{CH}_3$
B $\text{C}_6\text{H}_5\text{CO}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$
C $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_2\text{COCH}_3$
D $\text{C}_6\text{H}_5\text{CO}_2\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{OH}$

42. Which of the following formulae represents the organic compound formed



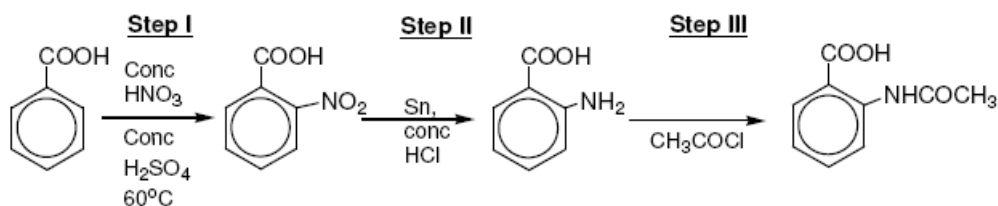
when the aromatic compound  is heated under reflux with alkaline potassium manganate(VII) solution and the mixture is then acidified with H_2SO_4

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

43. A compound Y, $C_8H_{10}O$, gives compound Z, C_8H_8O , on oxidation. Both Y and Z give a yellow precipitate on warming with aqueous alkaline iodine. Which of the following could be Y?

A 2,4-dimethylphenol
B 3-ethylphenol
C 1-phenylethanol
D 2-phenylethanol

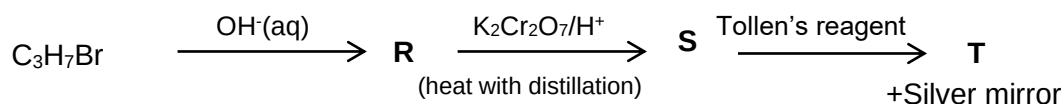
44. The following shows a series of reaction starting from benzoic acid.



Which of the step(s) will lead to an unsuccessful synthesis?

A I only
B II only
C II and III only
D I and II only

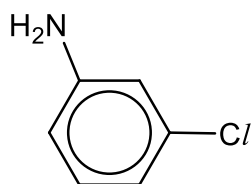
45. The compound C_3H_7Br undergoes a sequence of reactions as follows:



What could be the formulae for **R**, **S** and **T** respectively?

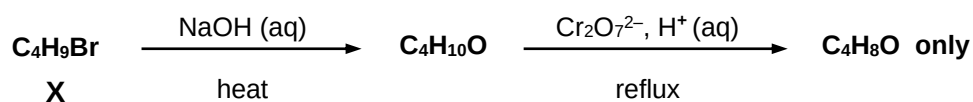
	R	S	T
A	$CH_3CH_2CH_2OH$	CH_3CH_2COOH	CH_3CH_2CHO
B	$CH_3CH_2CH_2OH$	$CH_3CH(OH)CH_2OH$	CH_3COOH
C	$CH_3CH_2CH_2OH$	CH_3CH_2CHO	$CH_3CH_2COO^-$
D	$CH_3CH(OH)CH_3$	CH_3COCH_3	CH_3COOH

46. Which of the methods would you choose for the synthesis of the compound shown below starting from benzene?



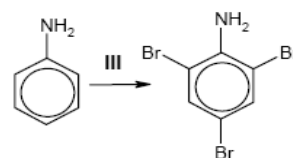
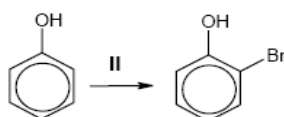
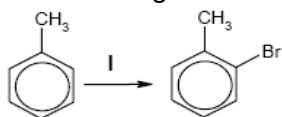
	<u>First step</u>	<u>Second step</u>	<u>Third step</u>
A	Nitration	Chlorination	Reduction
B	Nitration	Reduction	Chlorination
C	Oxidation	Chlorination	Nitration
D	Chlorination	Nitration	Oxidation

47. Compound X, C_4H_9Br , undergoes the following reactions:



What is X likely to be?

- A** 1-bromobutane
B 2-bromobutane
C 1-bromo-2-methylpropane
D 2-bromo-2-methylpropane
48. Methylbenzene, phenol and phenylamine all undergo electrophilic substitution with suitable reagents.



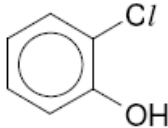
Which of the following could the reagents be?

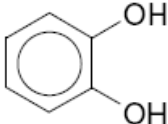
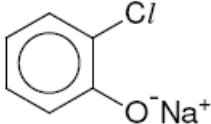
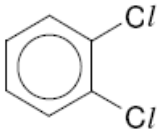
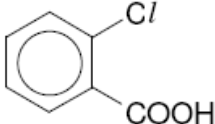
	I	II	III
A	Br_2, Fe	Br_2 in CCl_4	$Br_2(aq)$
B	$Br_2, FeBr_3$	$Br_2(aq)$	Br_2 in CCl_4
C	$Br_2(aq)$	Br_2 in CCl_4	Br_2, Fe
D	Br_2 in CCl_4	$Br_2, FeBr_3$	$Br_2(aq)$

49. What will be observed when the following compounds are added to hot acidified potassium manganate(VII)?

	C₆H₅CH₃	CH₃CH=CH₂	CH₃CH₂CH₂Cl
A	Solution turns colourless. No effervescence.	Solution turns colourless. Effervescence occurs.	Solution remains purple. No effervescence.
B	Solution remains purple. No effervescence.	Solution turns colourless. Effervescence occurs.	Solution turns colourless. No effervescence.
C	Solution turns colourless. Effervescence occurs.	Solution remains purple. No effervescence.	Solution remains purple. Effervescence occurs.
D	Solution remains purple. Effervescence occurs.	Solution remains purple. Effervescence occurs.	Solution turns colourless. No effervescence.

50.

The compound  reacts with

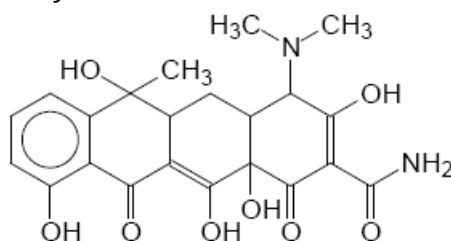
- A** hot HCl(aq) to form 
- B** NaOH(aq) to form 
- C** HCl in CCl₄ to form 
- D** hot acidic KMnO₄ to form 

51. When an organic compound Q was treated with phosphorus pentachloride, fumes of hydrogen chloride were evolved. When Q was warmed with alkaline aqueous iodine, a yellow precipitate was formed.

Which of the following was Q?

- A CH_3COOH
- B $\text{CH}_3\text{COCH}_2\text{CH}_3$
- C $(\text{CH}_3)_3\text{COH}$
- D $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_3$

52. The anti-bacterial drug *tetracycline* has the structural formula shown below:

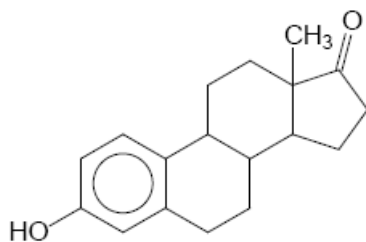


Which statement about *tetracycline* is correct?

- A It does not react with SOCl_2 .
 - B It reacts with sodium carbonate to liberate carbon dioxide gas.
 - C 3 moles of HBr is formed when 1 mole of *tetracycline* reacts in an excess of aqueous bromine in the dark.
 - D It reacts with sodium metal to liberate H_2 gas.
53. Concentrated ammonia was heated in a seal tube with excess 1-bromopropane ($\text{C}_3\text{H}_7\text{Br}$). Which one of the following products is unlikely to be present at the end of the reaction?
- A $\text{C}_3\text{H}_9\text{N}$
 - B $\text{C}_6\text{H}_{15}\text{N}$
 - C $\text{C}_9\text{H}_{21}\text{N}$
 - D $\text{C}_{12}\text{H}_{28}\text{N}^+\text{Br}^-$
54. By heating X in a sealed tube with ammonia, a primary amine can be obtained. The same primary amine can also be prepared by reduction of Y. Which pair of X and Y would give the same primary amine?

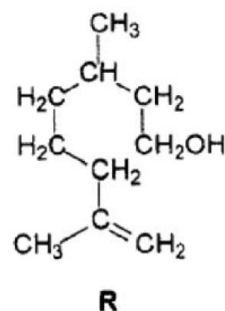
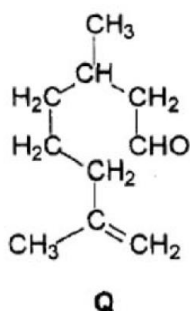
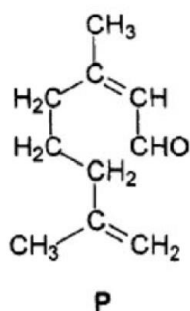
	X	Y
A	$\text{Cl}_2\text{CHCH}_2\text{Cl}$	$\text{HOCH}_2\text{CH}_2\text{CN}$
B	$\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{Br}$	$\text{C}_6\text{H}_5\text{CH}_2\text{CH}_2\text{CN}$
C	$(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{Cl}$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CN}$
D	$\text{HOCH}_2\text{C}(\text{CH}_3)_2\text{CH}_2\text{Br}$	$\text{HOCH}_2\text{C}(\text{CH}_3)_2\text{CN}$

55. *Oestrone*, a sex hormone, has the following structural formula.



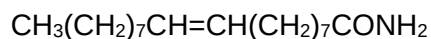
Which reagent would be expected to react with this compound?

- A lithium aluminium hydride
 - B concentrated sulfuric acid
 - C alkaline aqueous iodine
 - D acidified potassium dichromate(VI)
56. The three compounds **P**, **Q**, and **R** shown below are important flavours in citrus fruits. These compounds are often used in the food and perfume industries.



Which of the following statements concerning **P**, **Q** and **R** is true?

- A **Q** and **R** exhibit stereoisomerism but **P** does not.
 - B Reaction of **P** with hot, acidified KMnO_4 gives two organic products.
 - C **R** can be distinguished from **P** and **Q** by using phosphorus pentachloride.
 - D **P** can be converted to **R** using lithium aluminium hydride in dry ether.
57. A 'sleep factor', isolated from animal tissues, acts as a signal to the brain that it is time to sleep. It has been identified as **cis-octadec-9-enoamide**.



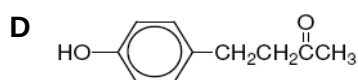
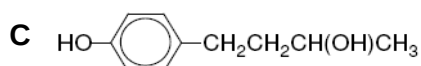
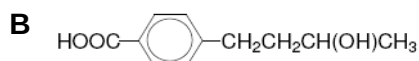
Which reagent would **not** readily destroy this molecule?

- A Dilute potassium manganate(VII)
- B Hydrogen with platinum catalyst
- C Alkaline Ag^+ ammonia complex
- D Hot aqueous sodium hydroxide

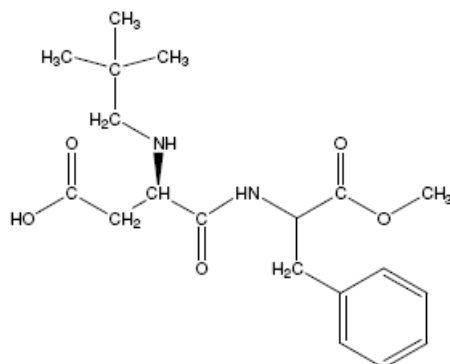
58. Compound **Z** gives the following observations when reacted with the specific reagents.

- (i) Decolourises aqueous bromine
- (ii) Forms yellow precipitate with alkaline aqueous iodine
- (iii) One mole of **Z** liberates one mole of hydrogen gas when two moles of sodium is added

What could Compound **Z** be?



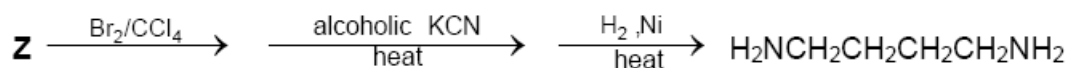
59. Neotame is an artificial sweetener made by NutraSweet that is between 8,000 and 13,000 times sweeter than sucrose.



Which of the following is true about neotame?

- A** It is optically inactive.
- B** It can exist as a zwitterion in solution.
- C** Two products are obtained upon heating with aqueous sodium hydroxide.
- D** It decolorizes aqueous bromine in the absence of light.

60. An organic compound **Z** undergoes the following successive reactions:

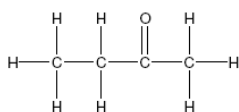


Which of the following compounds is **Z** likely to be?

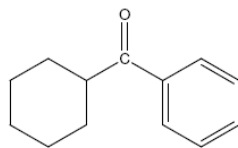
- A** $\text{CH}_3\text{CH}=\text{CHCH}_3$
- C** $\text{CH}_2=\text{CHCH}=\text{CH}_2$

- B** $\text{CH}_2=\text{CH}_2$
- D** $\text{C}/\text{CH}=\text{CHC}/$

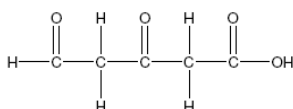
61. Which of the following compounds would react with H_2 in the presence of Pt catalyst at high temperature and pressure to produce a compound which is optically active?



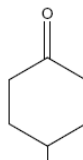
(i)



(ii)



(iii)

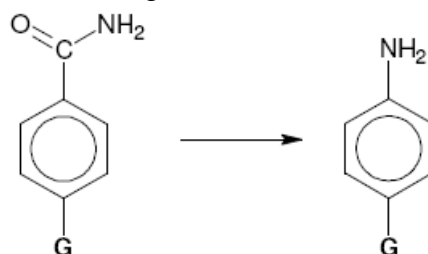


(iv)

- A (i) only
 B (i) and (iv) only
 C (i), (ii) and (iii) only
 D (i), (ii), (iii) and (iv)
62. The Hofmann degradation is the organic reaction where a primary amide is converted into a primary amine with one fewer carbon atom. An example is shown below:



When the R group is an aryl group, the rate of the Hofmann degradation is dependent on the substituent in the aromatic ring.



It is found that this reaction proceeded faster when the substituent **G** is a methyl group as compared to a bromine group.

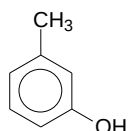
Which of the following substituents (in place of **G**) would result in the fastest rate of Hofmann degradation?

- A Cl B H C NO_2 D OCH_2CH_3

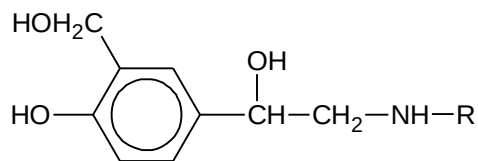
63. Which of the following compounds:
 (i) does **not** decolourise hot acidified $\text{KMnO}_4(\text{aq})$ and
 (ii) gives a salt when reacted with $\text{NaOH}(\text{aq})$?

- A $\text{CH}_3\text{CO}_2\text{CH}_2\text{CO}_2\text{H}$
 B $\text{CH}_2(\text{OH})\text{COCH}_2\text{CO}_2\text{H}$
 C $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{COOH}$

D



64. Salbutamol, with structure shown below, is used in *Ventolin* inhalers to help asthma sufferers breathe more easily.

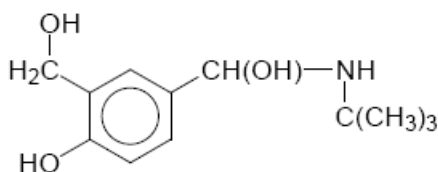


R is an alkyl group, which for the purpose of this question does not affect the rest of the molecule.

How many mole(s) of ethanoyl chloride would react with one mole of Salbutamol?

