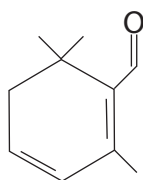


1 The total number of compounds with the structural formula $C_6H_3CH_3(NO_2)_2$, which contain a benzene ring, is

- A four.
- B five.
- C six.
- D seven.

(Total for Question = 1 mark)

2 Safranal is one of the substances that contributes to the aroma of saffron.



Separate samples of safranal were tested with bromine water, 2,4-dinitrophenylhydrazine and Fehling's solution.

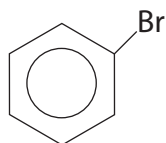
What are the final observations when safranal is tested with each of those reagents?

	Bromine water	2,4-dinitrophenylhydrazine	Fehling's solution
<input type="checkbox"/> A	orange solution	orange solution	red precipitate
<input type="checkbox"/> B	colourless solution	orange precipitate	red precipitate
<input type="checkbox"/> C	orange solution	orange solution	blue solution
<input type="checkbox"/> D	colourless solution	orange precipitate	blue solution

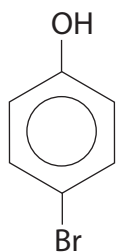
(Total for Question = 1 mark)

3 The structure of the organic product of the reaction between phenol and excess bromine water is

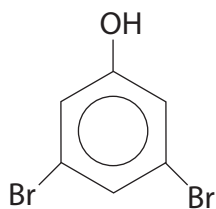
A



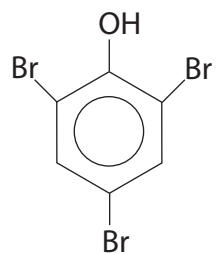
B



C

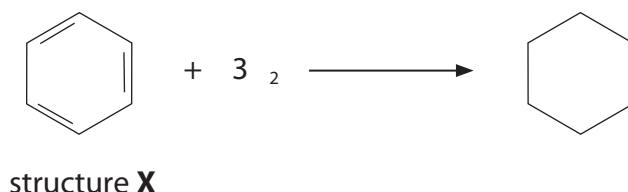


D



(Total for Question = 1 mark)

- 4 If it is assumed that the structure of benzene has three localised double bonds (structure **X**), the calculated standard enthalpy change of hydrogenation is -360 kJ mol^{-1} .



The actual standard enthalpy change of hydrogenation of benzene is -208 kJ mol^{-1} .

From these data, it can be deduced that the

- A** actual benzene structure is kinetically more stable than structure **X** as it requires a high activation energy to react.
- B** actual benzene structure is thermodynamically more stable than structure **X** as it has a lower enthalpy content.
- C** structure **X** is kinetically unstable as it undergoes addition reactions at room temperature.
- D** structure **X** is thermodynamically more stable than the actual benzene structure as the standard enthalpy change of hydrogenation is more exothermic.

(Total for Question = 1 mark)

- 5 In the reaction of benzene with chloromethane, aluminium chloride is added because it reacts with

- A** benzene to produce an electrophile.
- B** benzene to produce a nucleophile.
- C** chloromethane to produce a nucleophile.
- D** chloromethane to produce an electrophile.

(Total for Question = 1 mark)

6 Which of the following reacts with benzene under suitable conditions to form $C_6H_5COC_6H_5$?

- A C_6H_5CHO
- B C_6H_5COOH
- C $C_6H_5CH_2OH$
- D C_6H_5COCl

(Total for Question = 1 mark)

7 Benzene is converted to benzenesulfonic acid, $C_6H_5SO_3H$, by reaction with

- A sulfuric(IV) acid, H_2SO_3 .
- B sulfuric(VI) acid, H_2SO_4 .
- C sulfur dioxide dissolved in sulfuric(IV) acid.
- D sulfur trioxide dissolved in sulfuric(VI) acid.

(Total for Question = 1 mark)

8 Benzene reacts with chlorine to produce 1,2,3,4,5,6-hexachlorocyclohexane, $C_6H_6Cl_6$, by

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

(Total for Question = 1 mark)

9 Benzene reacts with a nitrating mixture of concentrated nitric and sulfuric acids. Which species is **least** likely to be present in the nitrating mixture?

- A NO_3^-
- B H_3O^+
- C HSO_4^-
- D NO_2^+

(Total for Question = 1 mark)

10 Benzene ($T_b = 80.1^\circ\text{C}$) has a higher boiling temperature than ethanol ($T_b = 78.5^\circ\text{C}$). This is because the

- A benzene ring is stabilised.
- B London forces between benzene molecules are stronger than the hydrogen bonds between ethanol molecules.
- C hydrogen bonds between benzene molecules are stronger than the hydrogen bonds between ethanol molecules.
- D C–H bonds in benzene are stronger than the C–H bonds in ethanol.

