



Catholic Junior College
JC 2 Preliminary Examinations
Higher 2

CANDIDATE
NAME

CLASS

CHEMISTRY

9729/01

Paper 1 Multiple Choice

Tuesday 3 September 2019

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

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

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.

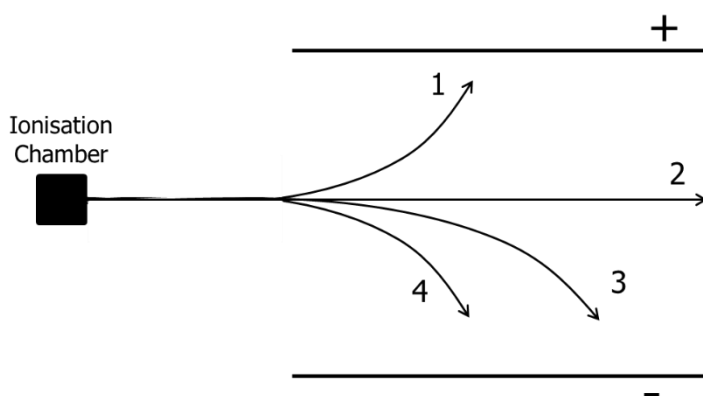
Any rough working should be done in this booklet.

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

- A** NaH_2PO_3 **C** Na_3PO_3
B Na_2HPO_3 **D** Na_3PO_4

- | | volume of ethene | volume of propane |
|----------|------------------|-------------------|
| A | 10 | 40 |
| B | 20 | 30 |
| C | 30 | 20 |
| D | 40 | 10 |

- A small amount of Plutonium-239 and Rubidium-87 are separately placed in an ionisation chamber to emit a constant stream of radiation and the emitted particles are passed through an electric field.



	Plutonium-239 (α -particles)	Rubidium-87 (β -particles)
A	1	2
B	1	3
C	4	1
D	3	1

- 4 Diazene has a molecular formula of N_2H_2 . Given that the nitrogen and hydrogen show their usual valencies, which of the following correctly describes the shape and bond angle around each central atom?

	shape	bond angle
A	bent	110°
B	linear	180°
C	tetrahedral	109°
D	trigonal planar	120°

- 5 Which of the following contains delocalised electrons?

- 1 Graphite
- 2 Sodium
- 3 Ethanoate ion
- 4 Cyclohexene

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

- 6 Which equation corresponds to the enthalpy change stated?

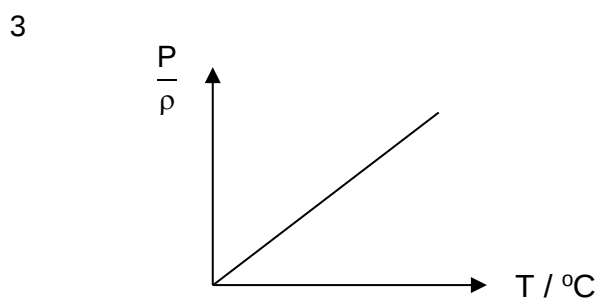
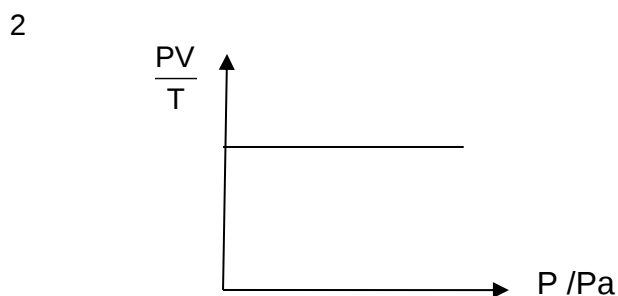
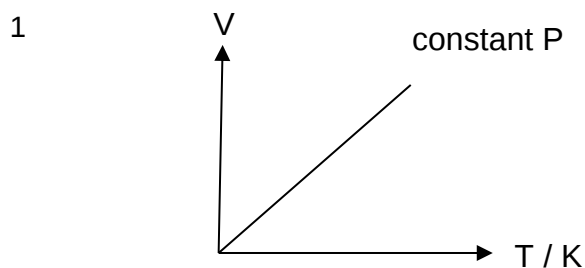
- A** $\text{Ba}(\text{OH})_2(\text{aq}) + 2\text{HCl}(\text{aq}) \rightarrow \text{BaCl}_2(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$ $\Delta H^\circ_{\text{neutralisation}}$
B $\text{Na}_2\text{SO}_4(\text{s}) + \text{aq} \rightarrow 2\text{Na}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$ $\Delta H^\circ_{\text{solution}}$
C $\text{S}_8(\text{s}) + 8\text{O}_2(\text{g}) \rightarrow 8\text{SO}_2(\text{g})$ $\Delta H^\circ_{\text{formation}}$
D $\text{Br}_2(\text{l}) \rightarrow 2\text{Br}(\text{g})$ $\Delta H^\circ_{\text{atomisation}}$