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

65. Salbutamol is used as a temporary relief of bronchospasm in asthmatic patients.

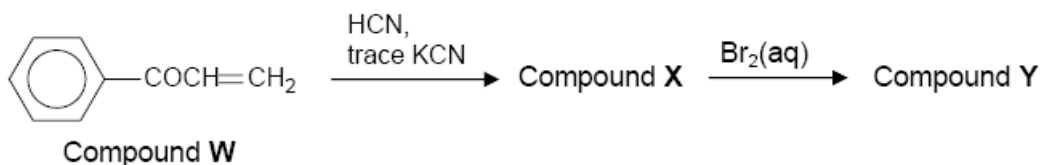


Salbutamol

Which deduction about Salbutamol can be made from this structure?

- A** 1 mole of Salbutamol reacts with 4 moles of dilute HNO_3 .
B The product of oxidation with acidified potassium manganate(VII) gives a red brown precipitate with Fehlings' solution.
C It undergoes dehydration with Al_2O_3 to form an alkene.
D It turns reddish brown bromine solution colourless.

66. Compound **W** was used in the following synthesis route.



What are the numbers of sp , sp^2 and sp^3 hybridised carbon atoms in compound **Y**?

- A** 0, 6, 4 **B** 0, 7, 3
C 1, 6, 3 **D** 1, 7, 2

67. Which pairs of reactions could have the same common intermediate?



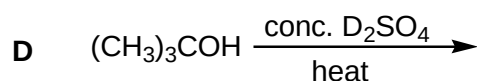
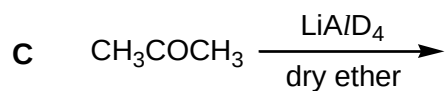
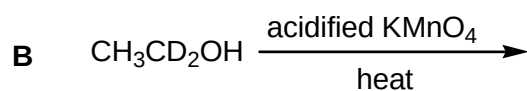
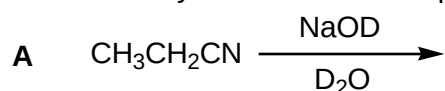
A E and F

B E and G

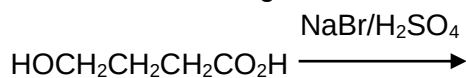
C E and H

D H and G

68. Which reaction yields a carbon compound incorporating deuterium, D? [D = ^2H]



69. What is the product of the following reaction?



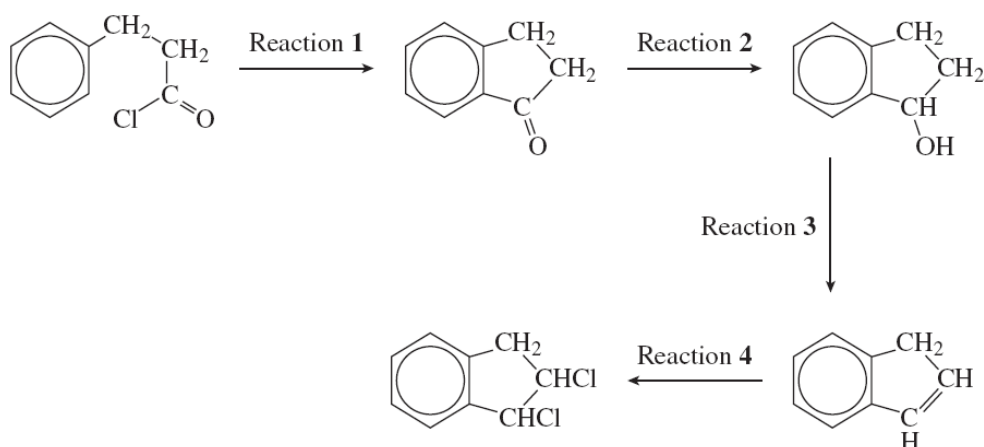
A $\text{BrCH}_2\text{CH}_2\text{CH}_2\text{COBr}$

B $\text{BrCH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$

C $\text{CH}_2=\text{CHCH}_2\text{CO}_2\text{H}$

D $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{COBr}$

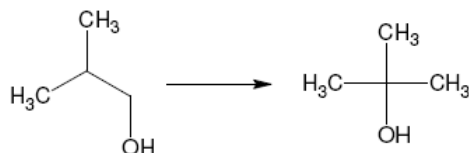
70. A sequence of reactions is shown below.



A correct list of substances for the sequence is

	<u>Reaction 1</u>	<u>Reaction 2</u>	<u>Reaction 3</u>	<u>Reaction 4</u>
A	CH_3COCl	NaBH_4	Conc. H_2SO_4	Cl_2
B	AlCl_3	HCl	NaOH	Cl_2
C	AlCl_3	NaBH_4	Conc. H_2SO_4	HCl
D	AlCl_3	NaBH_4	Conc. H_2SO_4	Cl_2

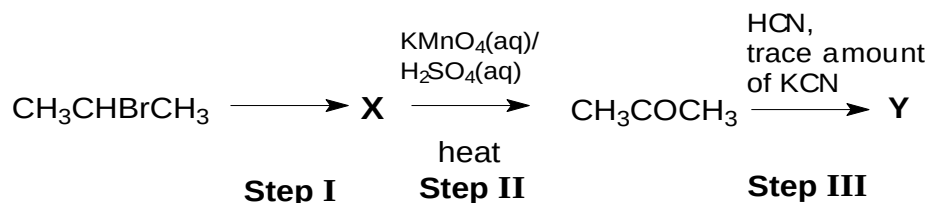
71. 2-methylpropan-1-ol can be converted into 2-methylpropan-2-ol as follows:



Which of the following sequences may be used for the conversion?

- A** Alcoholic KCN; Dilute H_2SO_4 , reflux
- B** Concentrated H_2SO_4 ; cold alkaline KMnO_4
- C** Al_2O_3 with heating; H_2O with H_3PO_4 at high temperature and pressure
- D** Alcoholic NaOH ; H_2O with H_3PO_4 at high temperature and pressure

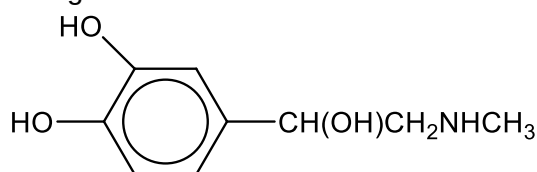
72. The reaction scheme below shows the formation of compound **Y**:



The reagent and condition required in **step I** and the structure of **Y** are:

	Reagent and condition in Step I	Structure of Y
A	aqueous KOH, heat	$(\text{CH}_3)_2\text{C}(\text{OH})\text{CN}$
B	alcoholic KOH, heat	$(\text{CH}_3)_2\text{C}(\text{OH})\text{CN}$
C	alcoholic KOH, heat	$(\text{CH}_3)_2\text{CHCN}$
D	aqueous KOH, heat	$(\text{CH}_3)_2\text{CHCN}$

73. Adrenaline has the following structure.



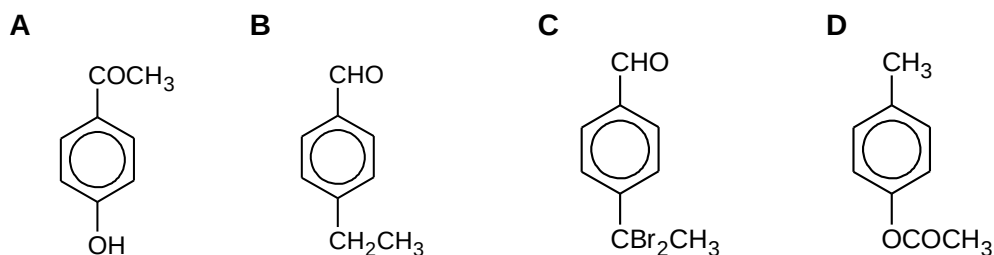
What reacts completely with 1 mol of adrenaline?

- | | |
|---------------------------------------|---|
| A 2 mole of Br_2 (aq) | B 3 mole of PCl_5 |
| C 3 mole of NaOH | D 4 mole of CH_3COCl |

74. Compound **X**

- can react with 2,4-dinitrophenylhydrazine,
- does not react with Fehling's solution,
- can be oxidized to benzene-1,4-dicarboxylic acid.

What could **X** be?



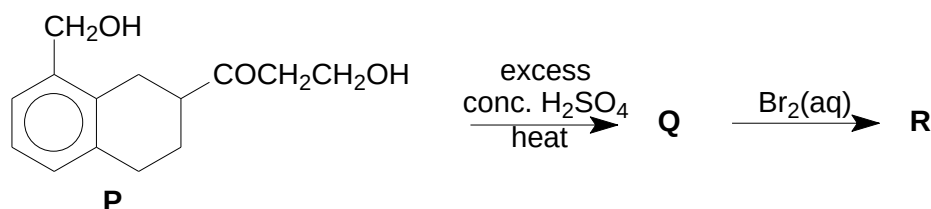
75. Which compound **cannot** be made from pent-1-ene in 3 steps or less?

- A pent-2-ene
- B propan-1-ol
- C butanal
- D 2-methylpentanoic acid

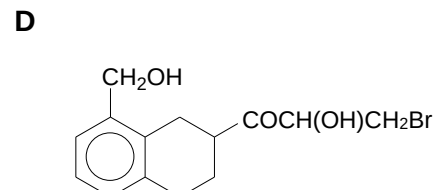
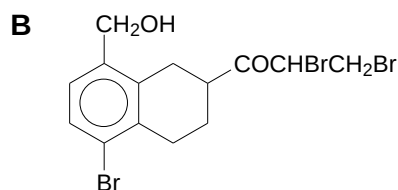
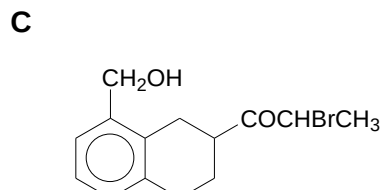
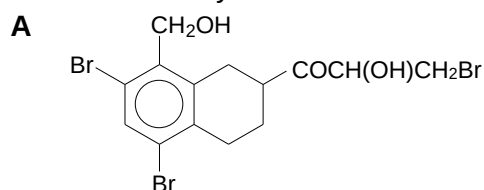
76. 1,2-dibromo-3-chloropropane (DBCP) has been used in the control of earthworms in agricultural land. Which of the following would be the best synthesis of this compound?

- A $\text{CH}_2=\text{CHCH}_2\text{Cl} + \text{Br}_2 \rightarrow \text{DBCP}$
- B $\text{CH}_3\text{CHBrCH}_2\text{Br} + \text{Cl}_2 \rightarrow \text{DBCP} + \text{HCl}$
- C $\text{CH}_2=\text{CHCHBr}_2 + \text{HCl} \rightarrow \text{DBCP}$
- D $\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl} + 2\text{Br}_2 \rightarrow \text{DBCP} + \text{HBr}$

77. Compound **P** is used in the following synthesis.



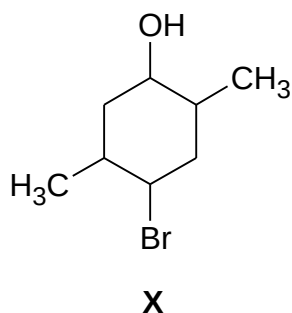
What is the likely structure of the final product **R**?



78. In the preparation of ethene, ethanol is added a drop at a time to heated reagent **Y**. The impure ethene is washed by being bubbled through a solution **Z** and then collected. What are the reagent **Y** and solution **Z** likely to be?

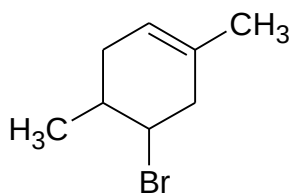
- | Reagent Y | solution Z |
|--|--------------------------------|
| A acidified $\text{K}_2\text{Cr}_2\text{O}_7$ | dilute NaOH |
| B acidified $\text{K}_2\text{Cr}_2\text{O}_7$ | dilute H_2SO_4 |
| C concentrated H_2SO_4 | dilute NaOH |
| D concentrated H_2SO_4 | dilute H_2SO_4 |

79. The compound **X** was heated with ethanolic potassium hydroxide.

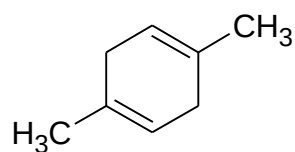


Which of the following would be the major product?

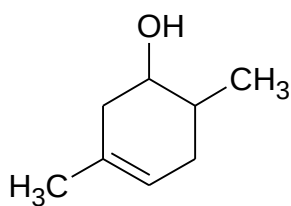
A



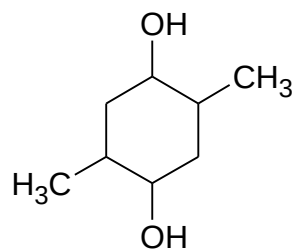
B



C

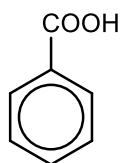


D

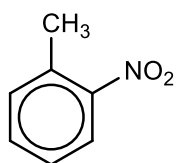


80. Which one of the following **cannot** be made directly from methylbenzene?

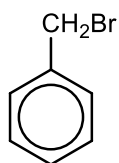
A



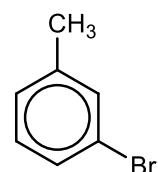
B



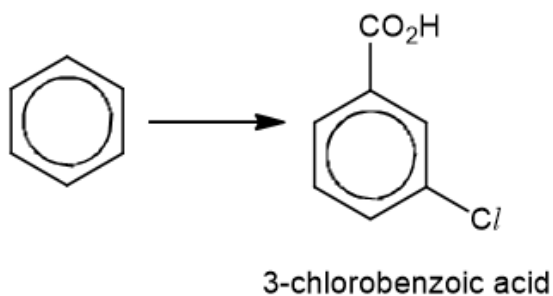
C



D



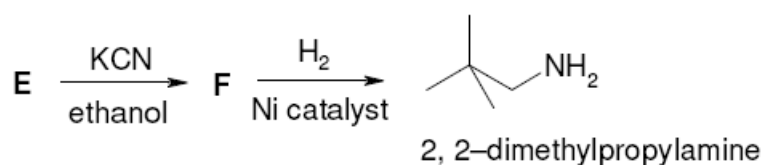
81. 3-chlorobenzoic acid can be synthesized from benzene in three steps.



Which of the following is the best method for this synthesis?

	Step 1	Step 2	Step 3
A	$\text{Cl}_2, \text{AlCl}_3$	$\text{CH}_3\text{Cl}, \text{AlCl}_3$	$\text{KMnO}_4, \text{H}_2\text{SO}_4$
B	$\text{Cl}_2, \text{AlCl}_3$	$\text{KMnO}_4, \text{H}_2\text{SO}_4$	$\text{CH}_3\text{Cl}, \text{AlCl}_3$
C	$\text{CH}_3\text{Cl}, \text{AlCl}_3$	$\text{KMnO}_4, \text{H}_2\text{SO}_4$	$\text{Cl}_2, \text{AlCl}_3$
D	$\text{CH}_3\text{Cl}, \text{AlCl}_3$	$\text{Cl}_2, \text{AlCl}_3$	$\text{KMnO}_4, \text{H}_2\text{SO}_4$

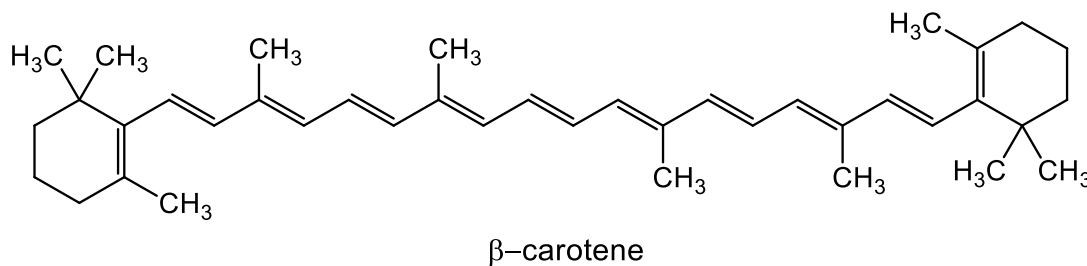
82. 2, 2-dimethylpropylamine can be produced by this reaction scheme starting with compound **E**.