(Total for Question = 1 mark)

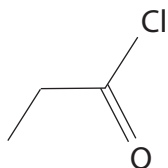
11 When benzene reacts with fuming sulfuric acid, which species is most likely to be the electrophile?

- A H_3O^+
- B SO_3
- C HSO_4^-
- D SO_4^{2-}

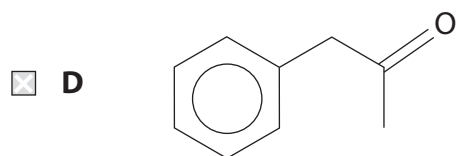
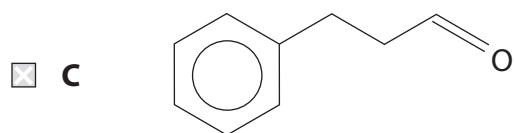
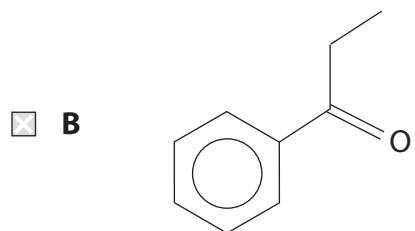
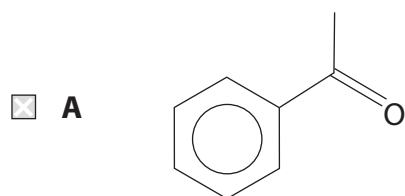
(Total for Question = 1 mark)

12 Benzene reacts with propanoyl chloride in the presence of a suitable catalyst.

The skeletal formula of propanoyl chloride is



What is the organic product of this reaction?



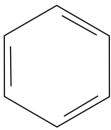
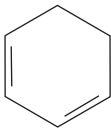
(Total for Question = 1 mark)

13 The total number of isomers of dibromobenzene, $C_6H_4Br_2$, containing a benzene ring is

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

(Total for Question = 1 mark)

14 Bromine reacts with benzene on heating in the presence of a catalyst and with cyclohexa-1,3-diene in the cold. The types of reaction involved are

	bromine with benzene 	bromine with cyclohexa-1,3-diene 
<input type="checkbox"/> A	addition	addition
<input type="checkbox"/> B	addition	substitution
<input type="checkbox"/> C	substitution	addition
<input type="checkbox"/> D	substitution	substitution

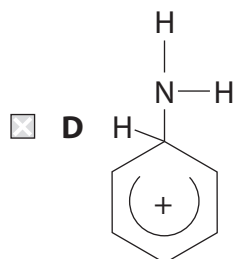
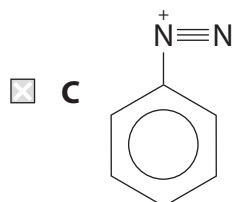
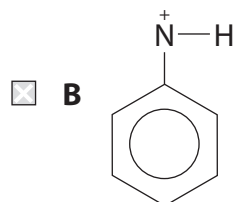
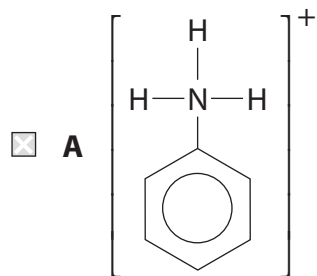
(Total for Question = 1 mark)

15 Phenylamine, $C_6H_5NH_2$, and benzene react with bromine in a similar way, but phenylamine reacts much faster. This increased rate of reaction is most likely due to the effect that the

- A electronegativity of the nitrogen has on the benzene ring.
- B electronegativity of the nitrogen has on the bromine molecule.
- C lone pair of electrons of the nitrogen has on the benzene ring.
- D lone pair of electrons of the nitrogen has on the bromine molecule.

(Total for Question = 1 mark)

16 When dilute nitric(V) acid, HNO_3 , reacts with phenylamine, the ion formed is



(Total for Question = 1 mark)

17 Phenol reacts with bromine water whereas benzene reacts with bromine in the presence of iron.

(a) The mechanism for both these reactions is

(1)

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

(b) In the reaction of benzene with bromine, iron

(1)

- A acts as a heterogeneous catalyst.
- B acts as a homogeneous catalyst.
- C reacts with the bromine to make iron(III) bromide, FeBr₃.
- D allows bromine to attack the hydrogen atoms on benzene more readily.

