



Catholic Junior College
JC 2 Preliminary Examinations
Higher 2

CHEMISTRY

9729/01

Paper 1 Multiple Choice

29 August 2017

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your name, HT group and NRIC/FIN number on the Answer Sheet in the spaces provided.

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

The use of an approved scientific calculator is expected, where appropriate.

For each question there are **four** possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

- 1** 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

- 2** *Use of the Data Booklet is relevant to this question.*

A vanadium salt of unknown oxidation state was dissolved in water to form a solution of 0.500 mol dm^{-3} . It was found that 20.4 cm^3 of this solution will react with 1.00 g of zinc powder to form vanadium(II) solution.

What is the possible identity of the vanadium salt used?

- A** V^{2+}
- B** V^{3+}
- C** VO^{2+}
- D** VO_2^+

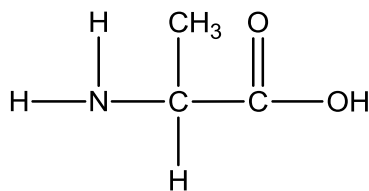
- 3** The table below gives some data about four ions.

ions	number of neutrons	number of nucleons
Q⁻	16	33
R⁺	19	39
S²⁻	17	33
T²⁺	18	35

Which of the following pairs consists of ions that are isoelectronic?

- A** **Q⁻** and **S²⁻**
- B** **R⁺** and **S²⁻**
- C** **S²⁻** and **T²⁺**
- D** **Q⁻** and **T²⁺**

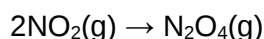
- 4 Which bond angle is present in a molecule of alanine, $\text{H}_2\text{NCH}(\text{CH}_3)\text{CO}_2\text{H}$, but is **not** present in its zwitterion?



alanine

- A 90° B 107° C 109° D 120°
- 5 What are the types of chemical bonds present in solid phenylammonium chloride, $\text{C}_6\text{H}_5\text{NH}_3\text{Cl}$?
- 1 dative covalent bonds
 - 2 ionic bonds
 - 3 hydrogen bonds
- A 2 only
 B 1 and 2 only
 C 2 and 3 only
 D 1, 2 and 3
- 6 Which one of the following shows the standard enthalpy change of formation of carbon monoxide?
- A $\text{C}(\text{s}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g})$
 B $\text{C}(\text{s}) + \text{CO}_2(\text{g}) \rightarrow 2\text{CO}(\text{g})$
 C $\text{C}(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CO}(\text{g})$
 D $\text{C}(\text{g}) + \text{CO}_2(\text{g}) \rightarrow 2\text{CO}(\text{g})$

- 7 Nitrogen dioxide, NO_2 , has an unpaired electron and dimerises to form N_2O_4 .



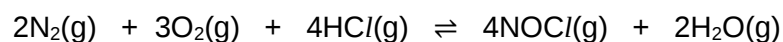
Which of the following statements about the spontaneity of the reaction is true?

- A The reaction is only spontaneous at low temperatures.
 - B The reaction is only spontaneous at high temperatures.
 - C The reaction is spontaneous at all temperatures.
 - D The reaction is non-spontaneous at all temperatures.
- 8 *Use of the Data Booklet is relevant to this question.*

Gas canisters used in camping stoves contain partially liquefied hydrocarbon. A canister was connected to a gas syringe and the valve opened slightly to allow some gas into the syringe. 0.200 g of the gas occupied a volume of 96.0 cm^3 at a temperature of 30.0°C and a pressure of 101 kPa.

What is the average M_r of the gas mixture?

- A 31 B 52 C 479 D 519
- 9 At a certain temperature, three gases N_2 , O_2 and HCl were mixed and the following reaction occurred:



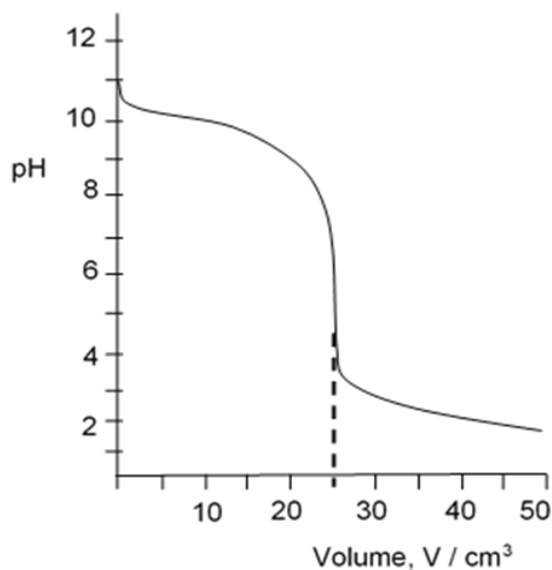
The initial partial pressures of N_2 , O_2 and HCl are 0.800 atm, 0.800 atm and 0.400 atm respectively. After equilibrium has been established, it is found that the partial pressure of steam is 0.15 atm.