- 7 In which of the following processes will ΔS be negative?

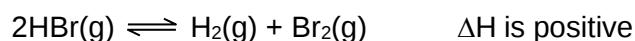
- A** photosynthesis
B electrolysis of water
C boiling of water
D dissolving solid MgSO_4 in water

- 8 Which of the following diagrams correctly describes the behaviour of a fixed mass of an ideal gas?

(P = pressure, ρ = density, V = volume, T = temperature).



- A 1 only
 B 1 and 2 only
 C 2 and 3 only
 D 1, 2 and 3
- 9 A sample of HBr gas was decomposed in a sealed container at temperature T . The decomposition equation is given below.

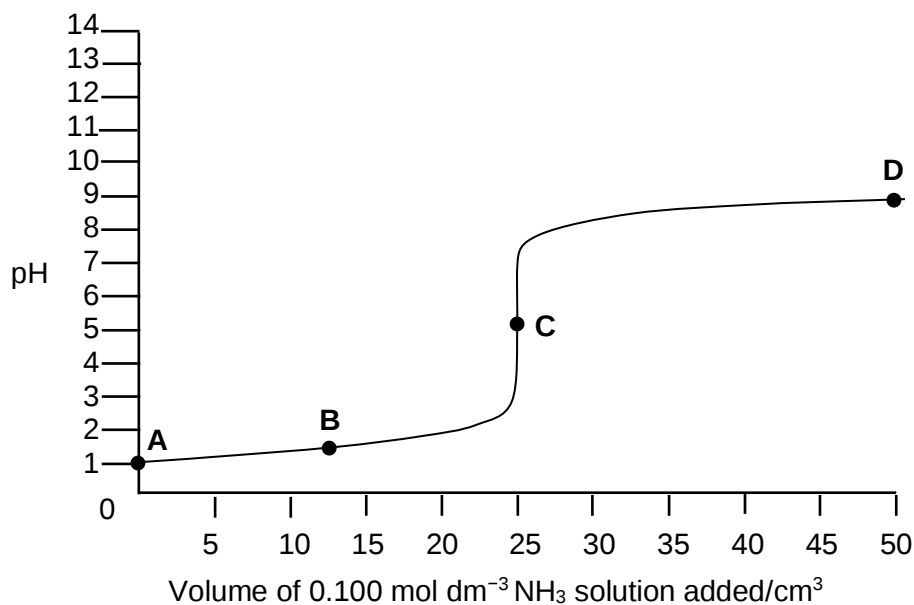


Which of the following statements is **false**?

- A Equal amounts of H_2 and Br_2 are formed at equilibrium.
 B When a catalyst is added, the rates of the forward and reverse reactions are increased by the same extent.
 C The K_c will decrease if the reaction is carried out at higher temperature.
 D The equilibrium position is unaffected when the volume of the container is decreased.

- 10** The pH changes when $0.100 \text{ mol dm}^{-3} \text{ NH}_3(\text{aq})$ is added dropwise to 25.0 cm^3 of $0.100 \text{ mol dm}^{-3} \text{ HCl}$ as shown below.

