



NATIONAL JUNIOR COLLEGE
SH2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE
NAME

SUBJECT
CLASS

REGISTRATION
NUMBER

CHEMISTRY

Paper 1 Multiple Choice

Additional Materials:

Optical Answer Sheet
Data Booklet

9729/01

Thur 13 September 2018

1 hour

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, subject class and registration number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **30** 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.

This paper consists of **17** printed pages

NJC Preliminary Examination 9729/01/18

Instructions on how to fill in the Optical Mark Sheet

1. Enter your NAME (as in NRIC). <u>TAN AM TECK</u> 2. Enter the SUBJECT TITLE. <u>CHEMISTRY</u> 3. Enter the TEST NAME. <u>SH2 Prelim</u> 4. Enter the CLASS. <u>cmA</u>	RUB OUT ERRORS THOROUGHLY USE PENCIL ONLY FOR ALL ENTRIES ON THIS SHEET <table style="width: 100%; text-align: center; font-size: x-small;"> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <td>☐</td><td>☐</td><td>☒</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td> </tr> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <td>☐</td><td>☒</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td> </tr> <tr> <td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td> </tr> <tr> <td>☒</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td> </tr> </table>	0	1	2	3	4	5	6	☐	☐	☒	☐	☐	☐	☐	0	1	2	3	4	5	6	☐	☒	☐	☐	☐	☐	☐	0	1	2	3	4	5	6	☒	☐	☐	☐	☐	☐	☐
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Student	Examples of Registration No.	Shade:
	<u>1705648</u>	75648

Example:

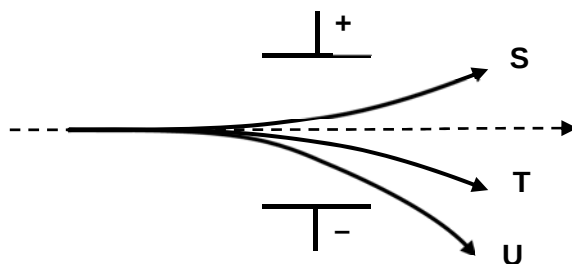
Shade the index number in a 5 digit format on the optical mark sheet:

2nd digit and the last 4 digits of the Registration Number.

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

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

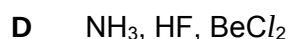
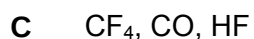
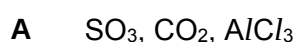
The following are flight paths of charged particles when accelerated in an electric field.



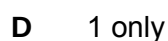
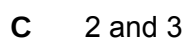
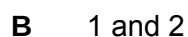
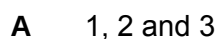
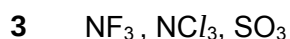
Which correctly identifies **S**, **T** and **U**?

	S	T	U
A	$^{15}\text{O}^+$	$^{14}\text{C}^+$	$^{14}\text{N}^+$
B	$^{15}\text{O}^-$	$^{15}\text{O}^+$	$^{28}\text{Si}^+$
C	$^{14}\text{N}^-$	$^{28}\text{Si}^{2+}$	$^{14}\text{C}^{2+}$
D	$^{14}\text{N}^-$	$^{14}\text{C}^+$	$^{28}\text{Si}^{2+}$

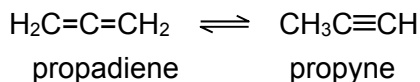
- 2 In which sequence is the molecules listed in the order of increasing dipole moment?



- 3 In which row are the molecules arranged in order of increasing bond angle?