What is the numerical value of K_p for this reaction at this temperature?

- A 1.20 B 22.7 C 0.0217 D 0.0251

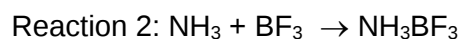
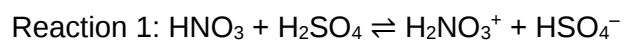
- 10** In an acid-base titration, a 0.10 mol dm^{-3} solution of an acid is added to a 25 cm^3 of a 0.10 mol dm^{-3} solution of a base.

The pH value of the solution is plotted against the volume, V , of acid added as shown in the diagram.



Which of the following statements is **incorrect**?

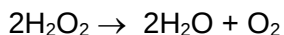
- A** The titration involved a strong acid and a weak base.
- B** The pair of solutions could have been HCl(aq) and $\text{CH}_3\text{NH}_2\text{(aq)}$.
- C** Methyl orange is a suitable indicator for the above titration.
- D** When concentration of acid is doubled, the end point volume of the titration would be halved while the pH at equivalence point would remain unchanged.
- 11** The following two reactions are examples of acid-base reactions.



Which of the following correctly describes the behaviour of each species?

	Brønsted acid	Brønsted base	Lewis acid	Lewis base
A	HNO_3	NH_3	H_2SO_4	HSO_4^-
B	H_2SO_4	HNO_3	BF_3	NH_3
C	HSO_4^-	NH_3	BF_3	H_2NO_3^+
D	H_2NO_3^+	HSO_4^-	NH_3BF_3	NH_3

- 12** The decomposition of hydrogen peroxide is known to be a first order reaction.



The rate constant is found to be $4.95 \times 10^{-2} \text{ min}^{-1}$. If the initial concentration of H_2O_2 is 4.00 mol dm^{-3} , what will be the concentration of H_2O_2 after 64 min?

- A** 0.50 mol dm⁻³ **C** 0.17 mol dm⁻³
B 0.20 mol dm⁻³ **D** 0.13 mol dm⁻³

- 13** The rate equation for the reaction $2\mathbf{W} + \mathbf{X} \rightarrow \mathbf{Y} + \mathbf{Z}$ is given as $\text{rate} = k[\mathbf{W}][\mathbf{X}]$. In an experiment to study the kinetics of the reaction, the initial concentration of $\mathbf{W}$ used is 0.20 mol dm^{-3} and the initial concentration of $\mathbf{X}$ used is $0.001 \text{ mol dm}^{-3}$.

Which of the following statements regarding the experiment is correct?

- A** The half-life for the $[X]$ against time curve is approximately constant.
- B** The mechanism for the above reaction involves one step.
- C** The units of the rate constant is $\text{mol}^{-2}\text{dm}^6\text{s}^{-1}$.
- D** Doubling the initial concentration of **W** to 0.40 mol dm^{-3} will not affect the half-life of **X**.

- 14** The oxide and chloride of an element **E** are mixed separately with water. The two resulting solutions have the same effect on litmus.

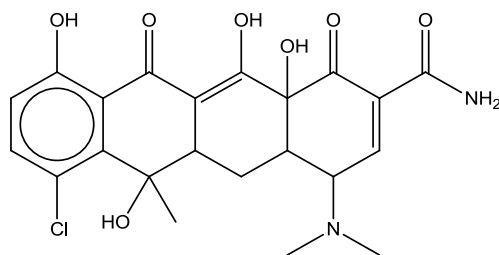
What is element **E**?

- A** Mg **B** Al **C** Si **D** P

- 15** Which of the following statements about iodine or its compounds are correct?