Which one of the following structures represents **E**?

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

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

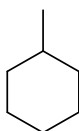


β -carotene is oxidised by hot, concentrated, acidified KMnO_4 .

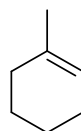
How many different products formed from the above reaction contain the ketone functional group?

- A** 2 **B** 4 **C** 6 **D** 8

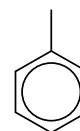
84. Which of the statements are true regarding the three compounds below?



I



II

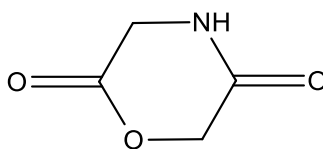


III

- 1 Compounds **I** and **III** will not decolourise Br_2 in CCl_4 .
- 2 Compounds **I** and **II** will decolourise acidified KMnO_4 at 298 K.
- 3 Compound **III** will not react with chlorine in the presence of uv light.
- 4 Compound **III** will react with bromine in the presence of a homogeneous catalyst.

- A** 1 and 4 only
- B** 2 and 3 only
- C** 1, 3 and 4 only
- D** 1, 2, 3 and 4

85. The cyclic compound **X** is heated with acidified KMnO_4 .

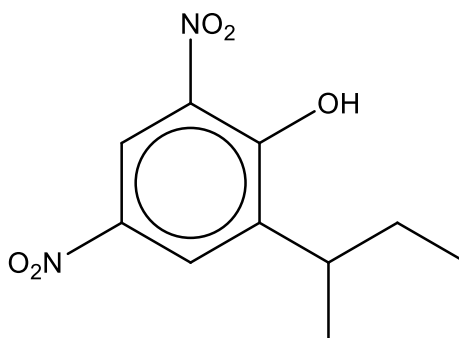


Compound **X**

What are the final organic products of the reaction?

- A** $\text{HOCH}_2\text{CO}_2\text{H}$ and $\text{HO}_2\text{CCH}_2\text{NH}_3^+$
- B** $\text{HO}_2\text{CCH}_2\text{NH}_3^+$
- C** HOCH_2CHO and $\text{H}_2\text{NCH}_2\text{CO}_2\text{H}$
- D** $\text{H}_2\text{NCOCH}_2\text{OH}$ and HOCH_2CHO

86. *Binapacryl* is used as a fungicide.

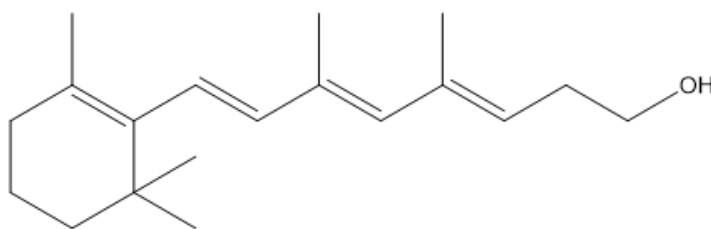


Binapacryl

Which of the following statements about *Binapacryl* are correct?

- 1 It dissolves in water to give a neutral solution.
 - 2 It is inert towards acidified potassium dichromate(VI) solution.
 - 3 It decolourises aqueous bromine to form a white precipitate.
 - 4 It reacts with ethanoic acid in the presence of concentrated sulfuric acid to form an ester.
-
- A** 2 only
 - B** 2 and 3 only
 - C** 1 and 4 only
 - D** 1, 2, 3 and 4 only

87. The structure of Vitamin A is shown below.



Vitamin A

Which of the following statements about Vitamin A is true?

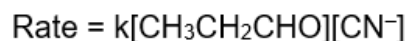
- A** White fumes is observed when it is treated with excess ethanoyl chloride.
 - B** When it reacts completely with LiAlH_4 in dry ether, a saturated compound that contains 4 chiral carbon centres is produced.
 - C** Effervescence is observed when it reacts with hot alkaline potassium manganate(VII) solution.
 - D** 1 mol of Vitamin A reacts with excess sodium metal to produce 22.7 dm^3 of hydrogen gas at 273 K and 1 bar.
88. An optically active sample of 2-chlorobutane, $\text{CH}_3\text{CH}_2\text{CHClCH}_3$, was heated under reflux with aqueous sodium hydroxide to produce compound **Q**, which rotates plane of polarised light.

Which of the following statements about the reaction are correct?

- 1** The reaction occurred via a $\text{S}_{\text{N}}1$ mechanism.
- 2** $\text{CH}_3\text{CH}_2\text{CH}_2\text{OCH}_3$ is a functional group isomer of **Q**.
- 3** The rate of reaction increases when the sample is replaced with 2-bromobutane.
- 4** **Q** reacts with concentrated sulfuric acid at 170°C to give a mixture of three isomeric alkenes.

- A** 1 and 3 only
- B** 2 and 3 only
- C** 2 and 4 only
- D** 2, 3 and 4 only

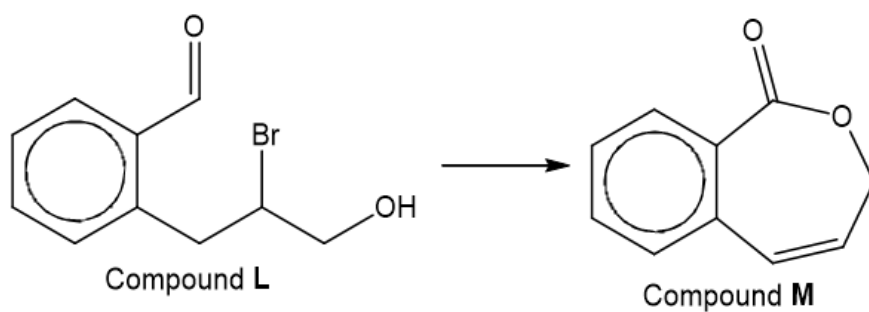
89. The uncatalysed reaction between propanal and HCN proceeds via two steps and the rate equation for the formation of cyanohydrin is as follows.



Which of the following statements is correct?

- A** The intermediate formed in this reaction is planar.
- B** An optically active product is obtained.
- C** The uncatalysed reaction between propanone and HCN occurs at a faster rate than that of propanal.
- D** The same product can be obtained by heating 1-chloropropan-1-ol with ethanolic NaCN.
90. ^{18}O is an isotope of oxygen.
- When butyl ethanoate is hydrolysed with dilute sulfuric acid in the presence of H_2^{18}O , a mixture of 2 products is formed. Which of the following pairs gives the correct structures of the two products?
- A** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CO}^{18}\text{OH}$
- B** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2^{18}\text{OH}$ and $\text{CH}_3\text{CO}_2\text{H}$
- C** $\text{CH}_3\text{CH}_2\text{OH}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}^{18}\text{OH}$
- D** $\text{CH}_3\text{CH}_2^{18}\text{OH}$ and $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$

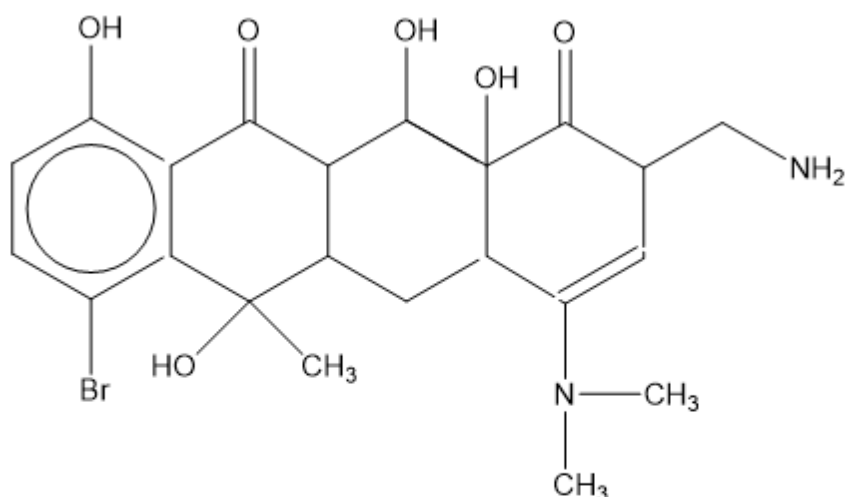
91.



Which of the following sequence of reagents and conditions can be used to carry out the conversion above?

	Stage 1	Stage 2	Stage 3
A	warm with ammonical silver nitrate solution	hot NaOH(aq)	heat in the presence of concentrated H ₂ SO ₄
B	warm with Fehling's solution	heat in the presence of concentrated H ₂ SO ₄	hot NaOH(aq)
C	warm with ammonical silver nitrate solution	hot NaOH(alc)	heat in the presence of concentrated H ₂ SO ₄
D	warm with Fehling's solution	heat in the presence of concentrated H ₂ SO ₄	hot NaOH(alc)

92. Compound **X** is an isomer of the antibiotic *Aureomycin*.



Compound **X**

Which of the following statements are true for compound **X**?

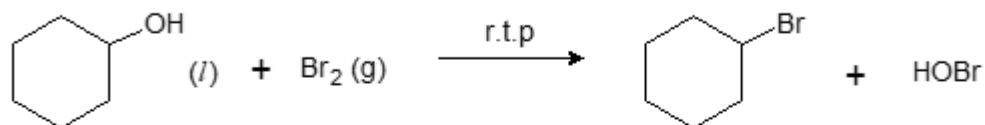
- 1 mole of **X** reacts with 5 moles of propanoyl chloride.
- 1 mole of compound **X** reacts with 3 moles of hydrogen gas in the presence of Ni catalyst at 150°C .
- 1 mole of compound **X** reacts with 6 moles of $\text{HBr}(\text{g})$ at room temperature.

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

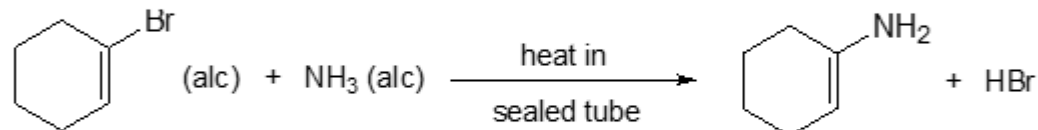
93. Which reaction gives the best yield of products?

[(alc) indicates an alcoholic solution.]

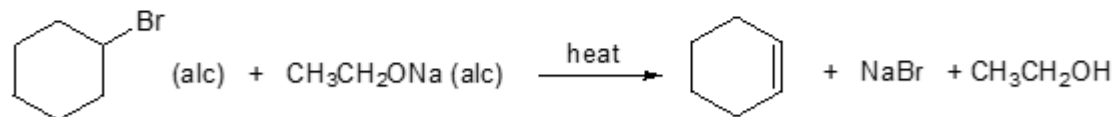
A



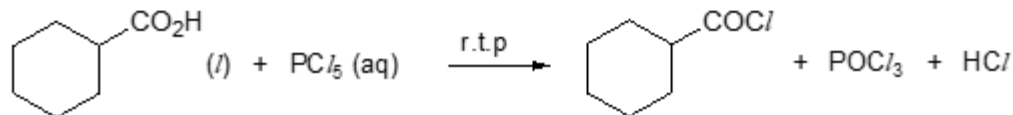
B



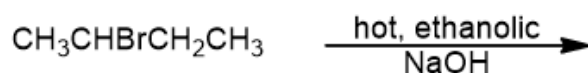
C



D



94. The following reaction gives a mixture of organic products.



Which of the following statements are true?

- 1 The minor organic product formed is an alcohol.
- 2 The predominant type of reaction occurring is nucleophilic substitution.
- 3 There is a pair of cis-trans isomers among the organic products.

A 1, 2 and 3

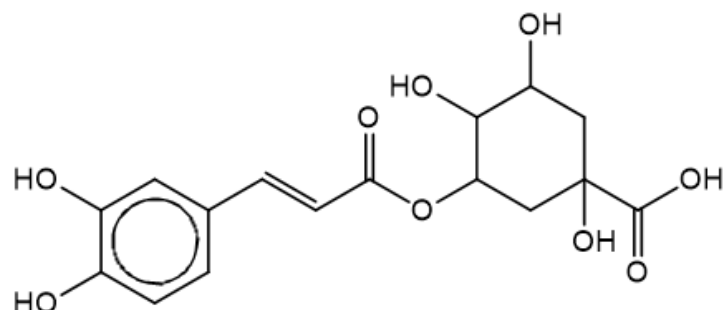
B 1 and 3 only

C 2 and 3 only

D 3 only

95. Chlorogenic acids account for up to 8% of the composition of unroasted coffee beans. More than 40 different varieties have been identified in green coffee beans, with 5-caffeoylquinic acid being the most prevalent.

The structure of 5-caffeoylquinic acid is shown below.

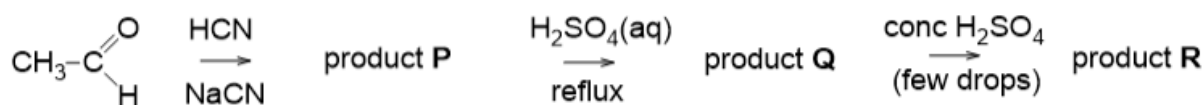


5-caffeoylquinic acid

How many moles of aqueous sodium hydroxide, sodium hydrogencarbonate and phosphorus(V) chloride will react with one mole of 5-caffeoylquinic acid at room temperature?

	NaOH(aq)	NaHCO ₃ (aq)	PCl ₅ (s)
A	6	3	6
B	5	1	3
C	4	3	4
D	3	1	4

96. Ethanal, CH₃CHO, is used to make product **R** in a three-stage synthesis.



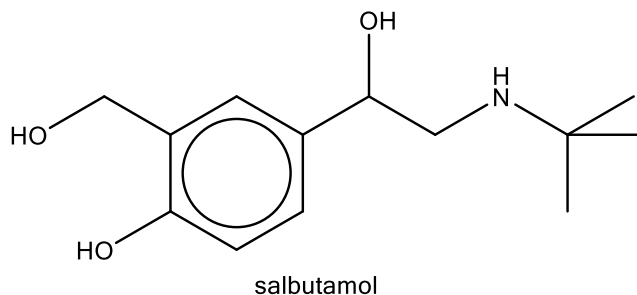
Two molecules of **Q** react to give one molecule of **R** plus two molecules of water.

R does not react with sodium.

What is the molecular formula and empirical formula of **R**?

	Molecular formula	Empirical formula
A	C ₃ H ₄ O ₂	C ₃ H ₄ O ₂
B	C ₆ H ₈ O ₄	C ₃ H ₄ O ₂
C	C ₃ H ₅ O ₂	C ₃ H ₅ O ₂
D	C ₆ H ₁₀ O ₅	C ₆ H ₁₀ O ₅

97. Salbutamol is a common medicine used to alleviate asthma attacks.



Which statement about 1 mol of salbutamol is **incorrect**?

- A** It reacts with 4 mol of ethanoyl chloride, CH_3COCl , to form 3 ester and 1 amide group.
- B** It reacts with excess acidified $\text{K}_2\text{Cr}_2\text{O}_7(\text{aq})$ to form 1 carboxylic acid and 1 ketone group.
- C** It reacts with 3 mol of sodium metal.
- D** It reacts with 2 mol of $\text{NaOH}(\text{aq})$.
98. A compound **T** is boiled with aqueous sodium hydroxide and the resulting mixture cooled and acidified. The final product includes a compound $\text{C}_3\text{H}_6\text{O}_2$ and an alcohol that gives a positive iodoform test.

Which formula could represent compound **T**?

- A** $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}_2\text{Cl}$
- B** $\text{CH}_3\text{CH}_2\text{OCOCH}_3$
- C** $\text{CH}_3\text{OCOCH}_2\text{COCH}_3$
- D** $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_2\text{CH}(\text{Cl})\text{CH}_3$
99. Which of the following compounds cannot be turned into a carboxylic acid in a single reaction?