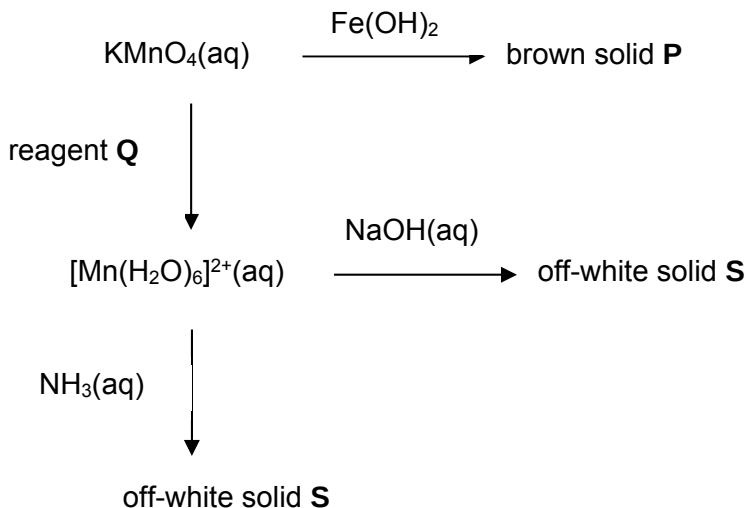
- 4 Propadiene and propyne both have the same molecular formula, C_3H_4 . They exist in equilibrium as shown:



Which bond is present in propadiene but **not** present in propyne?

- A** a σ bond formed by s – sp overlap
- B** a π bond formed by p – p overlap
- C** a σ bond formed by sp – sp² overlap
- D** a σ bond formed by sp² – sp² overlap
- 5** *Use of the Data Booklet is relevant to this question.*

A reaction scheme regarding manganese compounds is shown below.



Which statements are true?

- 1 Off-white solid **S** is able to dissolve in excess of $\text{NH}_3(\text{aq})$.
2 Manganese in brown solid **P** has an oxidation state of +4.
3 Reagent **Q** can be acidified $[\text{V}(\text{H}_2\text{O})_6]^{3+}(\text{aq})$.
4 Off white solid **S** turns brown upon standing.
- A** 1, 2 and 4
B 2, 3 and 4
C 2 and 3
D All correct

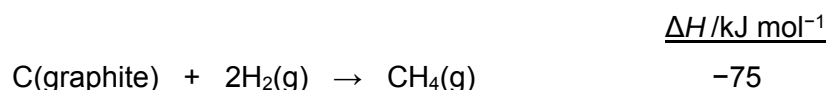
6 In which chemical reaction does the transition metal compound or element behave as the described catalyst?

	Reaction	Catalyst
1	Formation of ethanal from ethanol, using acidified potassium dichromate	Homogeneous
2	Formation of oxygen from hydrogen peroxide, using iron(III) hydroxide	Heterogeneous
3	Chlorination of benzene, using chlorine and iron(III) chloride	Homogeneous
4	Removal of air pollutants in exhaust systems of cars, using nickel	Heterogeneous

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

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

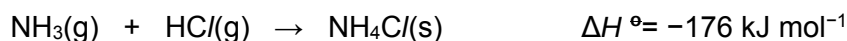
Given the following standard enthalpy changes,



What is the standard enthalpy change of atomisation of graphite?

- A** +693 kJ mol⁻¹
B +1129 kJ mol⁻¹
C -2151 kJ mol⁻¹
D -2587 kJ mol⁻¹

8 Ammonia gas and hydrogen chloride gas react to form ammonium chloride as shown in the equation below:



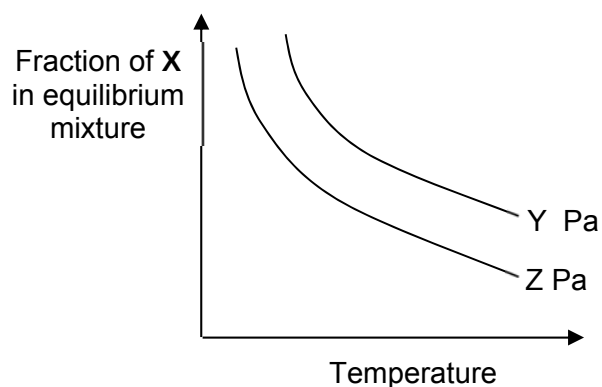
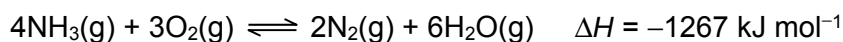
The magnitude of standard entropy change of this reaction is $284 \text{ J K}^{-1} \text{ mol}^{-1}$.