At which point on the graph does $\text{pOH} = \text{p}K_b$, where K_b is the base dissociation constant of the weak base?



- 11** Ammonia usually reacts as a base. In which reaction does it behave as an acid?

- 1 $\text{Hg}_2\text{Cl}_2 + 2\text{NH}_3 \rightarrow \text{Hg} + \text{HgCl}(\text{NH}_2) + \text{NH}_4^+ + \text{Cl}^-$
- 2 $\text{Cu}^{2+}(\text{aq}) + 4\text{NH}_3(\text{aq}) \rightarrow [\text{Cu}(\text{NH}_3)_4]^{2+}(\text{aq})$
- 3 $\text{HCl}(\text{g}) + \text{NH}_3(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$

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

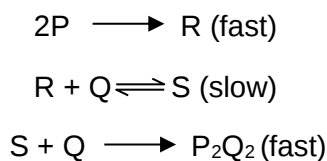
- 12** The table shows experimental results obtained for the reaction of hydrogen peroxide with acidified iodide ions to liberate iodine.

<i>initial concentrations of reactants / mol dm⁻³</i>			<i>initial rate of formation of iodine / mol dm⁻³ s⁻¹</i>
[H ₂ O ₂]	[I ⁻]	[H ⁺]	
0.010	0.010	0.010	2.0×10^{-6}
0.030	0.010	0.010	6.0×10^{-6}
0.030	0.020	0.010	1.2×10^{-5}
0.030	0.020	0.020	1.2×10^{-5}

What can be deduced from these results?

- 1 The rate equation for the reaction can be written: $\text{rate} = k[\text{H}_2\text{O}_2][\text{I}^-]$.
 - 2 The reaction is zero order with respect to acid.
 - 3 The units of rate constant is $\text{mol}^{-2} \text{dm}^6 \text{s}^{-1}$.
 - 4 Both hydrogen peroxide and iodide ions are involved in the rate-determining step.
- A** 1 and 2 only
B 3 and 4 only
C 1, 2 and 4
D 2, 3 and 4

- 13** The mechanism for a certain reaction is given below:



What conclusion can be drawn from the above mechanism?

- A** The rate equation is $\text{rate} = k[\text{P}]^2[\text{Q}]$.
B The overall order of reaction is 2.
C The units of the rate constant, k , is $\text{mol}^{-1} \text{dm}^3 \text{s}^{-1}$.
D The half-life of Q is halved when [Q] is doubled,

- 14 Four elements with atomic numbers from 11 to 17 inclusive have the following properties.

- Chloride of **E** dissolves in water and turns moist blue litmus red.
- Oxide of **F** is amphoteric.
- **G** has the lowest electronegativity among these four elements.
- **H** has the smallest atomic radius.

Which of the following is the correct sequence of the four elements in order of increasing atomic number?

- A** F, G, H, E
B F, G, E, H
C G, F, E, H
D G, F, H, E

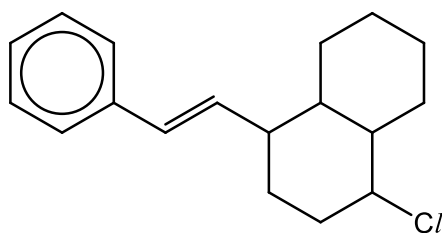
- 15 Use of Data Booklet is relevant to this question.

Which statements about the elements chlorine, bromine and iodine are correct?

- 1 The oxidising power increases from chlorine to iodine.
- 2 The strength of the covalent bonds in the molecules decreases from chlorine to iodine.
- 3 The magnitude of the first electron affinity increases from chlorine to iodine.

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

- 16 How many stereoisomers does compound **Q** exhibit?



Compound **Q**

- A** 2 **B** 5 **C** 16 **D** 32

- 17 Which of the following is a **propagation** step in the formation of 1,1-dibromopropane from the reaction between propane and bromine in the presence of ultraviolet light?