- 1 A crystal of iodine contains covalent bonds and instantaneous dipole-induced dipole forces of attraction.
 - 2 When aqueous chlorine is added to potassium iodide and the aqueous mixture shaken with tetrachloromethane, a purple organic layer is obtained.
 - 3 The first ionisation energy of iodine is less than that of bromine.
 - 4 The thermal stability of hydrogen iodide is higher than that of hydrogen bromide.
- A** 1 and 3 only
B 1, 2 and 3 only
C 3 and 4 only
D 2, 3 and 4 only

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

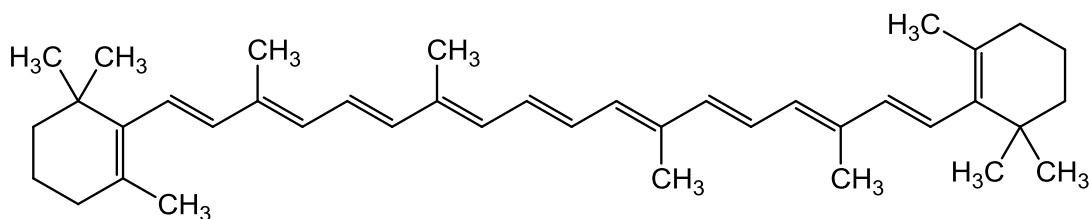


Aureomycin

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

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



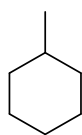
β -carotene

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

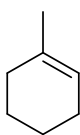
How many different products formed from the above reaction contain the ketone functional group?

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

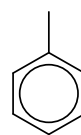
18 Which of the statements are true regarding the three compounds below?



I



II

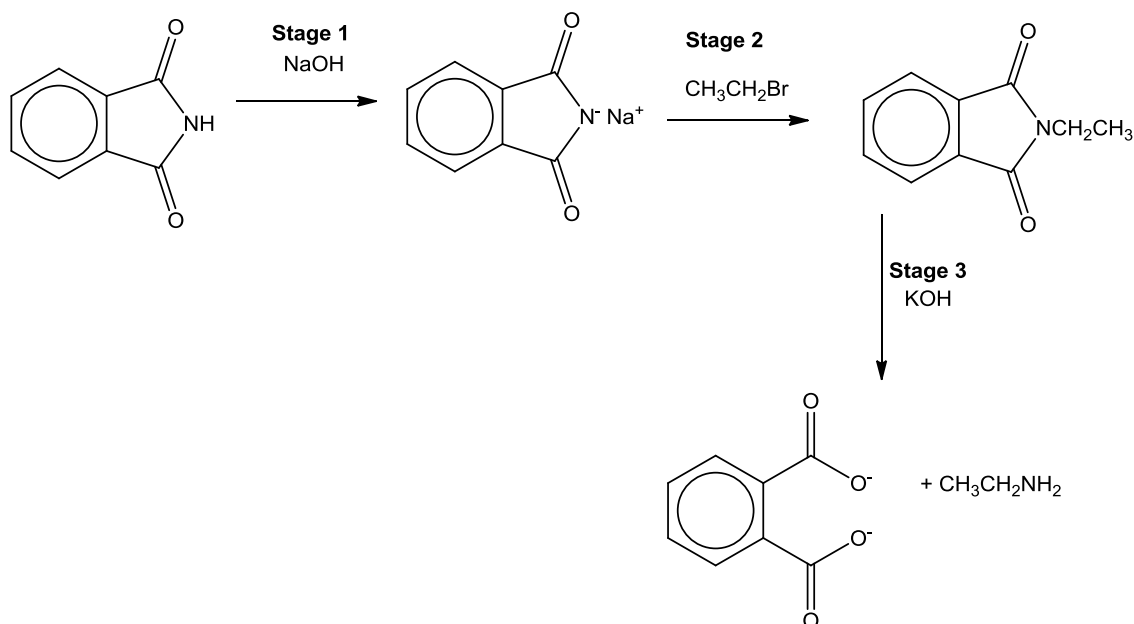


III

- Compounds I and III will not decolourise Br_2 in CCl_4 .
- Compounds I and II will decolourise acidified KMnO_4 at 298 K.
- Compound III will not react with chlorine in the presence of uv light.
- 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

19 A sequence of reactions is shown below.

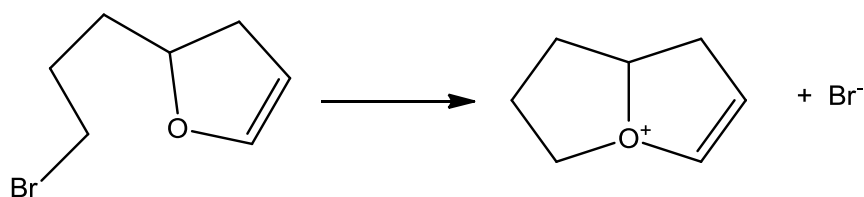


Which of the following correctly describes the type of reactions for Stages 1 to 3?