Which statements are correct?

- 1 $\Delta G^\circ = -261 \text{ kJ mol}^{-1}$.
- 2 The reaction becomes non-spontaneous at temperatures higher than 620 K.
- 3 There is an increase in order as strong hydrogen bonding between NH_3 and HCl hold the particles in NH_4Cl in fixed positions and close to each other.

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

- 9 The graph below shows how the fraction of **X**, which represents one of the following compounds in the given equilibrium mixture, varies with temperature at pressures of Y Pa and Z Pa.



Identify **X** and the correct relative magnitudes of Y and Z.

	X	Pressure
A	N_2	$Z > Y$
B	O_2	$Y > Z$
C	H_2O	$Y > Z$
D	NH_3	$Z > Y$

- 10 One of the key production stages in the Contact Process is the production of sulfur trioxide.

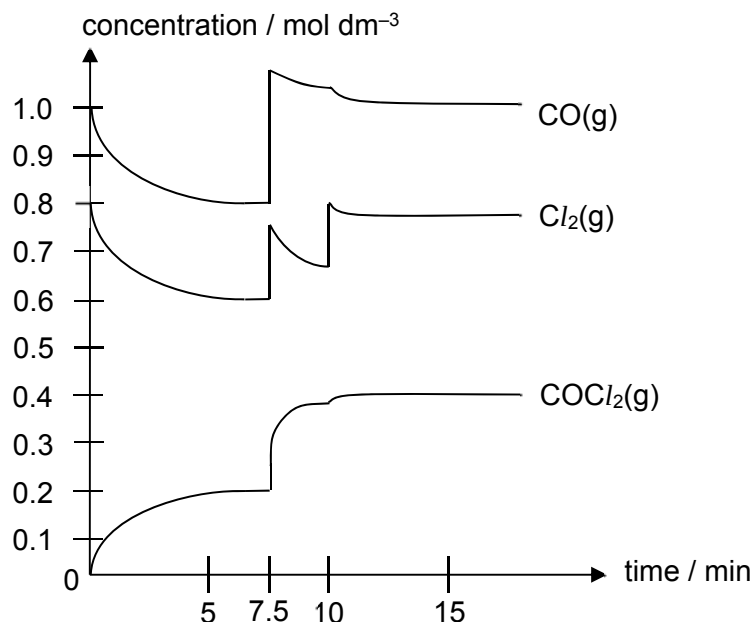
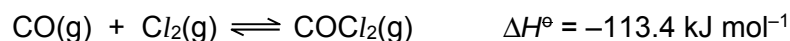


The rate constants of the forward and backward reactions are given as k_1 and k_{-1} respectively.

What happens to k_1 , k_{-1} and K_c if the temperature of the reaction is increased?

	k_1	k_{-1}	K_c
A	increase	increase	increase
B	increase	decrease	increase
C	decrease	increase	decrease
D	increase	increase	decrease

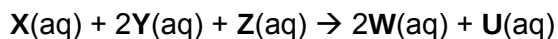
- 11 The reaction between carbon monoxide and chlorine was studied in an experiment by mixing the two gases and changing the reaction conditions inside the reaction vessel at different times during the experiment. The concentrations of the gases in the vessel were followed with time, and the following graph is obtained.