(c) Bromine reacts more readily with phenol than with benzene because the OH group on phenol

(1)

- A is a good leaving group.
- B attracts the bromine particles more readily.
- C is a good nucleophile.
- D increases the electron density of the ring.

(Total for Question 3 marks)

18 If phenol and benzene are tested separately with bromine water, you would expect to see that

- A benzene and phenol would both decolorize bromine water.
- B benzene would decolorize bromine water, but phenol would not do so.
- C neither benzene nor phenol would decolorize bromine water.
- D benzene would not decolorize bromine water, but phenol would do so.

(Total for Question = 1 mark)

19 Which of the following shows the generation of the electrophile in the reaction of benzene with ethanoyl chloride in the presence of anhydrous aluminium chloride?

- A $\text{CH}_3\text{COCl} + \text{AlCl}_3 \rightarrow [\text{CH}_3\text{CO}]^+ + \text{AlCl}_4^-$
- B $\text{CH}_3\text{COCl} + \text{AlCl}_3 \rightarrow [\text{CH}_3\text{CO}]^- + \text{AlCl}_4^+$
- C $\text{CH}_3\text{CH}_2\text{Cl} + \text{AlCl}_3 \rightarrow [\text{CH}_3\text{CH}_2]^+ + \text{AlCl}_4^-$
- D $\text{CH}_3\text{COOCl} + \text{AlCl}_3 \rightarrow [\text{CH}_3\text{COO}]^- + \text{AlCl}_4^+$

(Total for Question = 1 mark)

20 Bromine reacts much faster with phenylamine than with benzene. This is because

- A N—H bonds are weaker than C—H bonds.
- B nitrogen is very electronegative.
- C the benzene ring has greater electron density in phenylamine than in benzene.
- D phenylamine reacts by addition whereas benzene reacts by substitution.

(Total for Question = 1 mark)

21 X-ray diffraction provides evidence that benzene molecules have

- A delocalized π electrons.
- B carbon–carbon bonds that are all the same length.
- C lower thermodynamic stability than molecules of 1,3,5-cyclohexatriene.
- D greater thermodynamic stability than molecules of 1,3,5-cyclohexatriene.

(Total for Question = 1 mark)

22 Benzene is nitrated using a mixture of concentrated nitric and sulfuric acids. The sulfuric acid

- A acts as a solvent for the benzene and the nitric acid.
- B protonates the benzene to speed up the reaction.
- C protonates the nitric acid which acts as a base.
- D reacts with the benzene to form a benzenesulfonic acid intermediate.

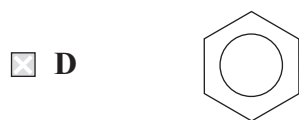
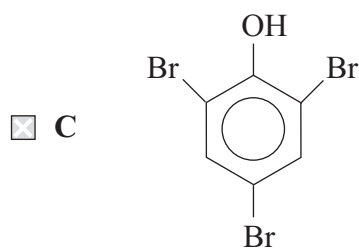
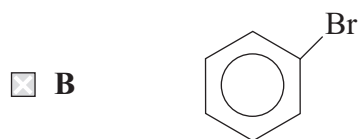
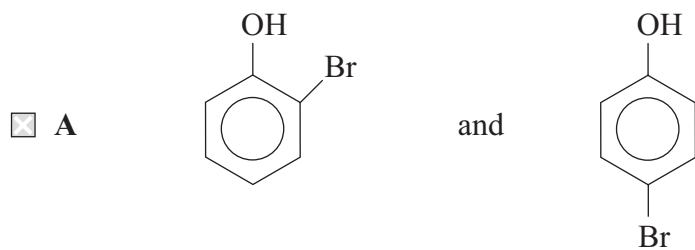
(Total for Question = 1 mark)

23 For the nitration of phenol, which is the most suitable set of conditions and the reason for its use?

		Conditions	Reactivity of phenol to electrophiles compared with benzene
<input type="checkbox"/>	A	dilute nitric acid at room temperature	more reactive
<input type="checkbox"/>	B	concentrated nitric and sulfuric acid at room temperature	more reactive
<input type="checkbox"/>	C	concentrated nitric and sulfuric acid at 55 °C	the same
<input type="checkbox"/>	D	dilute nitric acid and dilute sulfuric acid at room temperature	less reactive

(Total for Question = 1 mark)

24 Phenol reacts with excess bromine water to give as the organic product(s)



(Total for Question 1 mark)