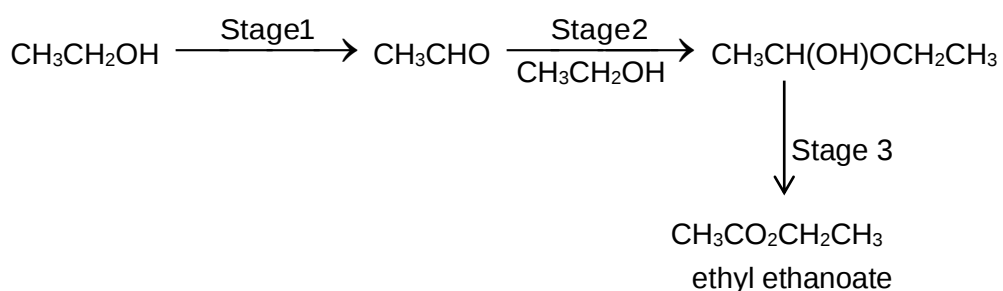
- A** $\text{CH}_3\text{CH}_2\text{CH}_2\text{Br} + \text{Br}\bullet \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\bullet + \text{Br}_2$
B $\text{CH}_3\text{CH}_2\text{CH}_2\bullet + \text{Br}\bullet \rightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$
C $\text{CH}_3\text{CH}_2\text{CH}_2\bullet + \text{Br}_2 \rightarrow \text{CH}_3\text{CH}_2\text{CHBr}\bullet + \text{HBr}$
D $\text{CH}_3\text{CH}_2\text{CHBr}\bullet + \text{Br}_2 \rightarrow \text{CH}_3\text{CH}_2\text{CHBr}_2 + \text{Br}\bullet$

- 18** Methane is a greenhouse gas but is destroyed in the troposphere by the action of hydroxyl radicals.



Which statement about this reaction is correct?

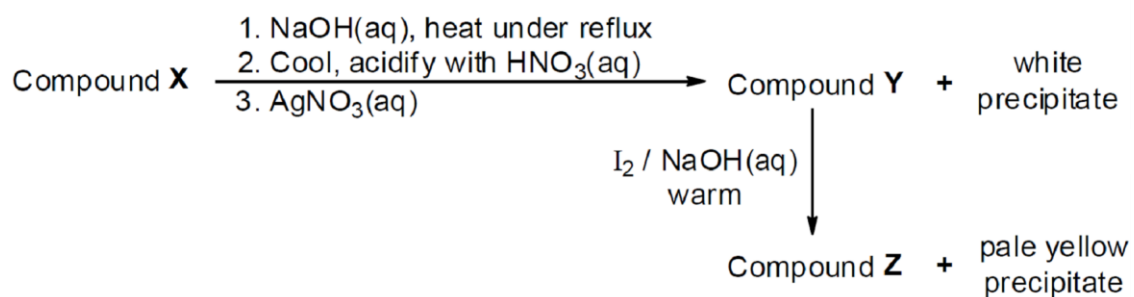
- A** The reaction involves homolytic fission and σ bond formation.
B The reaction involves heterolytic fission and σ bond formation.
C The reaction involves heterolytic fission and π bond formation.
D The total number of electrons in the two reacting species is 20.
- 19** A new industrial preparation of ethyl ethanoate has been developed using cheap sources of ethanol.



Which process is involved at some stage in this reaction sequence?

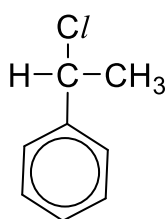
- | | |
|---------------------------------|------------------------------------|
| A electrophilic addition | B nucleophilic substitution |
| C nucleophilic addition | D condensation |

20 Compound **X** was subjected to the following sequence of reactions.

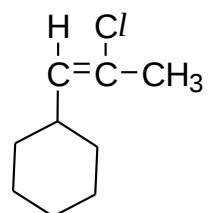


Which of the following could be the structure of **X** ?