- | | |
|--|---|
| A $\text{C}_6\text{H}_5\text{COCl}$ | B $\text{CH}_2=\text{CHCH}(\text{CH}_3)_2$ |
| C $(\text{CH}_3)_2\text{CHCl}$ | D $\text{CH}_3\text{CH}_2\text{CN}$ |

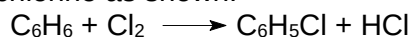
100. Compound **Z**, $(\text{CH}_3)_2\text{NCO}(\text{CH}_2)_9\text{CH}_3$, is being studied as a mosquito repellent.

Which pair of compounds would produce **Z** when reacted together?

- | | |
|--|---|
| A $(\text{CH}_3)_2\text{NH}$ and $\text{CH}_3(\text{CH}_2)_9\text{COCl}$ | B $(\text{CH}_3)_2\text{NH}$ and $\text{CH}_3(\text{CH}_2)_9\text{CO}_2\text{H}$ |
| C $(\text{CH}_3)_2\text{NCl}$ and $\text{CH}_3(\text{CH}_2)_9\text{CO}_2\text{H}$ | D $(\text{CH}_3)_2\text{COCl}$ and $\text{CH}_3(\text{CH}_2)_9\text{NH}_2$ |

Organic Reaction Mechanism

101. Benzene reacts with chlorine as shown:



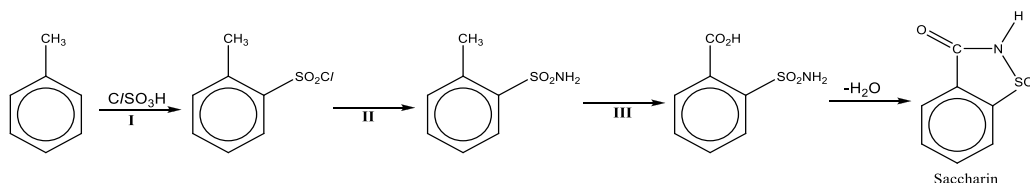
Which term describes this type of reaction?

- A Free radical substitution
- B Electrophilic substitution
- C Electrophilic addition
- D Nucleophilic addition

102. Which is a possible propagation step in the reaction of chlorine with cyclohexane in the presence of uv light?

- A  + Cl• →  + HCl
- B  + Cl• →  + H•
- C  + Cl• →  + Cl
- D $\text{Cl}_2 \rightarrow 2 \text{Cl}^\bullet$

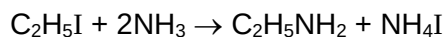
103. Saccharin is a low-calorie artificial sweetener manufactured from methylbenzene by the following series of reactions:



Which of the following best describes reactions I, II and III?

- | | I | II | III |
|---|----------------------------|----------------------------|------------|
| A | nucleophilic substitution | electrophilic addition | oxidation |
| B | nucleophilic addition | electrophilic substitution | hydrolysis |
| C | electrophilic addition | nucleophilic addition | hydrolysis |
| D | electrophilic substitution | nucleophilic substitution | Oxidation |

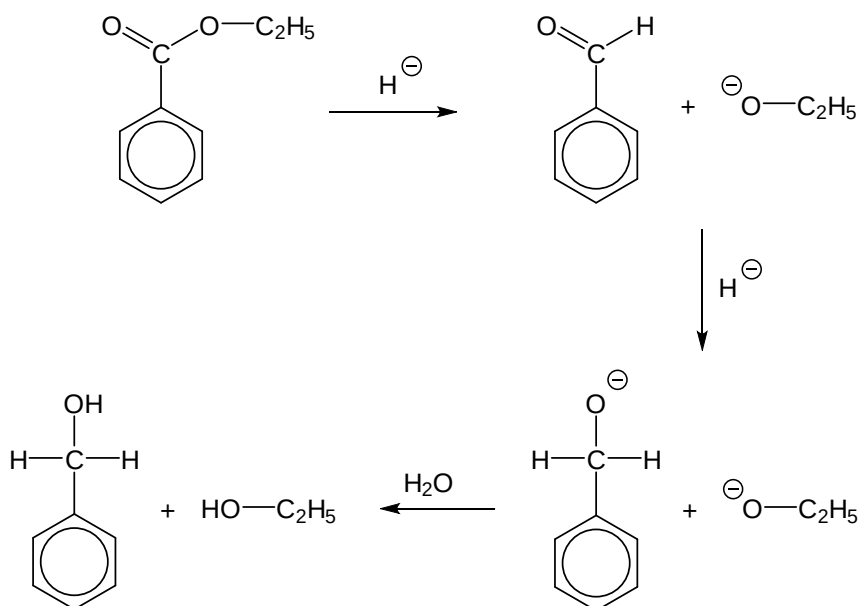
104. An amine is produced in the following reaction.



What is the reaction mechanism involved?

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

105. Esters can be converted to alcohols using lithium aluminium hydride followed by the addition of water.



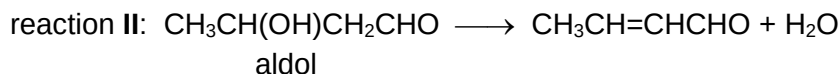
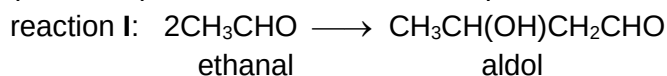
Which of the following reaction does **not** occur in this process?

- A condensation
- B acid-base reaction
- C nucleophilic addition
- D nucleophilic substitution

106. Ethane reacts with chlorine gas in the presence of ultraviolet light to form a mixture of products via free radical substitution. Which statement is **correct** about this reaction?

- A Homolytic fission occurs only at initiation step.
- B Butane is present in small quantities in the product mixture.
- C Bond formation occurs only in the termination step.
- D Chloroethane is formed only in the propagation step.

107. The Russian composer Borodin was also a research chemist who discovered a reaction in which two ethanal molecules combine to form a compound commonly known as aldol (reaction I). Aldol forms another compound on heating (reaction II).



Which of the following best describes reactions I and II?

	I	II
A	addition	elimination
B	addition	reduction
C	elimination	reduction
D	substitution	elimination

108. *The use of the Data Booklet is relevant to this question.*

Which of the following would be the easiest initiating step in a free radical process (i.e. the one involving the least energy)?

- A $\text{HCl} \rightarrow \text{H}\cdot + \text{Cl}\cdot$
 B $\text{Cl}_2 \rightarrow 2\text{Cl}\cdot$
 C $\text{H}_2 \rightarrow 2\text{H}\cdot$
 D $\text{C}_6\text{H}_5\text{CH}_3 \rightarrow \text{C}_6\text{H}_5\text{CH}_2\cdot + \text{H}\cdot$

109. In the free radical substitution of 2-methylbutane with bromine, a mixture of mono-brominated compounds were obtained.

What is the statistical ratio of the two compounds with the highest yields?

- A 1 : 1
 B 1 : 2
 C 1 : 3
 D 1 : 6

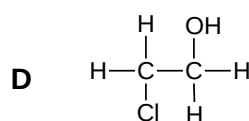
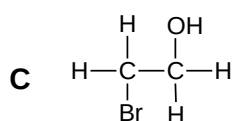
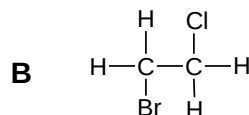
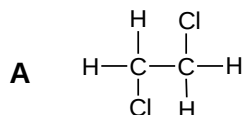
110. Pentane was reacted with limited chlorine in the presence of *uv* light. Assuming that only mono-chlorination takes place and the reaction occurs at the same rate at all carbon atoms, predict the ratio of the products obtained.

	1-chloropentane	:	2-chloropentane	:	3-chloropentane
A	3	:	2	:	1
B	1	:	2	:	3
C	1	:	3	:	2
D	3	:	1	:	2

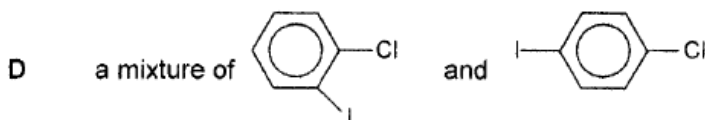
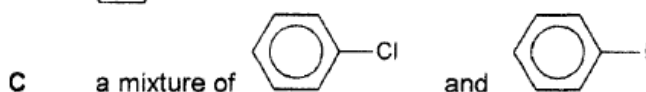
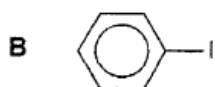
111. Which of the following statements concerning the nature of carbocations (carbonium ions) is **NOT** true?

- A They are positively-charged species.
- B They contain an effectively 'trivalent' carbon atom.
- C They contain a carbon atom with only six outermost shell electrons.
- D They contain an unpaired electron

112. Which of the following compounds is **not** an addition product of the reaction between ethene with aqueous chlorine in the presence of sodium bromide?

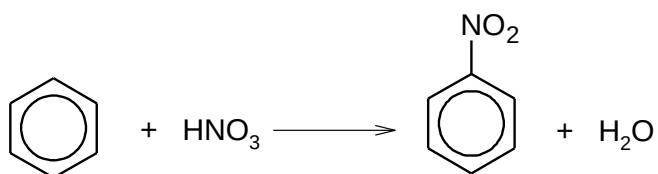


113. Which of the following is the product formed when benzene reacts with iodine chloride, ICl in the presence of a suitable catalyst?



114. Nitrobenzene is a yellow liquid with the smell of almonds. It may be prepared by heating a mixture of benzene, concentrated nitric acid and concentrated sulfuric acid under reflux.

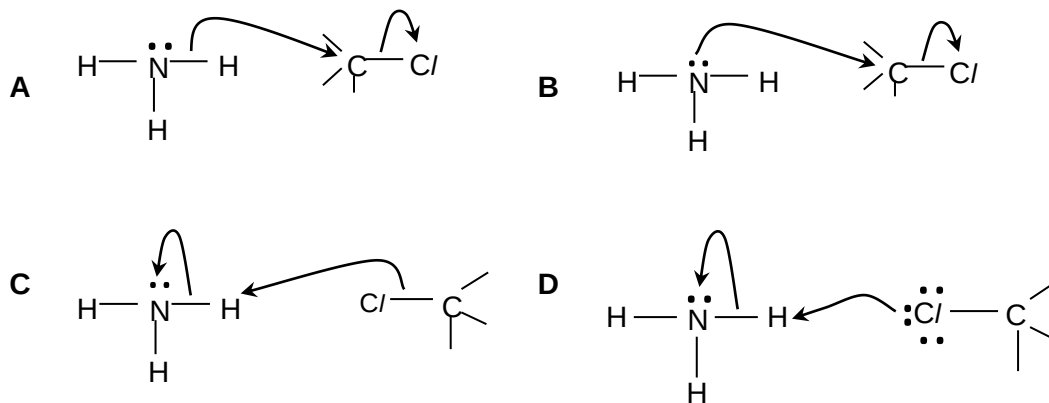
Why is concentrated sulfuric acid used?



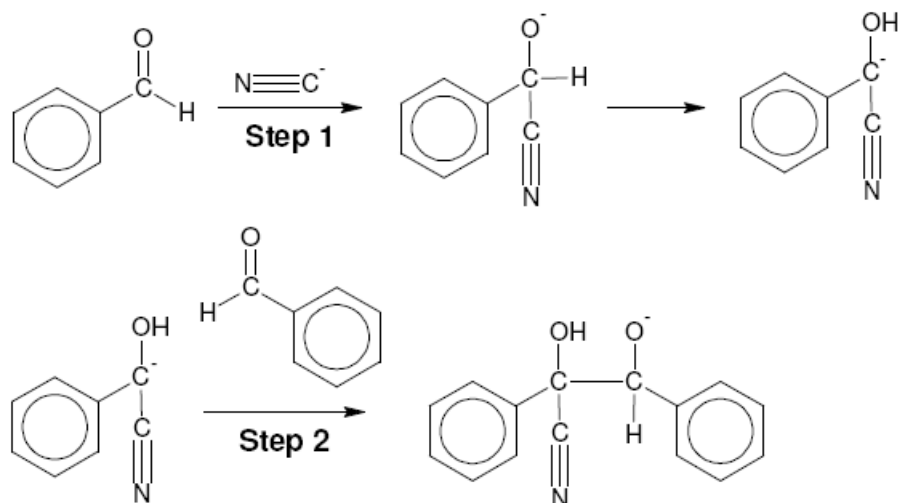
- A** It acts as a dehydrating agent to remove the water produced.
B It donates protons to nitric acid, thus forming NO_2^+ ions.
C It removes protons from nitric acid, thus forming NO_2^- ions.
D It acts as a heterogeneous catalyst to speed up the reaction.
115. In the presence of anhydrous aluminium chloride, benzene reacts with chloromethane to produce methylbenzene. Which of the following statements is true?

- A** Aluminium chloride is used to produce Cl^-
B The reacting carbon atom in the intermediate formed is sp^2 hybridised
C Benzene undergoes nucleophilic substitution in this reaction
D Aluminium chloride is used to produce CH_3^+

116. Which diagram correctly shows the movement of electrons when ammonia reacts with a chloroalkane?



117. The *Benzoin* condensation is a coupling reaction between two aldehydes that allows the preparation of α -hydroxyketones. The first methods were only suitable for the conversion of aromatic aldehydes such as benzaldehyde. Some of the steps involved in the reaction are shown below:



Which of the following correctly represents the type of reaction occurring in **Steps 1** and **2**?

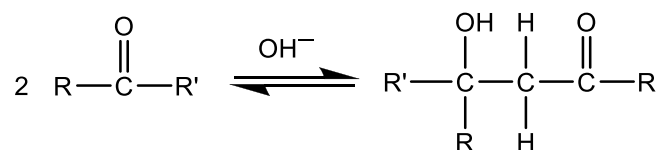
Step 1

- A** nucleophilic addition
B nucleophilic addition
C nucleophilic addition
D nucleophilic substitution

Step 2

- condensation
 nucleophilic addition
 electrophilic substitution
 nucleophilic addition

118. In the presence of a base, some aldehyde and ketone undergo a rapid and reversible condensation reaction, where they dimerise to form a hydroxycarbonyl compound (an aldol).

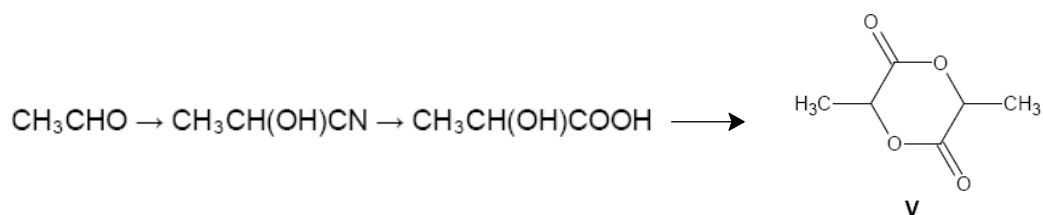


This reaction is initiated by the production of the enolate ion, RCOCH_2^- , formed from the reaction between a carbonyl molecule and a base.

What is the mechanism involved in the above reaction?

- | | |
|-------------------------------------|------------------------------------|
| A Electrophilic addition | C Nucleophilic addition |
| B Electrophilic substitution | D Nucleophilic substitution |

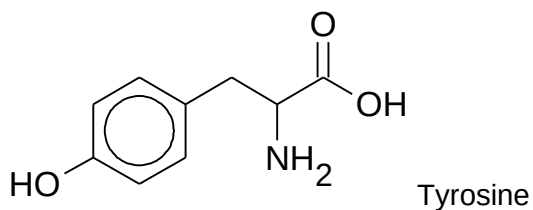
119. Compound **V** is formed from ethanal via a series of reactions below.



Which of the following reactions is **not** represented in the sequence?