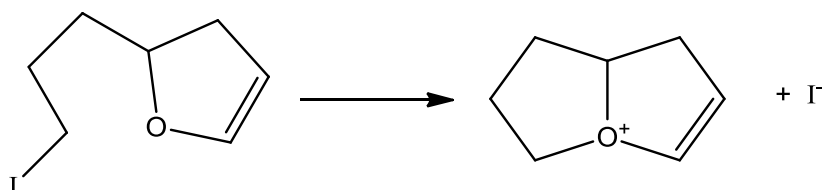
	Stage 1	Stage 2	Stage 3
A	neutralisation	electrophilic substitution	nucleophilic substitution
B	hydrolysis	nucleophilic substitution	hydrolysis
C	redox	nucleophilic addition	nucleophilic substitution
D	neutralisation	nucleophilic substitution	hydrolysis

20 The intramolecular reactions below occur via nucleophilic substitution mechanism.

Reaction 1



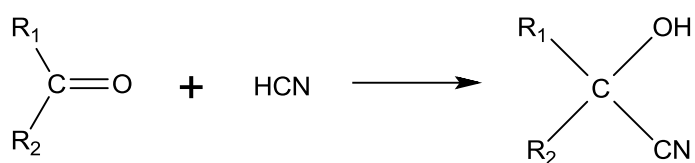
Reaction 2



Reaction 2 is faster than reaction 1 under identical conditions.

Which statement explains this difference?

- A** Br is more electronegative than I.
 - B** The I^- ion is a stronger nucleophile than Br^- .
 - C** The C–Br bond is more polar than the C–I bond.
 - D** The C–Br bond is stronger than the C–I bond.
- 21** Cyanohydrins can be made from carbonyl compounds by generating CN^- ions from HCN in the presence of a weak base.

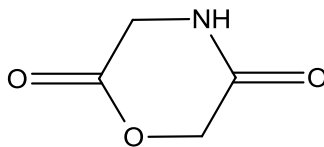


In a similar reaction, $^-\text{CH}_2\text{COOCH}_3$ ions are generated from $\text{CH}_3\text{COOCH}_3$ by strong bases.

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** $(\text{CH}_3)_2\text{C}(\text{OH})\text{CH}_2\text{COOCH}_3$

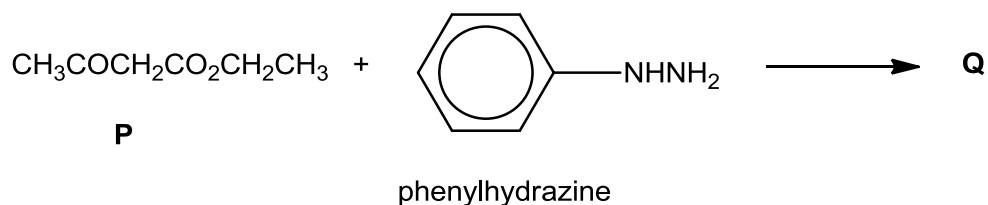
- 22 The cyclic compound **X** is heated with acidified KMnO_4 .



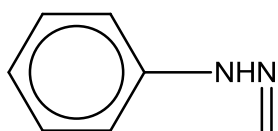
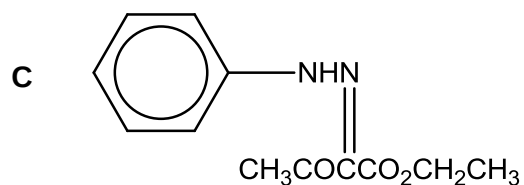
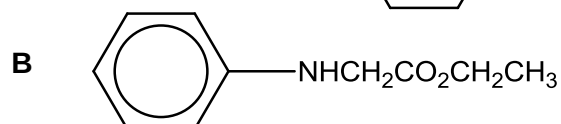
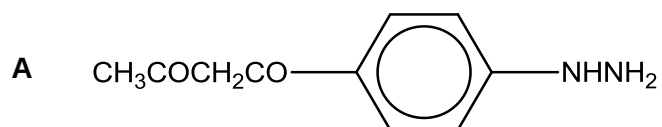
Compound **X**

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
- 23 The first stage in the synthesis of *Antipyrine*, a fever medication, is the reaction between compound **P** and phenylhydrazine.