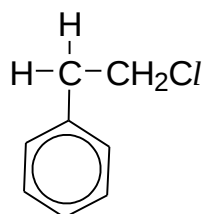
A



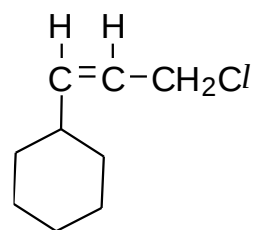
C



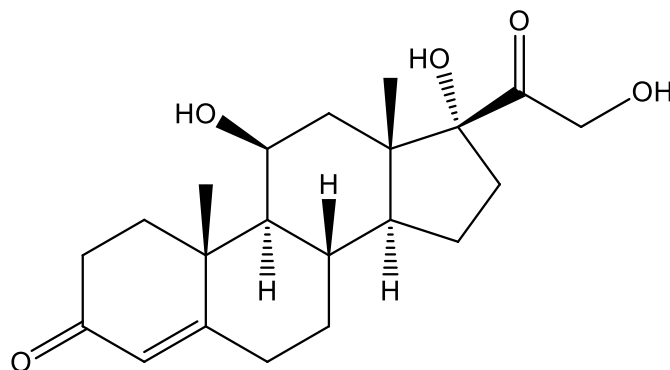
B



D



- 21 Hydrocortisone is commonly used as an active ingredient in anti-inflammatory creams and has the following structure.



hydrocortisone

Which of the following statements about hydrocortisone is correct?

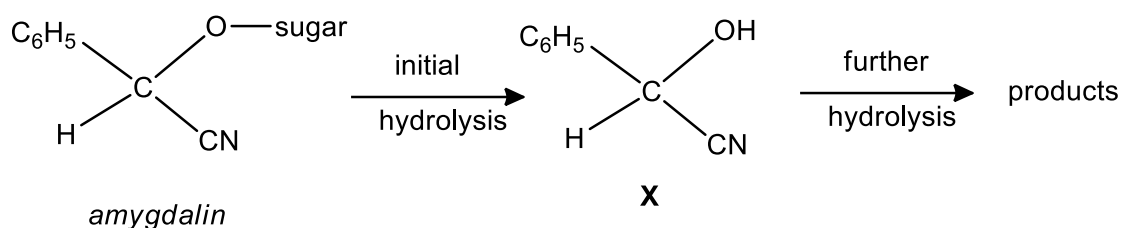
- A** When treated with an excess of hot acidified KMnO_4 , it forms a compound containing six carbonyl groups.
- B** When warmed with aqueous alkaline iodine, a yellow precipitate is observed.
- C** When treated with cold dilute KMnO_4 , it forms a compound containing two additional hydroxy groups.
- D** When treated with NaBH_4 in the presence of methanol, it forms a compound containing seven hydroxy groups.
- 22 Compound **P**, $\text{C}_4\text{H}_8\text{O}_2$, has an unbranched carbon chain. An aqueous solution of **P** has an approximate pH of 3. Compound **Q**, $\text{C}_3\text{H}_8\text{O}$, is a secondary alcohol.

P and **Q** are reacted together in the presence of a small amount of concentrated sulfuric acid to form **R** as the major organic product.

What is the structural formula of **R**?

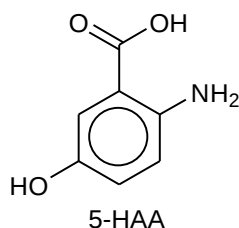
- A** $(\text{CH}_3)_2\text{CHCO}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- B** $\text{CH}_3(\text{CH}_2)_2\text{CO}_2\text{CH}(\text{CH}_3)_2$
- C** $\text{CH}_3(\text{CH}_2)_2\text{CO}_2(\text{CH}_2)_2\text{CH}_3$
- D** $(\text{CH}_3)_2\text{CHCO}_2\text{CH}(\text{CH}_3)_2$

- 23 *Amygdalin* is partly responsible for the flavour of almonds. On hydrolysis, it first gives compound **X**, which is then further hydrolysed to give other products.