- A nucleophilic addition
- B electrophilic addition
- C hydrolysis
- D condensation

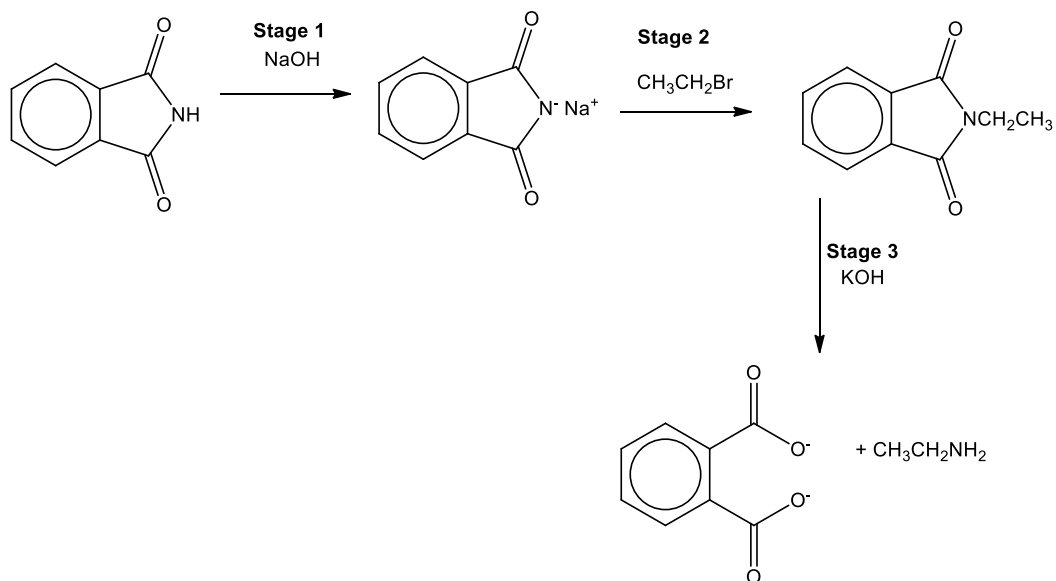
120. Tyrosine is one of the 20 amino acids that is used by cells to synthesise proteins, and was first discovered in cheese.



Which of the following types of reaction will Tyrosine **not** undergo?

- A reduction
- B nucleophilic addition
- C nucleophilic substitution
- D electrophilic substitution

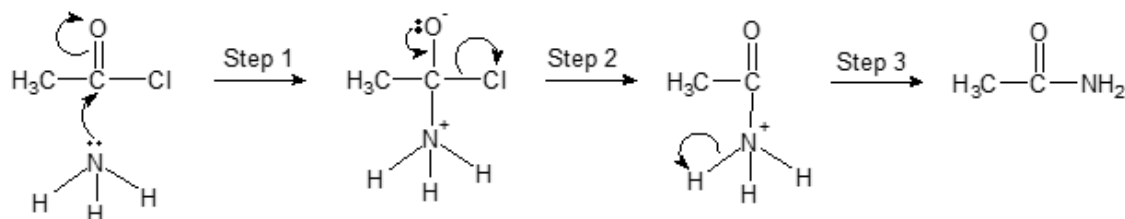
121. A sequence of reactions is shown below.



Which of the following correctly describes the type of reactions for Stages 1 to 3?

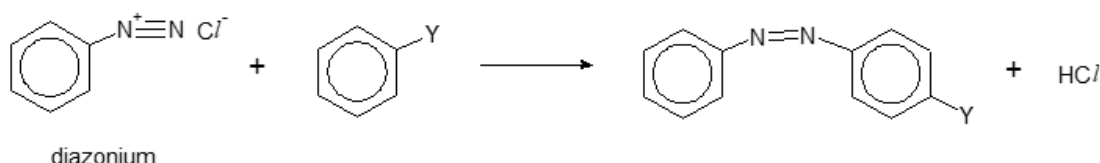
	Stage 1	Stage 2	Stage 3
A	neutralisation	electrophilic substitution	nucleophilic substitution
B	hydrolysis	nucleophilic substitution	hydrolysis
C	redox	nucleophilic addition	nucleophilic substitution
D	neutralisation	nucleophilic substitution	hydrolysis

122. A mechanism for the reaction between ammonia and ethanoyl chloride is given below.



Which of the following statements are correct?

- 1 The ammonia behaves as a nucleophile.
 - 2 The loss of proton in **step 3** is shown incorrectly.
 - 3 The ammonia attacks an electron-deficient carbon atom.
 - 4 The rate of reaction will increase if ethanoyl bromide is used.
- A 1, 2, 3 and 4.
 B 1, 3 and 4 only.
 C 1 and 3 only.
 D 2 and 4 only.
123. Azo coupling is an organic reaction between a diazonium compound and another aromatic compound that produces an azo compound.

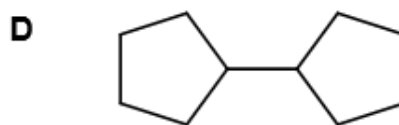
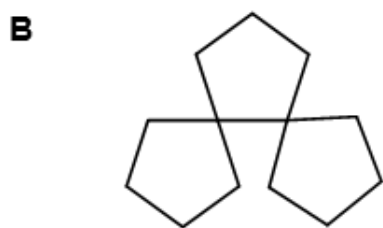
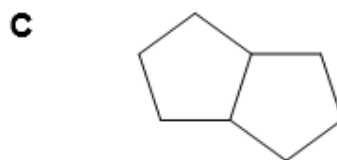
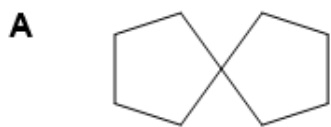


Which of the following correctly represents the type of reaction and the role of diazonium compound?

- | | <u>Type of reaction</u> | <u>Role of diazonium</u> |
|---|----------------------------|--------------------------|
| A | nucleophilic substitution | nucleophile |
| B | electrophilic substitution | electrophile |
| C | nucleophilic substitution | electrophile |
| D | electrophilic substitution | nucleophile |

124. Cyclopentane undergoes substitution with bromine.

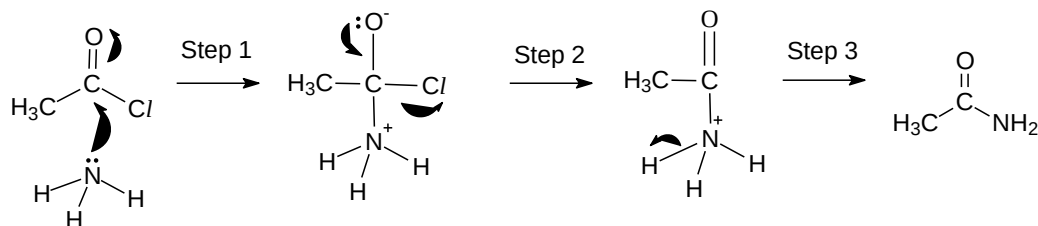
What is a possible by-product of this reaction?



125. Which of the following reactions has no change in the hybridisation state of the carbon atom indicated with an asterisk (*) from the reactant to the **intermediate** in the mechanism?

A	
B	
C	
D	

126 A mechanism for the reaction between ammonia and ethanoyl chloride is given below.



Which of the following statements are correct?

1	The ammonia behaves as a nucleophile in the mechanism.
2	The loss of proton in step 3 is shown incorrectly.
3	The oxidation number of the carbonyl C atom in ethanoyl chloride and ethanamide are the same.

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

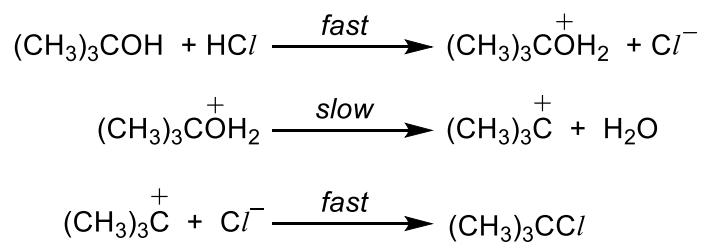
127 CH_3F and Cl_2 are mixed together in the presence of sunlight.

Which statements are correct?

- 1 $\text{F}\bullet$ free radicals are produced.
- 2 Hydrogen gas is produced.
- 3 The reaction involves homolytic fission and σ bond formation.

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

128 The mechanism for a certain reaction is given below.

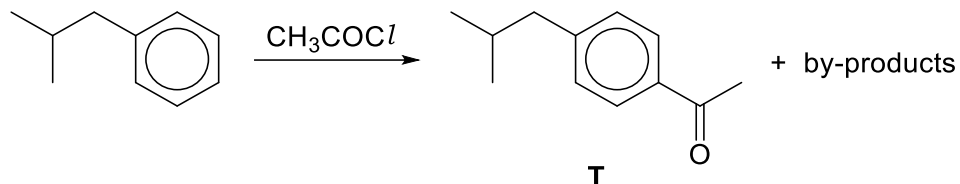


Which of the following statements is not true?

- A** $(\text{CH}_3)_3\text{CO}^+\text{H}_2$ and $(\text{CH}_3)_3\text{COH}$ are conjugate acid-base pair.
- B** The nucleophile in the reaction is HCl .
- C** The overall reaction is $(\text{CH}_3)_3\text{COH} + \text{HCl} \rightarrow (\text{CH}_3)_3\text{CCl} + \text{H}_2\text{O}$
- D** The above mechanism is a nucleophilic substitution reaction.

129 Ibuprofen is a pain killer.

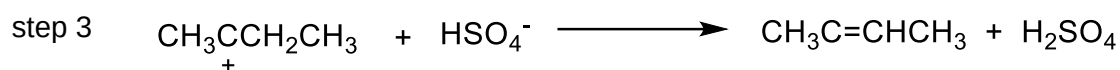
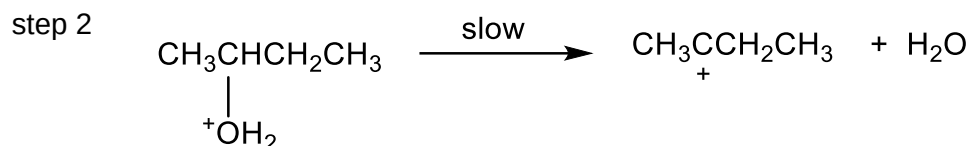
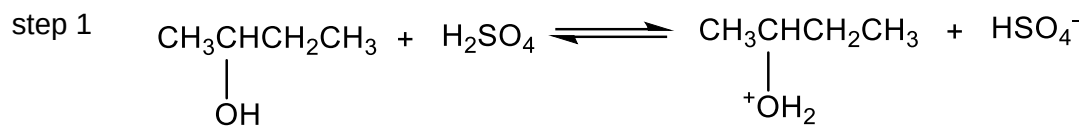
The first step in the synthesis of ibuprofen involves the synthesis of compound **T** via a Friedel–Crafts acylation, which is similar to the Friedel–Crafts alkylation in terms of conditions required and the mechanism involved.



Which statement is **false** about the reaction above?

- A** The reaction will proceed at a faster rate if benzene was used instead.
- B** FeCl_3 can be used to catalyse the reaction.
- C** The major product is 1,4-substituted due to steric hindrance.
- D** HCl is produced as a by-product.

130 The dehydration of butan-2-ol to form but-2-ene is thought to involve the following steps.



Which of the following statements is incorrect?

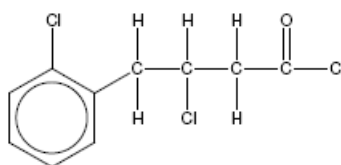
- A** Butan-2-ol serves as a base in step 1.
- B** H_2SO_4 is a catalyst in the dehydration reaction.
- C** A possible side product is $\text{CH}_3\text{C}(\text{OSO}_3\text{H})\text{CH}_2\text{CH}_3$.
- D** Primary alcohols are more likely to proceed via this mechanism than tertiary alcohols.

Hydrolysis

131. Which of the following statements best explains why fluoroalkanes are the least reactive halogenoalkanes?

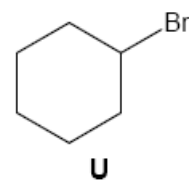
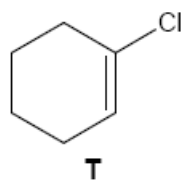
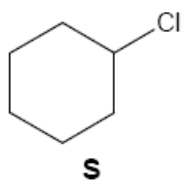
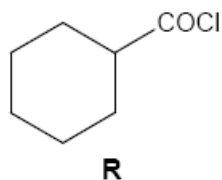
- A** Fluorine is much more electronegative than carbon.
- B** The F^- ion is the most stable halide ion.
- C** The C–F bond is the most polar carbon–halogen bond.
- D** The C–F bond is the strongest carbon–halogen bond.

132. Calculate the mass of precipitate produced when 2 mol of the compound below is refluxed with NaOH(aq), followed by the addition of acidified silver nitrate solution.



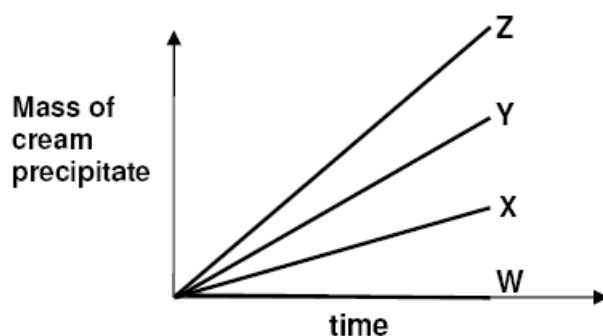
- A** 287 g **B** 431 g **C** 574 g **D** 861 g

133. Which sequence shows the correct order of increasing ease of hydrolysis of the following compounds?



- A** $T < U < S < R$ **B** $T < S < U < R$
C $R < S < U < T$ **D** $R < U < S < T$

134. Bromine-containing organic compounds can be hydrolysed under suitable conditions to produce the corresponding bromide ion, Br^- , which then can be reacted with aqueous silver nitrate to form a cream precipitate.

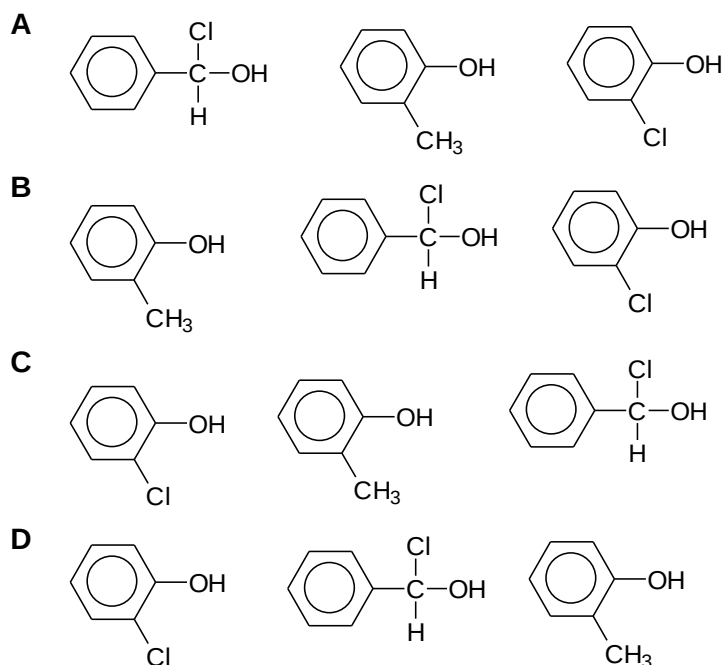


A student investigated the mass produced by hydrolysing 4 different bromine-containing compounds, **W**, **X**, **Y**, **Z**.

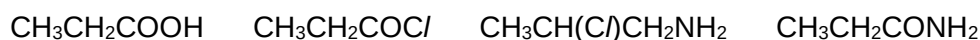
Which of the following gives the correct structures for **W**, **X**, **Y**, **Z**?