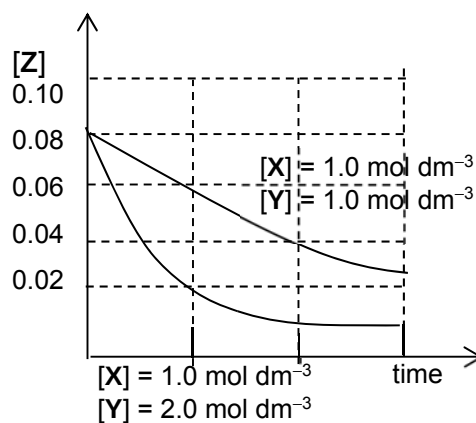
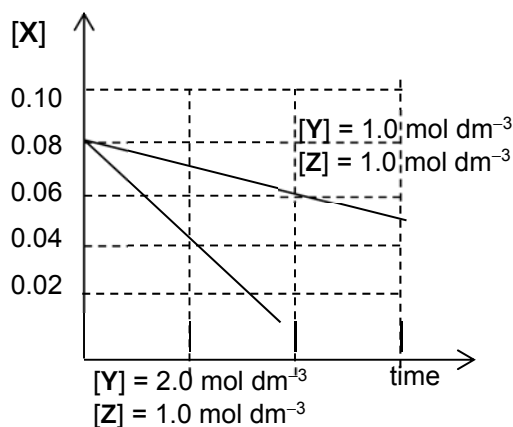
Which conclusion deduced from the graph is **incorrect**?

- A The rate of forward reaction equals the rate of backward reaction at 7 min.
- B The change in concentration from 7.5 min to 10 min was produced by an increase in volume at constant temperature.
- C The equilibrium constant, K_c , for the system when determined at 7 min is $0.417 \text{ mol}^{-1} \text{ dm}^3$.
- D The change in concentration from 10 min to 15 min was produced by the addition of more chlorine.

- 12 Substances X, Y and Z react according to the following equation:



To find the rate equation for the above reaction, two sets of separate experiments were performed, in which the initial concentrations of each of the reactants X, Y and Z were varied while the other two were kept constant. The results are shown below.

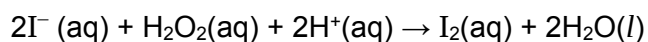


Which rate equations represent the experimental results?

- | | |
|---|---|
| A rate = $k[\text{Y}]^2$ | B rate = $k[\text{Y}][\text{Z}]$ |
| C rate = $k[\text{Y}]^2[\text{Z}]$ | D rate = $k[\text{X}][\text{Y}][\text{Z}]$ |

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

The reaction of acidified aqueous potassium iodide with hydrogen peroxide is represented by the following equation.

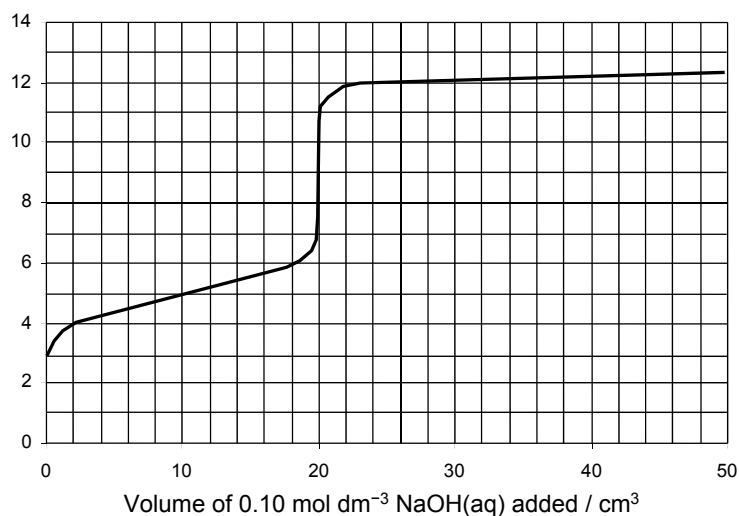


Which statements about the reaction are true?

- 1 $E^\ominus_{\text{cell}} = +1.23 \text{ V}$.
- 2 E_{cell} becomes more negative when $\text{Br}_2(\text{aq})$ is added to the anode.
- 3 E_{cell} becomes more positive when a few drops of $\text{AgNO}_3(\text{aq})$ is added to the anode.

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

- 14 The titration curve below shows the reaction between a monoprotic acid, **HX**, and aqueous sodium hydroxide.



Given the following data:

Indicator	Colour change (acidic to basic medium)	pH range in which colour change occurs
Methyl red	red to yellow	4.2 – 6.3
Bromothymol blue	yellow to blue	6.0 – 7.6
Thymolphthalein	colourless to blue	8.3 – 10.5

What statements are correct?