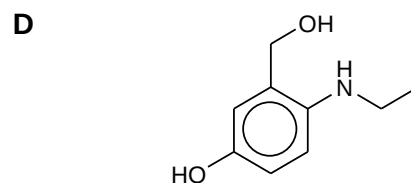
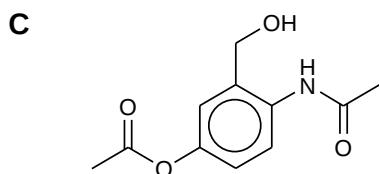
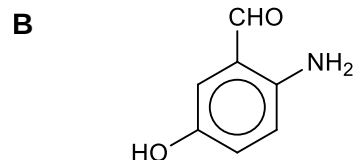
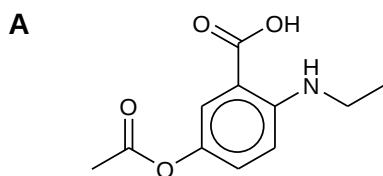
What are the other products formed after further hydrolysis?

- A** $\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{CO}_2\text{H}$ and NH_3
B $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$ and CO_2 and NH_3
C $\text{C}_6\text{H}_5\text{CO}_2\text{H}$ and HCHO and NH_3
D $\text{C}_6\text{H}_5\text{OH}$ and CH_3CN
- 24 5-hydroxyanthranilic acid (5-HAA) is a tryptophan metabolite that is suspected of generating oxidative stress and neuronal death.

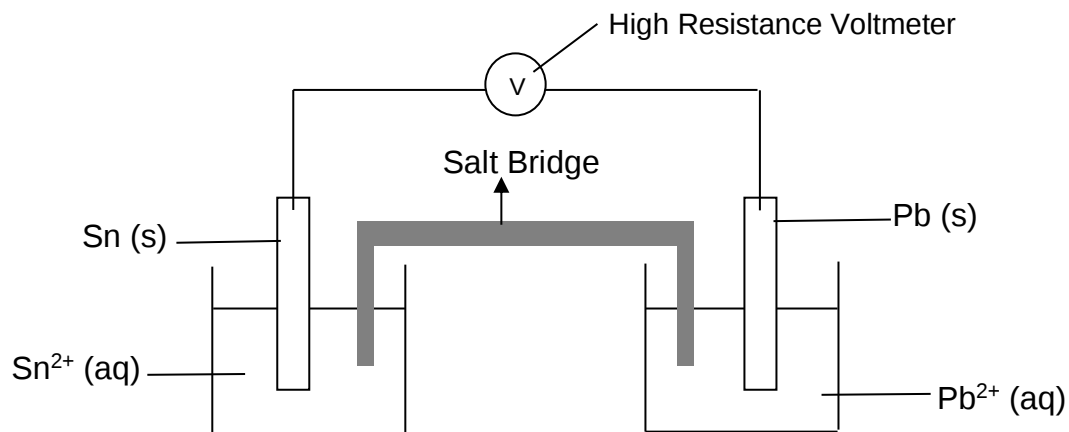


When 5-HAA was reacted with ethanoyl chloride followed by lithium aluminium hydride, LiAlH_4 , in dry ether, the product was found to give a purple colouration with neutral $\text{FeCl}_3(\text{aq})$.

Which is a likely product?



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

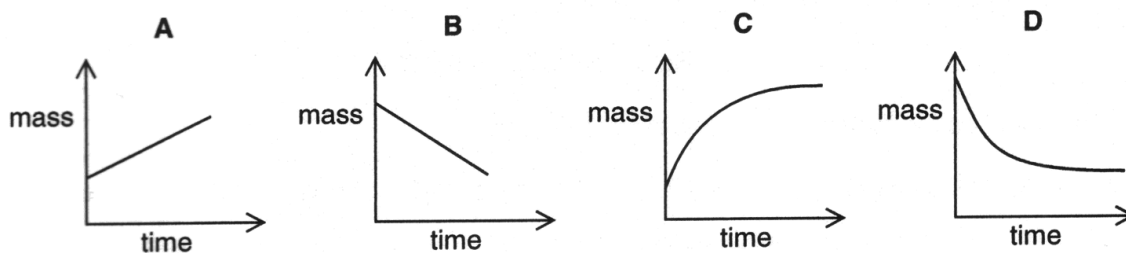


A student set up an electrochemical cell as above and made the conclusion listed below. Which of the statements are correct?