	W	X	Y	Z
A	$\text{C}_6\text{H}_5\text{Br}$	$\text{C}_6\text{H}_4(\text{Br})\text{CH}_2\text{Br}$	$\text{BrCH}_2\text{CH}_2\text{COBr}$	$\text{BrCH}_2\text{CH}_2\text{Br}$
B	$\text{C}_6\text{H}_5\text{Br}$	$\text{BrCH}_2\text{CH}_2\text{COBr}$	$\text{C}_6\text{H}_4(\text{Br})\text{CH}_2\text{Br}$	$\text{BrCH}_2\text{CH}_2\text{Br}$
C	$\text{C}_6\text{H}_5\text{Br}$	$\text{C}_6\text{H}_4(\text{Br})\text{CH}_2\text{Br}$	$\text{BrCH}_2\text{CH}_2\text{Br}$	$\text{BrCH}_2\text{CH}_2\text{COBr}$
D	$\text{BrCH}_2\text{CH}_2\text{COBr}$	$\text{BrCH}_2\text{CH}_2\text{Br}$	$\text{C}_6\text{H}_4(\text{Br})\text{CH}_2\text{Br}$	$\text{C}_6\text{H}_5\text{Br}$

135. Which sequence correctly represents the compounds in the order of increasing pK_a values?



136. When equimolar amounts of organic compounds **R**, **S**, **T** and **U** are added separately to water, solutions of increasing pH values are obtained. The possible identities of the compounds are given below.



Which is the correct set of identities of compounds **R** to **U**?

	R	S	T	U
A	$\text{CH}_3\text{CH}_2\text{COC/}$	$\text{CH}_3\text{CH}_2\text{COOH}$	$\text{CH}_3\text{CH}_2\text{CONH}_2$	$\text{CH}_3\text{CH(C/)}\text{CH}_2\text{NH}_2$
B	$\text{CH}_3\text{CH}_2\text{COC/}$	$\text{CH}_3\text{CH}_2\text{COOH}$	$\text{CH}_3\text{CH(C/)}\text{CH}_2\text{NH}_2$	$\text{CH}_3\text{CH}_2\text{CONH}_2$
C	$\text{CH}_3\text{CH}_2\text{COOH}$	$\text{CH}_3\text{CH}_2\text{COC/}$	$\text{CH}_3\text{CH}_2\text{CONH}_2$	$\text{CH}_3\text{CH(C/)}\text{CH}_2\text{NH}_2$
D	$\text{CH}_3\text{CH}_2\text{COOH}$	$\text{CH}_3\text{CH}_2\text{COC/}$	$\text{CH}_3\text{CH(C/)}\text{CH}_2\text{NH}_2$	$\text{CH}_3\text{CH}_2\text{CONH}_2$

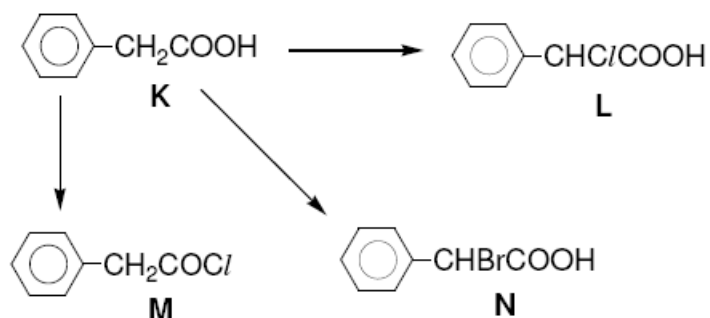
137. Which of the following shows the given ions arranged in the order of increasing pK_b value?

- A** ethanoate ion, phenoxide ion, 4-nitrophenoxide ion, ethoxide ion
B ethanoate ion, 4-nitrophenoxide ion, phenoxide ion, ethoxide ion
C ethoxide ion, 4-nitrophenoxide ion, phenoxide ion, ethanoate ion
D ethoxide ion, phenoxide ion, 4-nitrophenoxide ion, ethanoate ion

138. Which of the following pair of compounds would produce the same carboxylic acid upon hydrolysis?

- | | | |
|----------|-------------------------------------|--|
| A | $\text{CH}_3\text{CH}_2\text{COC/}$ | $\text{CH}_3\text{CO}_2\text{CH}_3$ |
| B | $\text{CH}_3\text{CH}_2\text{CN}$ | $\text{CH}_3\text{CO}_2\text{CH}_2\text{CH}_3$ |
| C | $\text{CH}_3\text{CH}_2\text{CN}$ | $\text{CH}_3\text{CH}_2\text{CO}_2\text{CH}_3$ |
| D | $\text{C}_6\text{H}_5\text{CONH}_2$ | $\text{C}_6\text{H}_5\text{NHCOCH}_3$ |

139. Three halogeno compounds can be synthesised from an organic compound **K** by the following routes:

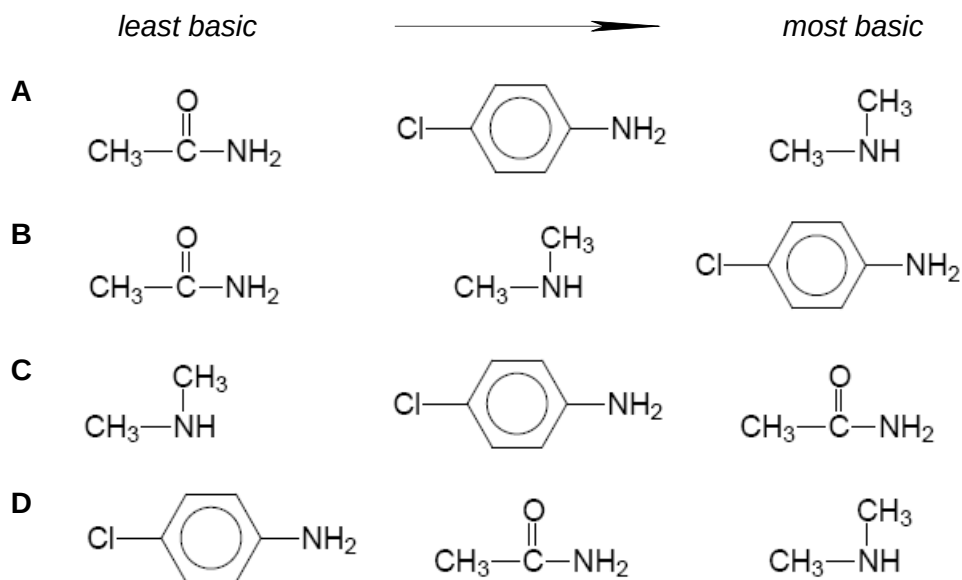


When compounds **K**, **L**, **M** and **N** (not necessarily in that order) are added to separate portions of water, solutions are formed with pH values of 0.5, 2.5, 3.0 and 3.5.

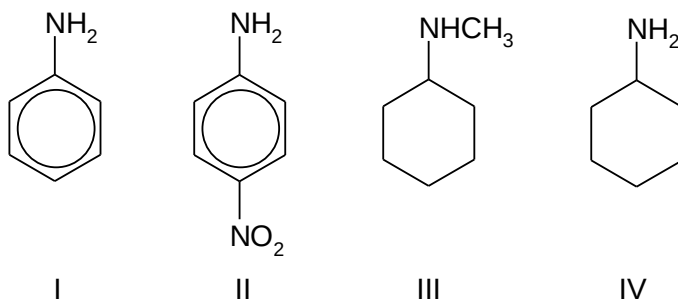
Deduce which pH value is associated with each of **K**, **L**, **M** and **N**.

	<u>pH 0.5</u>	<u>pH 2.5</u>	<u>pH 3.0</u>	<u>pH 3.5</u>
A	L	N	K	M
B	K	N	L	M
C	M	K	N	L
D	M	L	N	K

140. Which sequence shows the nitrogen compounds in increasing order of basic strength?



141. What is the order of increasing pK_b for the following compounds?



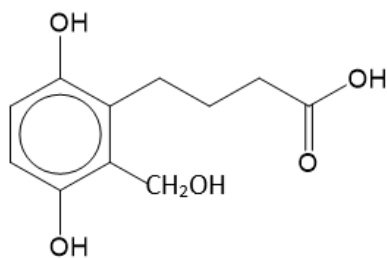
- A** II, I, III, IV
B IV, III, I, II
C III, IV, II, I
D III, IV, I, II

142. What is the order of increasing pH of 1 mol dm⁻³ of each organic compound?

- A** CH₃CO₂Na, CH₃CO₂H, CF₃CO₂H, HOCH₂CHO
B CH₃CO₂Na, HOCH₂CHO, CH₃CO₂H, CF₃CO₂H
C CF₃CO₂H, CH₃CO₂H, HOCH₂CHO, CH₃CO₂Na
D CF₃CO₂H, CH₃CO₂H, CH₃CO₂Na, HOCH₂CHO

143. Compound **X** is dissolved in heavy water, D₂O. It contains a number of hydrogen atoms which can be easily be replaced by deuterium, D.

[D, deuterium = ²H]

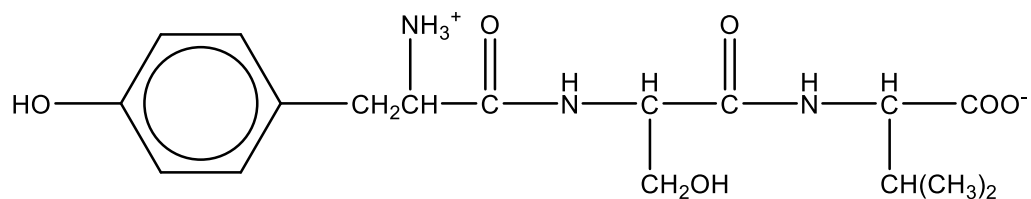


Compound **X**

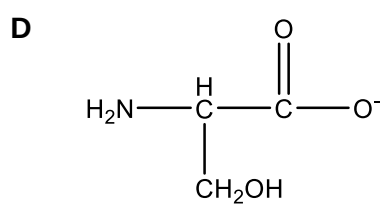
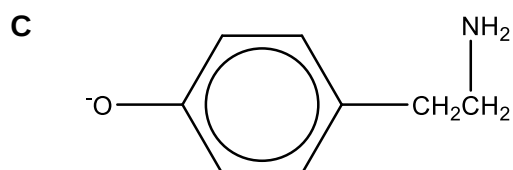
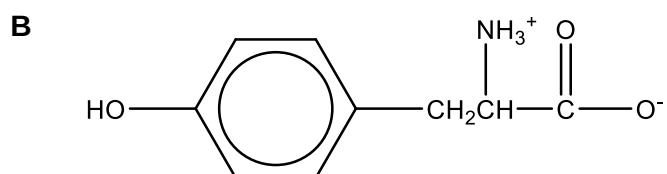
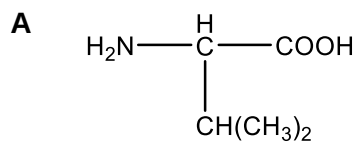
What is the maximum number of hydrogen atoms which could be replaced by deuterium atoms in each molecule of **X**?

A	1	B	2	C	3	D	4	
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144. The therapeutic effect of tyroserleutide on lung cancer is currently being studied. It has the following structure:

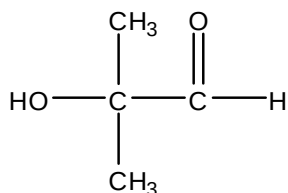
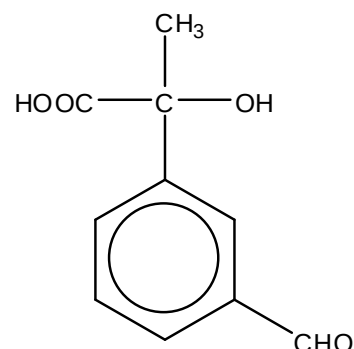


Which compound can be obtained when tyroserleutide reacts with hot dilute NaOH?



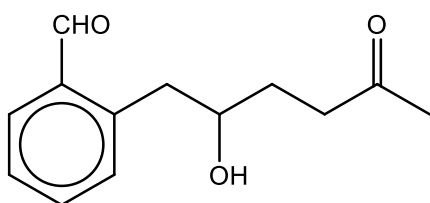
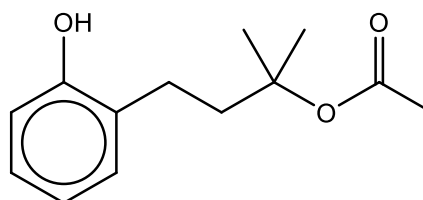
Distinguishing Test

145. Which of the following reagents may be used to distinguish between the compounds **P** and **Q**?

**Compound P****Compound Q**

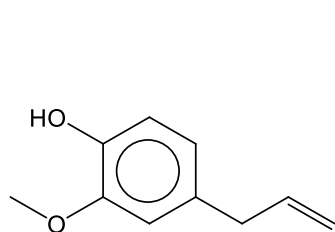
- A** Alkaline copper(II) complex
- B** Alkaline aqueous iodine
- C** Silver nitrate with excess aqueous ammonia
- D** Sodium metal

146. Which of the following reagents could **not** be used to distinguish between compound **X** and **Y**?

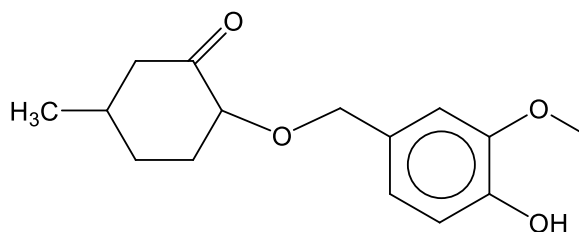
**Compound X****Compound Y**

- | | |
|-----------------------------|---|
| A I_2 in NaOH (aq) | C Cu^{2+} in alkaline solution |
| B PCl_5 | D acidified potassium dichromate |

147. Eugenol is an ally chain-substituted guaiacol found in essential oils and ginerol is found in ginger used for its antibacterial properties.



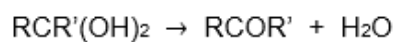
Eugenol



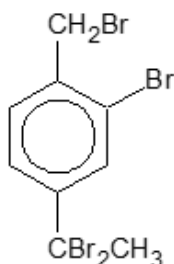
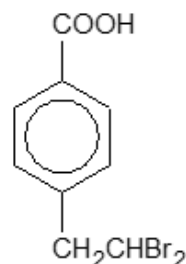
Ginerol

Which reagent can be used to distinguish eugenol from ginerol?

- A** Neutral FeCl_3
B HBr
C Fehling's reagent
D 2,4-dinitrophenylhydrazine
148. Diols formed on the same carbon atom are generally unstable and will undergo the following reaction.



Compounds **V** and **W** are both reacted with hot aqueous NaOH followed by dilute HCl at room temperature.

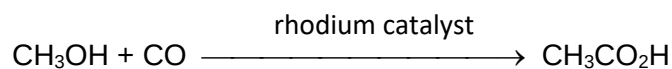
Compound **V**Compound **W**

Which reagents could be used to distinguish the final products of **V** and **W**?

- 1** 2,4 DNPH
2 Fehling's solution
3 Sodium carbonate solution
4 Hot acidified $\text{K}_2\text{Cr}_2\text{O}_7$
5 Iodine in aqueous NaOH
- A** 1 and 2 only
B 3 and 4 only
C 1, 4 and 5 only
D 2, 3 and 5 only

Pattern Identification

149. One industrial preparation of ethanoic acid is the direct carbonylation of methanol, using a rhodium catalyst.

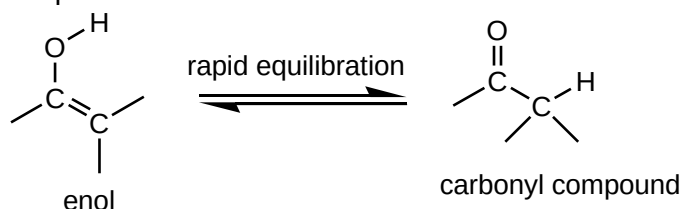


Which compound could be expected to produce $\text{HO}_2\text{CCH}(\text{CH}_2\text{CO}_2\text{H})_2$ by this method?