- 1 Methyl red will indicate an endpoint at a value lower than 20.0 cm³.
- 2 K_a value of HX is 1.0×10^{-5}
- 3 Buffer at maximum buffer capacity is formed at 25.0 cm³ since the pH change in that region is relatively constant.
- 4 Alkaline hydrolysis of salt takes place after the equivalence point accounting for the alkaline pH value of the reaction mixture.

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

15 Given the following data,

$$K_a \text{ of } \text{CH}_3\text{COOH} = 1.8 \times 10^{-5}$$

Reaction mixture X:

25.0 cm³ of $2.0 \times 10^{-5} \text{ mol dm}^{-3}$ CH₃COOH and 25.0 cm³ water

Reaction mixture Y:

25.0 cm³ of 0.02 mol dm^{-3} CH₃COOH and 25.0 cm³ of 0.01 mol dm^{-3} NaOH

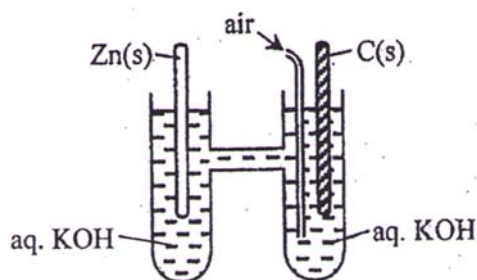
Reaction mixture Z:

25.0 cm³ of 0.01 mol dm^{-3} CH₃COOH and 25.0 cm³ of 0.02 mol dm^{-3} NaOH

Which is the correct order of pH values of the above reaction mixture?

- A $Z > Y > X$
- B $Z > X > Y$
- C $Y > X > Z$
- D $X > Y > Z$

16 A cell is constructed with zinc and carbon electrodes, each weighing 50 g, partly immersed in aqueous KOH.

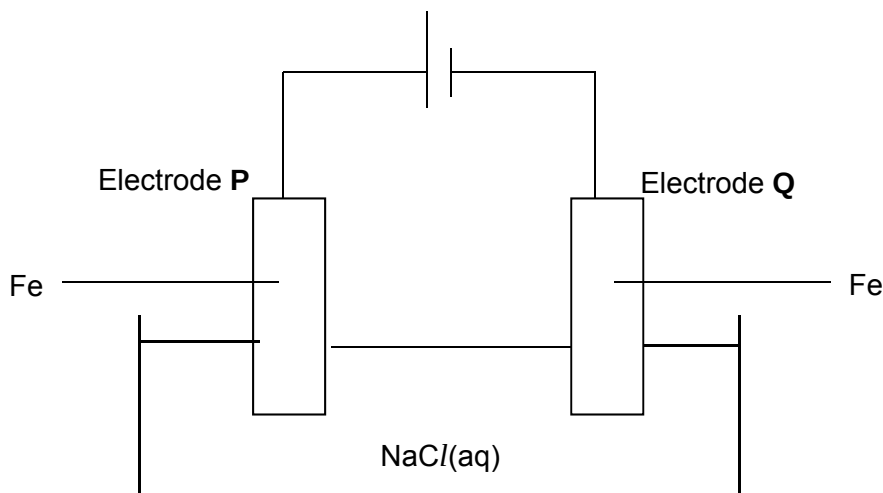


When connected in a circuit, some zinc passes into solution as zincate(II) ions, $\text{ZnO}_2^{2-}(\text{aq})$. The cell delivers a current of $1.68 \times 10^{-2} \text{ A}$. The zinc electrode is replaced once 60% of it is used up.

What is the time taken, in seconds, before replacement of zinc electrode becomes necessary?

- | | |
|----------------------|----------------------|
| A 2.63×10^6 | B 4.39×10^6 |
| C 5.27×10^6 | D 8.78×10^6 |

- 17 An experiment is set up as shown below to study the corrosion of iron.