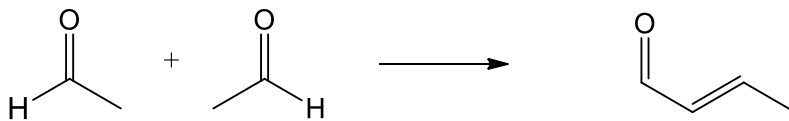
- 1 The reaction is feasible and Pb electrode grows larger with time.
- 2 Electrons flow from the Sn electrode to the Pb electrode.
- 3 Sn is the positive electrode while Pb is the negative electrode.
- 4 Concentrated KCl is suitable to be used as salt bridge.

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

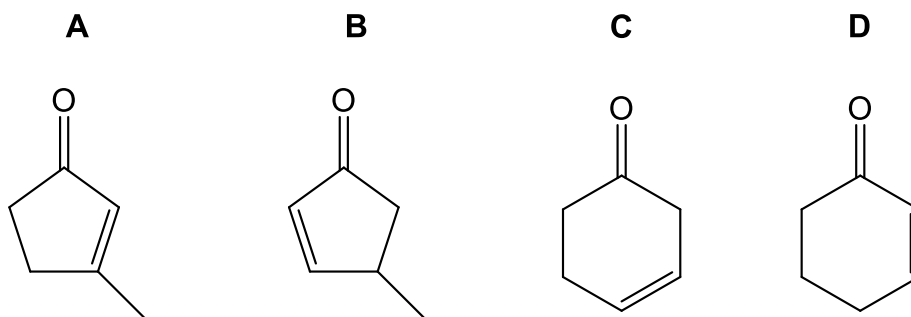
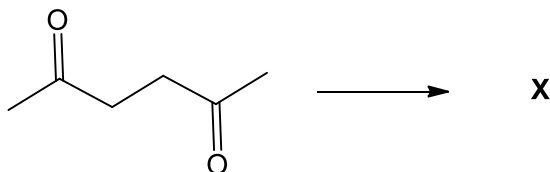
- 26 Electrolysis of aqueous copper(II) sulfate was carried out using copper electrodes and a steady current. Which graph shows the change in mass of the cathode with time?



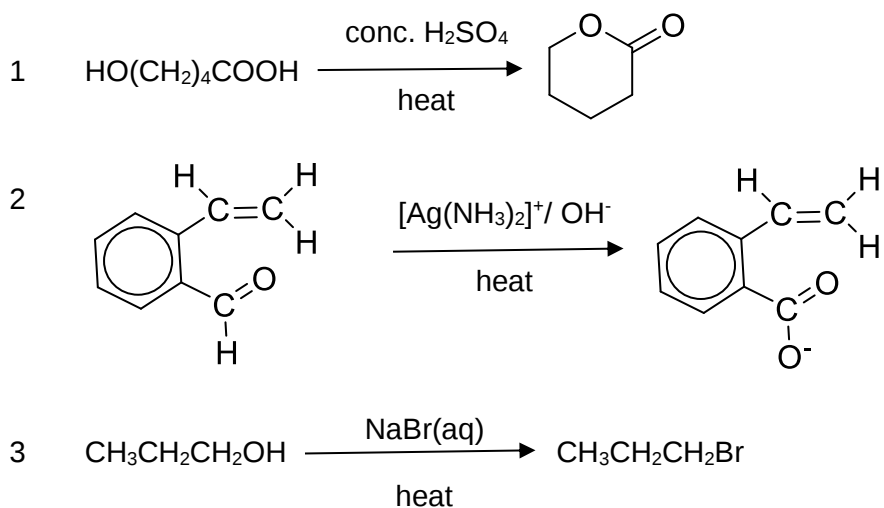
- 27 Aldol condensation is used in the manufacture of pharmaceuticals. One example of such a reaction is as shown below in the presence of a base.