- A** $\text{HOCH}_2\text{CH}(\text{OH})\text{CO}_2\text{H}$ **B** $\text{HOCH}_2\text{CH}(\text{CH}_2\text{CO}_2\text{H})_2$
C $\text{HO}_2\text{CCH}(\text{OH})\text{CH}_2\text{CO}_2\text{H}$ **D** $\text{HOCH}_2\text{CH}(\text{OH})\text{CH}_2\text{CO}_2\text{H}$
150. Methyl isocyanate, $\text{CH}_3\text{-N=C=O}$, readily reacts with nucleophiles. By analogy with the chemistry of other carbonyl compounds, predict which atom will be attacked by a nucleophile.

- A** carbon atom of the isocyanate group
B carbon atom of the methyl group
C nitrogen atom
D oxygen atom

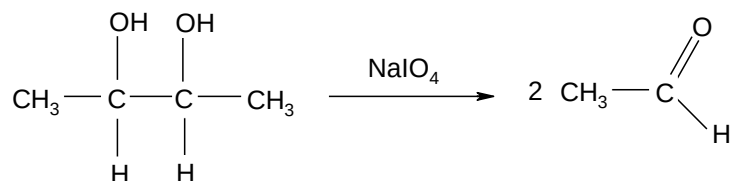
151. Enols, also known as alkenols, are alkenes with a hydroxyl group affixed to one of the carbon atoms composing the double bond. Enols and carbonyl compounds are rapidly interconvertible via a process called tautomerism.



Propane-1,2-diol can undergo dehydration with excess concentrated H_2SO_4 to give enols and a mixture of products. Which of the following is **false** about the resulting solution?

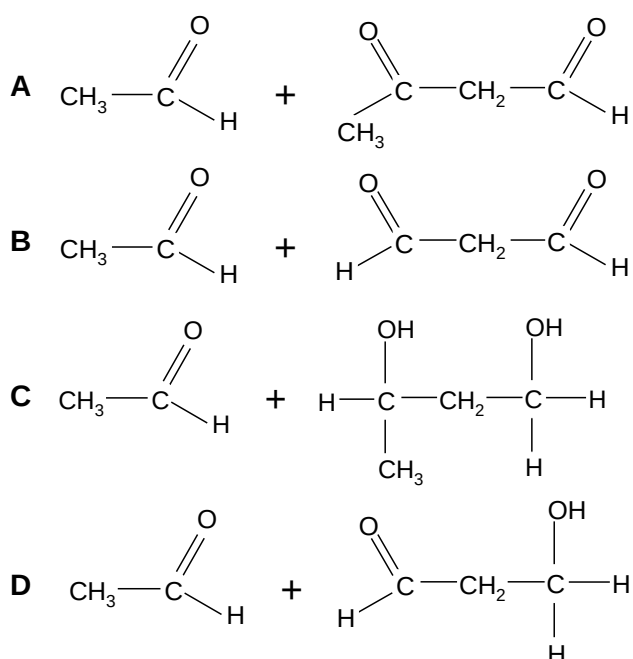
- A.** It decolourises hot acidified potassium manganate (VII) solution with the evolution of a colourless gas.
B. It gives a yellow precipitate with aqueous alkaline iodine
C. It gives a grey precipitate with silver diammine complex.
D. It reacts with $\text{H}_2(\text{g})$, $\text{Pt}(\text{s})$ to give an optically active product.

152. A useful oxidising agent specifically for *vicinal diols* (ie. the two OH groups are on adjacent carbons) used in the laboratory includes NaIO_4 . An example of the conversion using butane-2,3-diol is shown below:

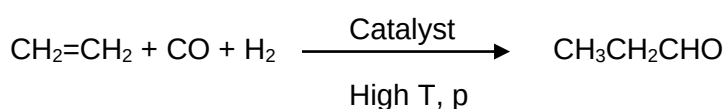


What would be the final organic products obtained when compound **Y** is first treated with cold alkaline aqueous KMnO_4 followed by NaIO_4 ?

Compound **Y** is $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)-\text{CH}_2-\text{CH}=\text{CH}(\text{CH}_3)$



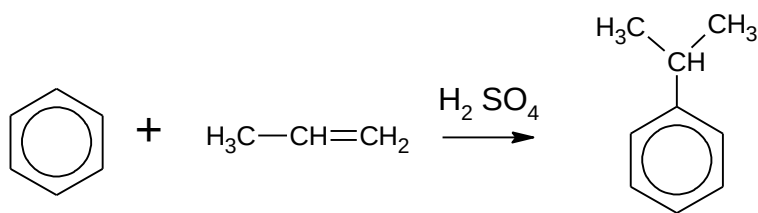
153. The oxo-reaction is an important industrial process in which an alkene combines directly with carbon monoxide and hydrogen under suitable conditions. The reaction with ethene is shown below.



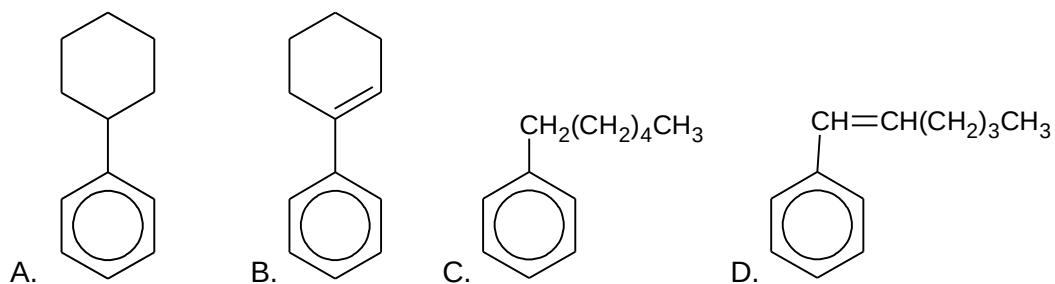
Which of the following structural formula correctly represents the product of the oxo-reaction starting with but-2-ene ?

- A.** $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CHO}$
B. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$
C. $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$
D. $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CH}_3$

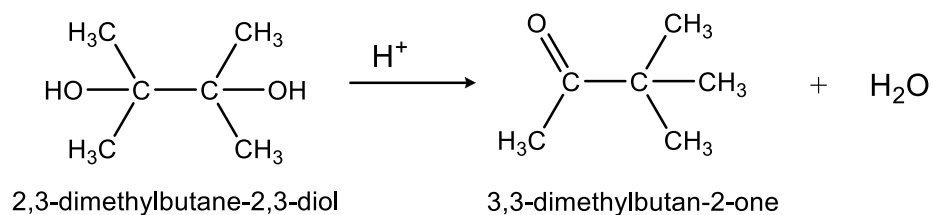
154. The 1st stage of the cumene process for the industrial production of phenol is as follows:



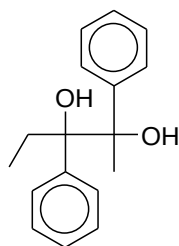
Which one of the following would be the product of the reaction under similar conditions between benzene and cyclohexene?



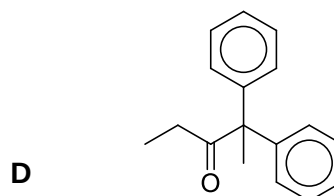
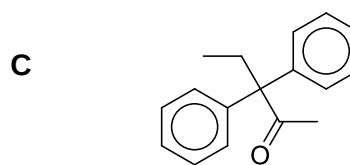
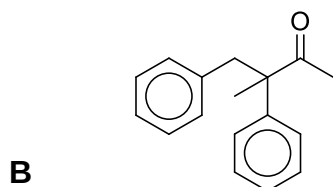
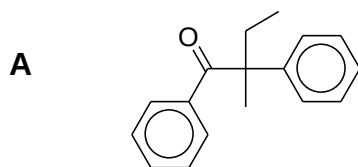
155. The pinacol rearrangement involves the reaction of a diol in acidic conditions to form a carbonyl compound as shown below.



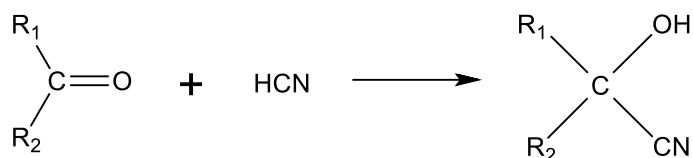
Which one of the following structural formulae is **not** a product of the pinacol rearrangement of 2,3-diphenylpentane-2,3-diol with the structure as shown below?



2,3-diphenylpentane-2,3-diol



156. Cyanohydrins can be made from carbonyl compounds by generating CN^- ions from HCN in the presence of a weak base.

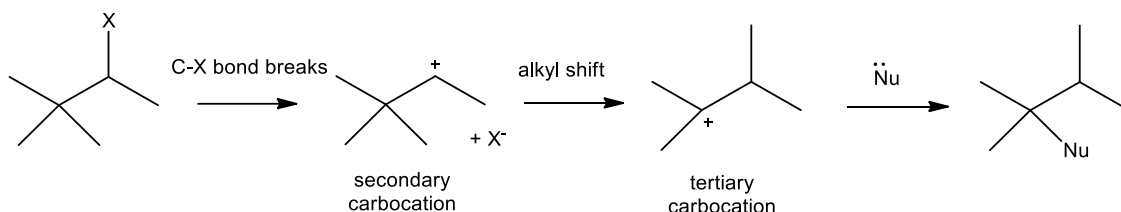


In a similar reaction, $^-\text{CH}_2\text{COOCH}_3$ ions are generated from $\text{CH}_3\text{COOCH}_3$ by strong bases.

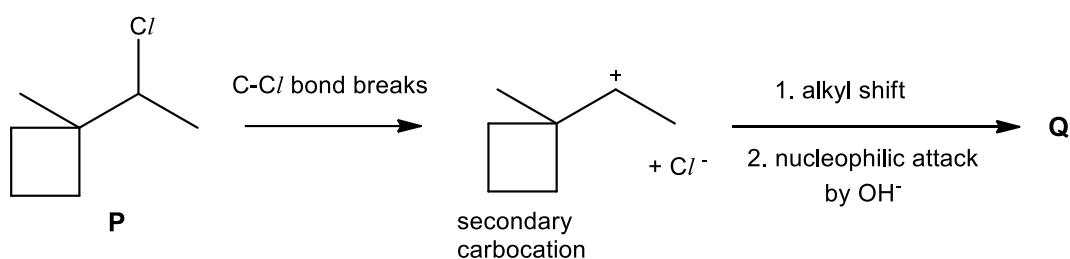
Which compound can be made from an aldehyde and $\text{CH}_3\text{COOCH}_3$?

- A** $\text{CH}_3\text{CH}(\text{OH})\text{COOCH}_3$
- B** $\text{CH}_3\text{COOCH}_2\text{CH}(\text{OH})\text{CH}_3$
- C** $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{COOCH}_3$
- D** $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{COOCH}_3$

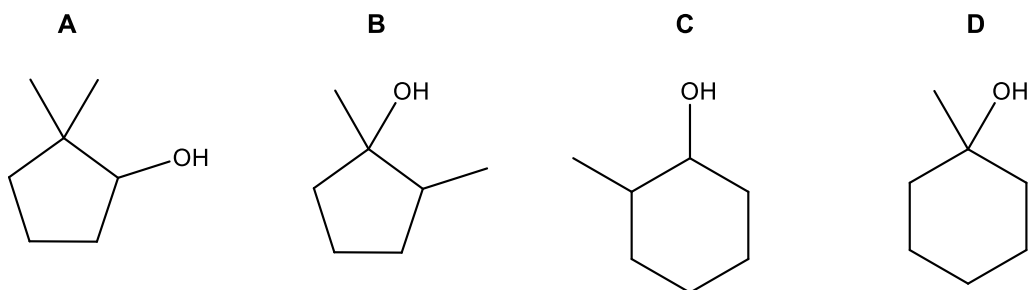
157. In S_N1 reactions involving secondary halogenoalkanes, alkyl shift can sometimes occur after the breaking of C–X bond to form a more stable tertiary carbocation.



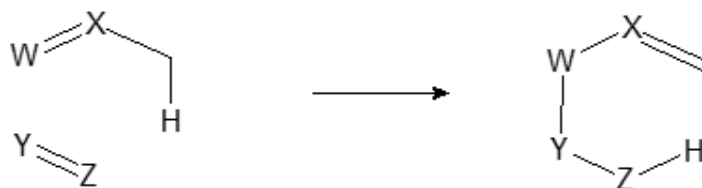
Rearrangements need not always involve methyl groups. In situation when the carbocation is formed adjacent to a strained ring, such as a cyclobutane, it is more favourable for one of the alkyl groups in the ring, rather than the methyl group, to shift so as to cause **ring expansion** and the formation of a less strained ring.



Which of the following is a possible identity of **Q**?



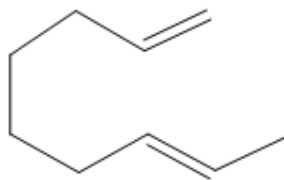
158. The Alder-ene reaction is a reaction between two alkenes and is capable of forming new carbon-carbon bonds. An example of the Alder-ene reaction is given below:



Note: W, X, Y & Z are carbon atoms and other hydrogens are not shown

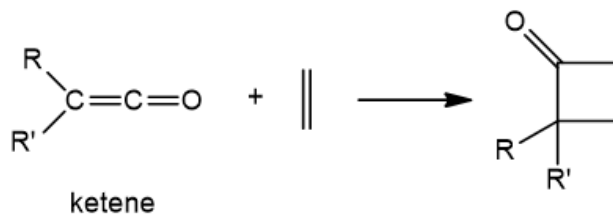
The Alder-ene reaction typically produces many products as the roles of the two alkenes can be exchanged.

Which compound will **not** be formed when the following compound undergoes Alder-ene reaction?

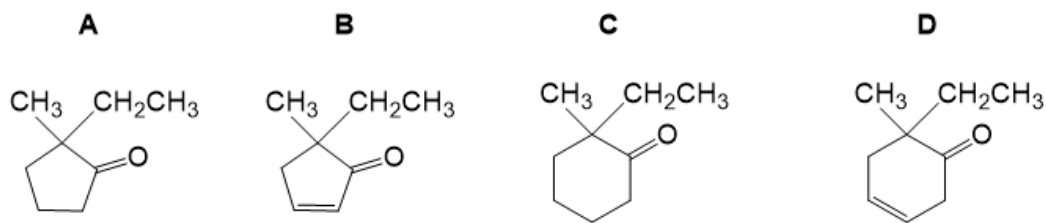
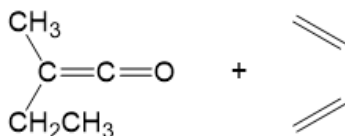


- A**
- B**
- C**
- D**

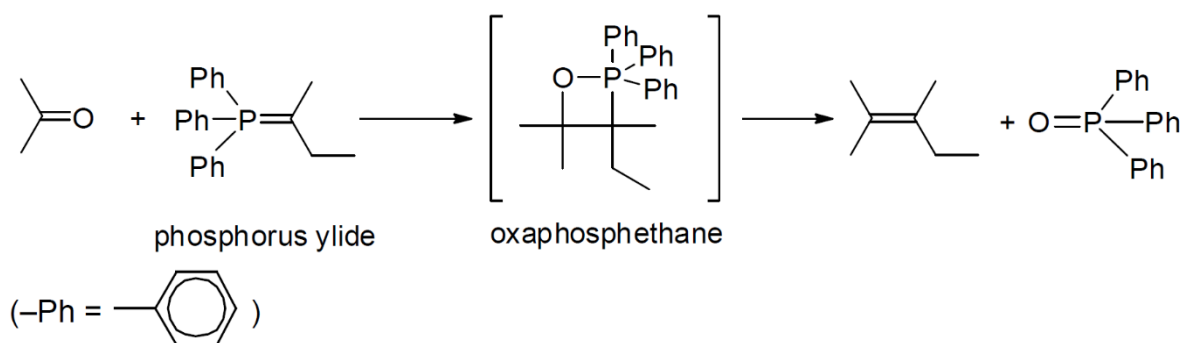
159. Ketenes contain a carbon involved in both alkene and ketone functional groups. It is a reactive compound which undergoes cycloaddition reaction readily with unsaturated compounds to form cyclic rings. One example of such a reaction is shown below.