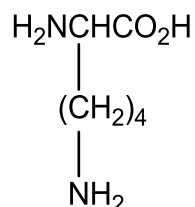


Which of the following correctly represents the structure of product **Q**?

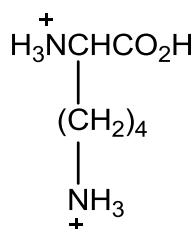


D

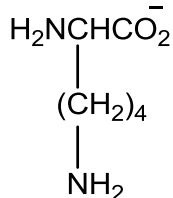
- 24 Lysine is an α -amino acid.



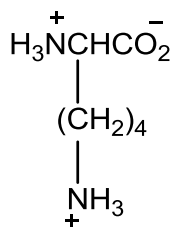
Which structure is predominant when lysine is in an aqueous solution of pH 9.5, given that lysine has three pK_a values of 2.2, 8.9 and 10.5?



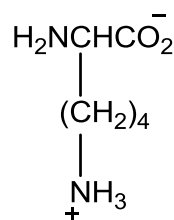
A



B



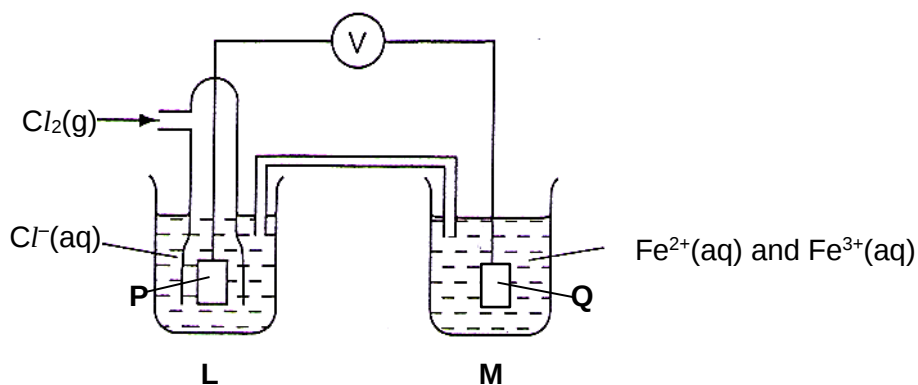
C



D

- 25 Use of the Data Booklet is relevant to this question.

The cell shown below is set up under standard conditions where **P** and **Q** are platinum electrodes.



Which of the following statements is correct?

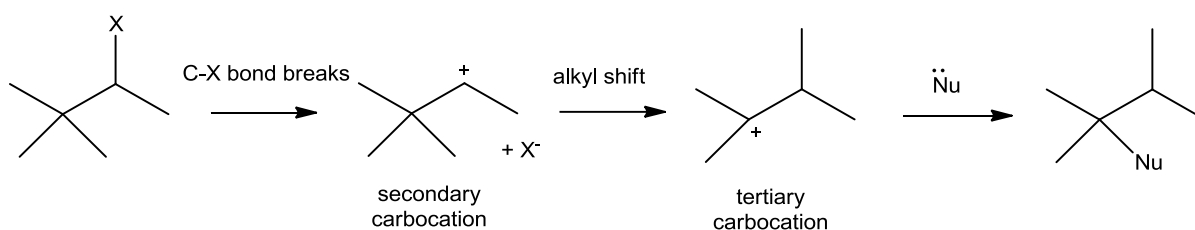
- A Addition of KCN to half-cell **M** will not affect $E_{\text{cell}}^\ominus$.
 B The voltmeter will show a reading of about 2.13 V.
 C The electrons will flow from **Q** to **P** through the voltmeter.

D P will be the negative electrode.

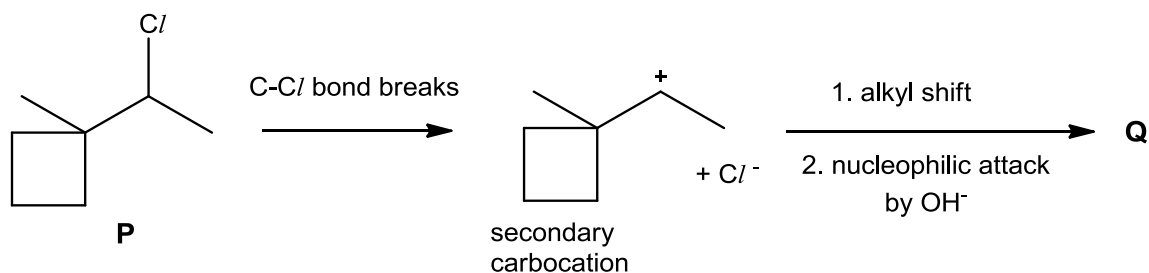
- 26** During electroplating, a current is passed through a cell containing aqueous silver nitrate using inert electrodes. After some time, 1.35 g of silver was deposited at one electrode. What volume of gas would be produced at the other electrode at r.t.p.?