Under similar conditions, what would be the product **X**?



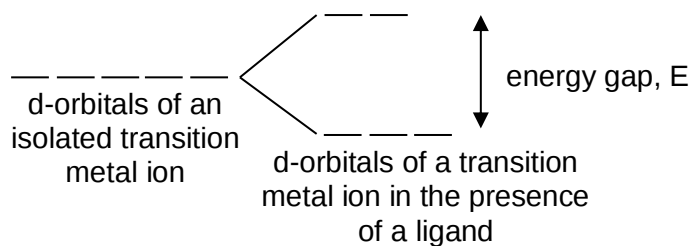
- 28 Which of the following reactions would yield the product shown?



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

29 Use of Data Booklet is relevant to this question.

The following diagram shows how the d-orbitals are split in an octahedral environment.



Some transition metal ions exhibit the ability to change their electronic configuration from a 'high spin' state to a 'low spin' state.

In a 'high spin' state, the electrons occupy all the d-orbitals singly first, before starting to pair up in the lower energy d-orbitals.

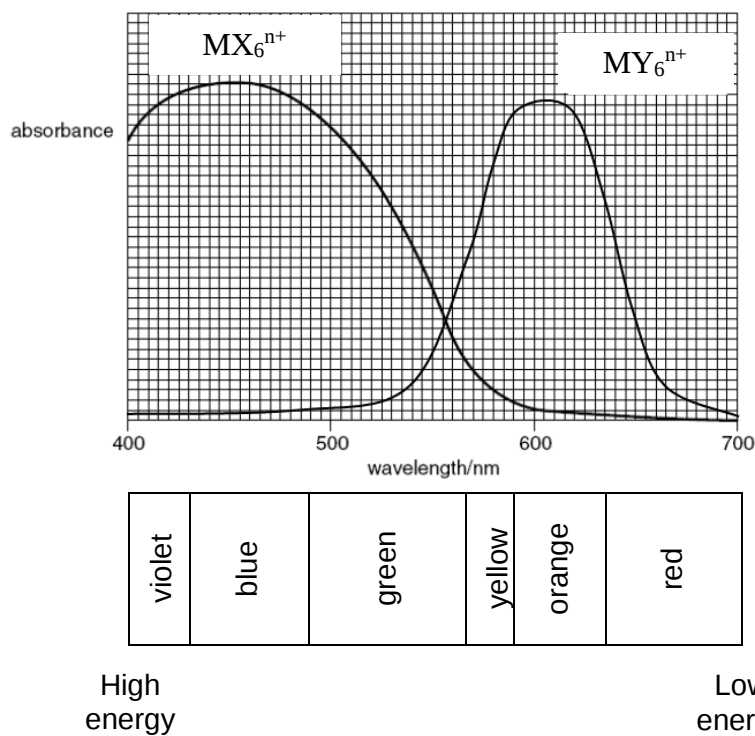
In a 'low spin' state, the lower energy d-orbitals are first filled, by pairing up if necessary, before the higher energy d-orbitals are used.

Which one of the following transition metal ions is likely to be able to exhibit both spin states?

- 1 Fe^{3+}
- 2 Cu^{2+}
- 3 Cr^{3+}
- 4 Co^{3+}

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

- 30 The absorbance graph below shows the visible spectra of two complexes of transition metal M, MX_6^{n+} and MY_6^{n+} .



What is the colour of each complex and which ligand causes a larger d-orbital splitting?

	Colour of MX_6^{n+}	Colour of MY_6^{n+}	ligand which causes a larger d-orbital splitting
A	Violet	Orange-red	X
B	Red	Green-blue	X
C	Violet	Orange-red	Y
D	Red	Green-blue	Y

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