Which of the following is the correct product formed for the following cycloaddition reaction?

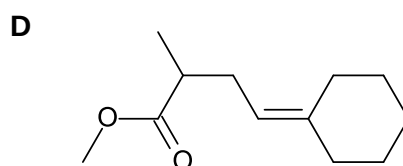
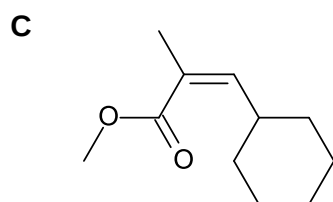
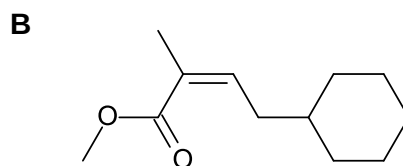
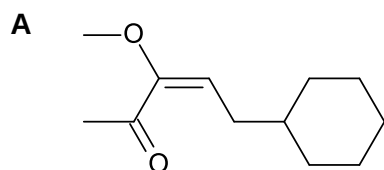


160. The Wittig reaction involves the reaction of a carbonyl compound with a phosphorus ylide to give an alkene. The reaction occurs via an oxaphosphetane intermediate.



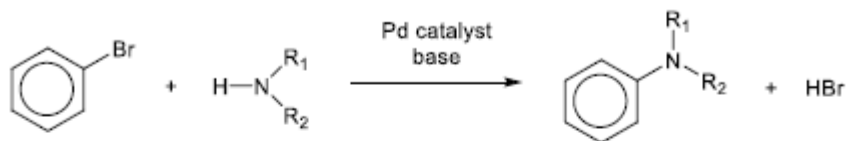
Which of the following is the product formed when reacts

with $(\text{Ph})_3\text{P=CH-CH}_2\text{-Cyclohexyl}$?

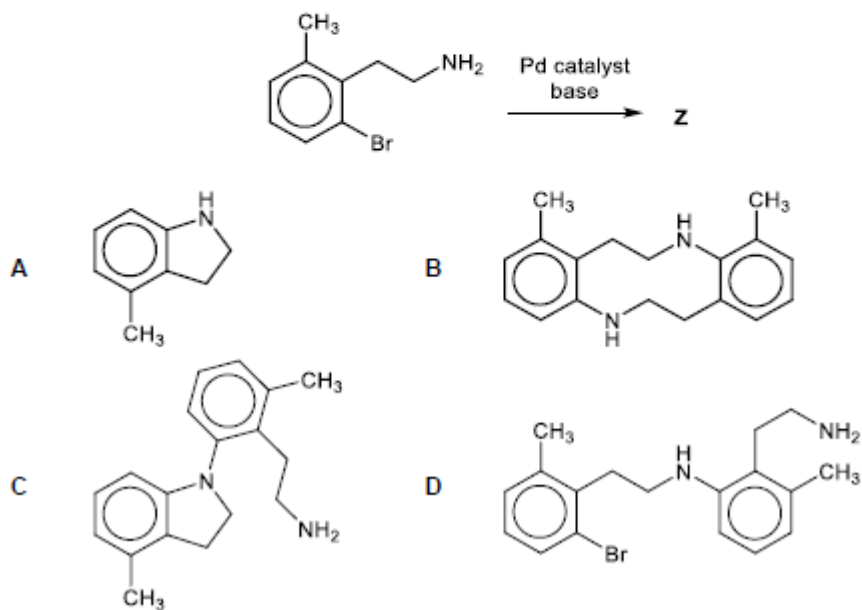


161.

Buchwald–Hartwig amination is an organic reaction for the synthesis of carbon–nitrogen bonds from the reactions of amines with aryl halides.



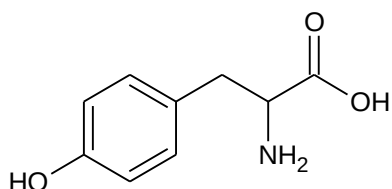
Which is **not** a possible structure for **Z**?



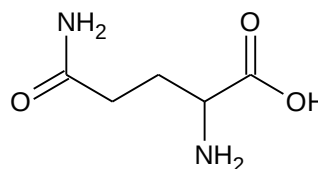
164. Electrophoresis is a technique of separating and identifying amino acids. A solution of amino acids is absorbed into paper that is moistened with a buffer solution and stretched between two electrodes. Positively charged species move towards the cathode, negatively charged species towards the anode.

With a buffer at pH 4, which amino acid will move most readily towards the cathode?

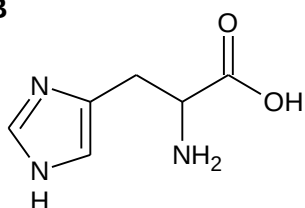
A



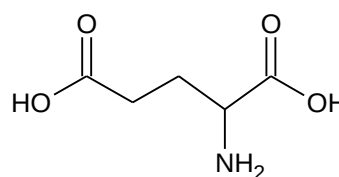
C



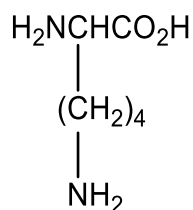
B



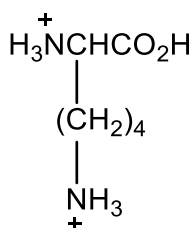
D



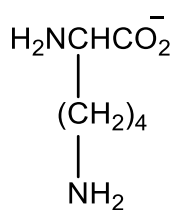
165. Lysine is an α -amino acid.



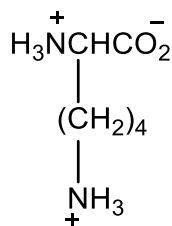
Which structure is predominant when lysine is in an aqueous solution of pH 9.5, given that lysine has three pK_a values of 2.2, 8.9 and 10.5?



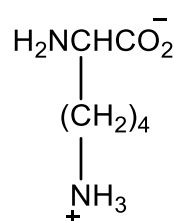
A



B

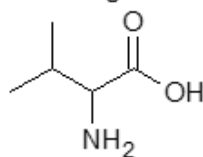


C

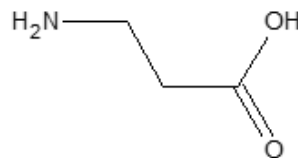


D

166. Valine is a naturally occurring amino acid.



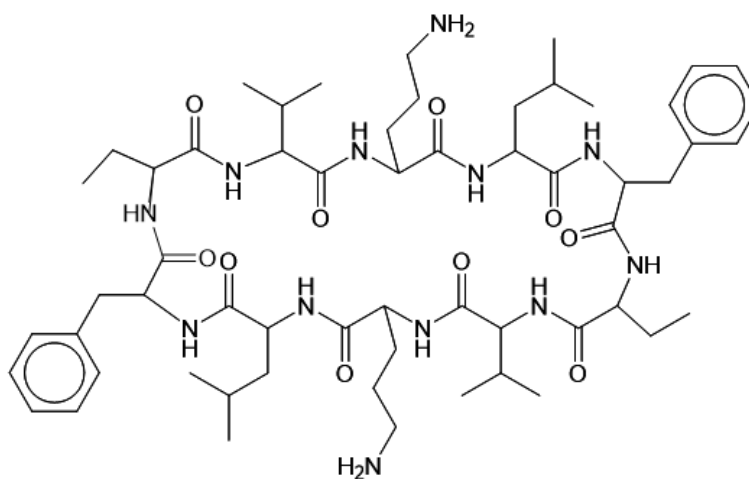
Valine



3-aminopropanoic acid

Which statements about valine and 3-aminopropanoic acid are correct?

- A** Both compounds are able to form zwitterions.
B Both compounds are able to react with ethanoic acid to give amide.
C Both compounds are able to react with NaBH_4 in methanol to give alcohol.
D Both compounds are soluble in water due to the formation of intermolecular hydrogen bonding.
167. Gramicidin Soviet is an antibiotic that is effective against some fungi. It is made up of several α amino acids.

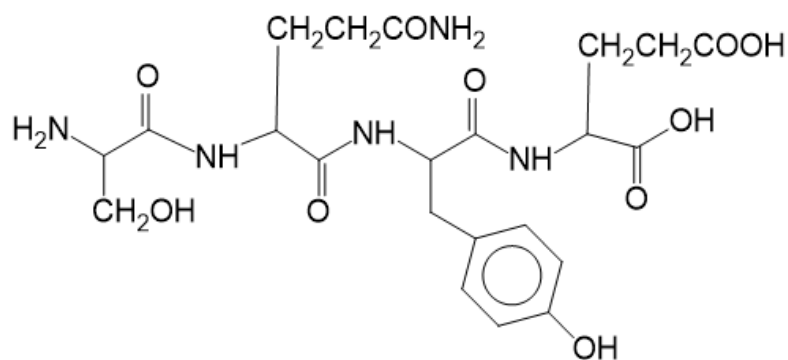


Gramicidin Soviet

Which statement about Gramicidin Soviet is correct?

- | | |
|----------|--|
| A | It is made up of 5 different amino acids. |
| B | 1 mole of Gramicidin Soviet consists of 9 amide bonds. |
| C | 1 mole of Gramicidin Soviet reacts with 10 moles of hot dilute H_2SO_4 . |
| D | Upon reaction with hot dilute NaOH , the products formed have high melting point as they can form strong intermolecular hydrogen bonding. |

168. The diagram shows the structure of the tetrapeptide, **J**.

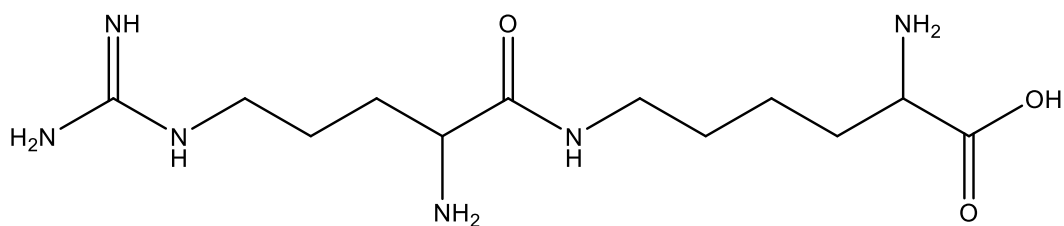


Which statements are correct?

- (1) When 1 mol of **J** reacts with hot NaOH(aq) until no further reaction occurs, 8 mol of NaOH will react.
- (2) When 1 mol of **J** reacts with hot HCl(aq) until no further reaction occurs, 5 mol of HCl will react.
- (3) When 1 mol of **J** reacts with ethanoyl chloride, 3 mol of ethanoyl chloride will react forming ester or amide.
- (4) When 1 mol of **J** reacts with Na(s), 4 mol of hydrogen gas will be given out.

A	1 and 2 only
B	2 and 3 only
C	1, 2 and 4 only
D	3 and 4 only

169. Compound **U** is a by-product formed in the body to counteract the effect of the drug administered to treat herpes.

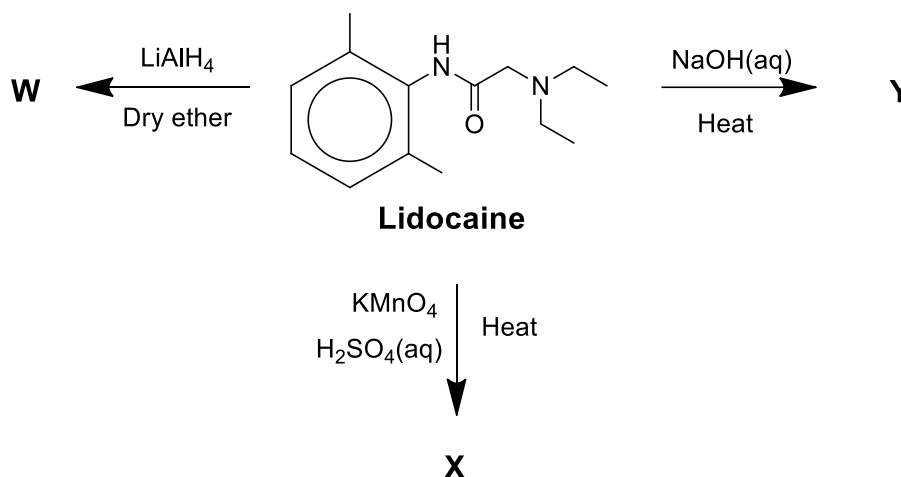


Compound **U**

Which one of the following statements about compound **U** is correct?

- A** **U** undergoes nucleophilic addition with chloroethane.
- B** 1 mol of **U** can be hydrolysed to produce 2 mol of amino acids.
- C** 1 mol of **U** can react with 6 mol of hydrochloric acid at room temperature.
- D** When an aqueous solution of **U** at pH 3 is analysed by electrophoresis, it is found near the anode.

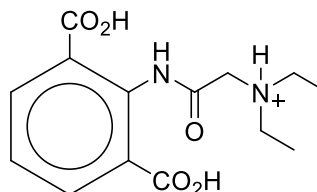
170. Lidocaine belongs to a family of medicines called local anaesthetics, where it prevents pain by blocking the signals at the nerve endings in the skin. Using specific reagents and conditions, it can be converted to other organic substances.



Which one of the following statements about lidocaine and the above reactions is correct?

- A** **W** has four more hydrogen atoms than lidocaine.
- B** **Y** is a mixture of amine and carboxylic acid.

- C** The structure of the cation in **X** is



- D** Lidocaine is a base and it reacts with HCl(aq) to form an ionic salt.

Answer Key:

1	D		28	A		55	A		82	B		109	B		136	A		163	D
2	D		29	C		56	C		83	A		110	A		137	D		164	B
3	A		30	B		57	C		84	A		111	D		138	C		165	D
4	C		31	B		58	C		85	B		112	C		139	D		166	A
5	C		32	D		59	B		86	A		113	B		140	A		167	A
6	B		33	C		60	B		87	A		114	B		141	D		168	B
7	C		34	B		61	C		88	D		115	D		142	C		169	B
8	C		35	B		62	D		89	D		116	B		143	C		170	D
9	C		36	B		63	C		90	A		117	B		144	D			
10	C		37	C		64	D		91	C		118	C		145	A			
11	B		38	A		65	D		92	C		119	B		146	C			
12	D		39	B		66	C		93	C		120	B		147	D			
13	A		40	C		67	C		94	B		121	D		148	D			
14	C		41	C		68	C		95	D		122	A		149	D			
15	C		42	D		69	B		96	B		123	B		150	A			
16	B		43	C		70	D		97	D		124	D		151	D			
17	D		44	D		71	C		98	D		125	D		152	A			
18	C		45	C		72	A		99	C		126	A		153	A			
19	D		46	A		73	D		100	A		127	D		154	A			
20	A		47	B		74	B		101	B		128	B		155	B			
21	C		48	A		75	B		102	A		129	A		156	C			
22	C		49	A		76	A		103	D		130	D		157	B			
23	C		50	B		77	D		104	D		131	D		158	A			
24	C		51	D		78	C		105	A		132	C		159	D			
25	D		52	D		79	C		106	B		133	B		160	B			
26	B		53	A		80	D		107	A		134	C		161	B			
27	C		54	D		81	C		108	B		135	C		162	B			