A 70 cm³ **B** 75 cm³ **C** 140 cm³ **D** 150 cm³

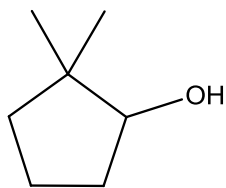
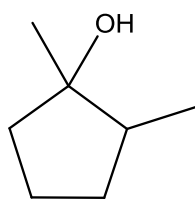
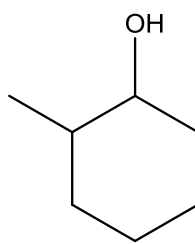
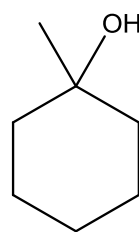
- 27** In S_N1 reactions involving secondary halogenoalkanes, alkyl shift can sometimes occur after the breaking of C–X bond to form a more stable tertiary carbocation.



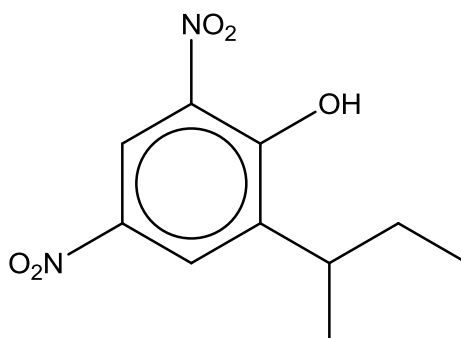
Rearrangements need not always involve methyl groups. In situation when the carbocation is formed adjacent to a strained ring, such as a cyclobutane, it is more favourable for one of the alkyl groups in the ring, rather than the methyl group, to shift so as to cause **ring expansion** and the formation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



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

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

28 *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.

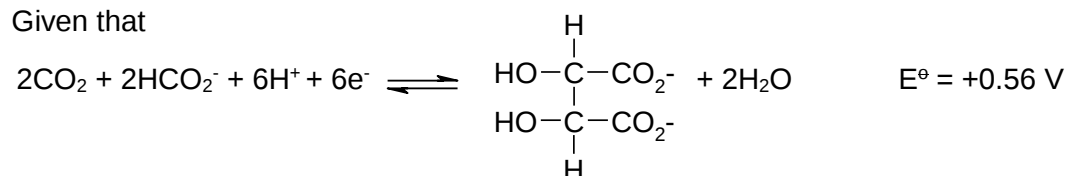
- A** 2 only
B 2 and 3 only
C 1 and 4 only
D 1, 2, 3 and 4 only

29 *Use of the Data Booklet is relevant to this question.*

The reaction between peroxodisulfate(VI) ion, $\text{S}_2\text{O}_8^{2-}$, and tartrate ion, $[\text{CH}(\text{OH})\text{CO}_2^-]_2$, is slow due to a high activation energy.

The reaction can be catalysed by a homogeneous catalyst.

Given that



Which metal ion is **not** a suitable catalyst for this reaction?

- A** Co^{2+} **B** Cr^{2+} **C** Mn^{3+} **D** Fe^{3+}

- 30** Chromium forms a series of compounds with the general formula $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$. One of these compounds, **X** is violet and produces an aqueous solution from which all the chlorine can be precipitated as AgCl upon addition of aqueous silver nitrate. Another compound **Y** is green and produces an aqueous solution from which only one third of the chlorine can be precipitated with silver nitrate.

Which of the following statements about **X** and **Y** is **incorrect**?

- A** **X** is an ionic compound consisting of $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ and Cl^- ions.
- B** **Y** is an ionic compound consisting of $[\text{Cr}(\text{Cl})_2(\text{H}_2\text{O})_4]^+$ and Cl^- ions.
- C** Oxidation number of Cr in **X** is +3 while the oxidation number of Cr in **Y** is +1.
- D** Oxidation number of Cr in **X** and **Y** remains unchanged during precipitation of AgCl .