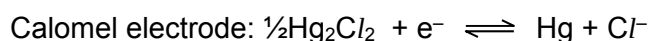


What will occur at electrodes **P** and **Q**?

	Electrode P	Electrode Q
A	No corrosion of Fe	Corrosion of Fe ; H ₂ gas evolved
B	No corrosion of Fe	Corrosion of Fe ; O ₂ gas evolved
C	Corrosion of Fe	No corrosion of Fe ; Na deposited
D	Corrosion of Fe	No corrosion of Fe ; H ₂ gas evolved

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

The calomel electrode was used extensively as a reference electrode in the past. However, it has since been replaced by safer options such as the standard hydrogen electrode (S.H.E.).

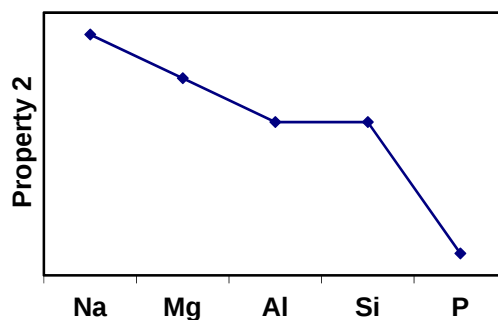
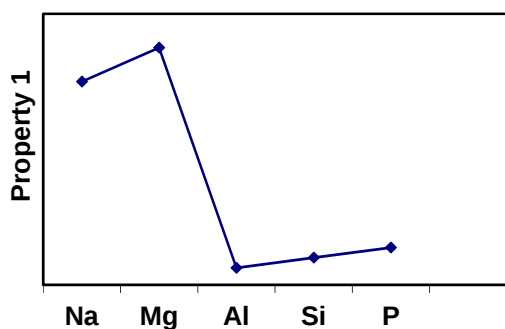


When measured with reference to the calomel electrode, a half-cell containing Zn²⁺/Zn has a change in Gibbs' free energy of +199 kJ per mole of Zn²⁺.

What is the standard electrode potential of the calomel electrode?

- A** +0.27 V **B** +1.30 V **C** -1.79 V **D** -2.82 V

- 19 The graphs below show the variation of two properties of some period 3 elements and/or their compounds.



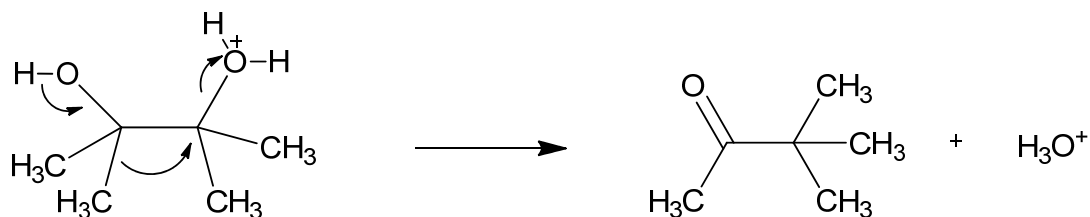
Which correctly describes properties 1 and 2?

Property 1

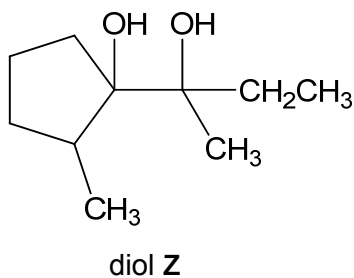
Property 2

- | | |
|---|---|
| A atomic radius of the elements | electrical conductivity of the elements |
| B boiling point of the chlorides at the highest oxidation states | pH of the oxides when added to water |
| C melting point of the oxides | first ionisation energies of the elements |
| D electrical conductivity of elements | pH of the chlorides at the highest oxidation states when added to water |
- 20 What mass of sodium ethanedioate, $\text{Na}_2\text{C}_2\text{O}_4$, should be added to 250 cm^3 of a $2.2 \times 10^{-3} \text{ mol dm}^{-3}$ solution of calcium nitrate before a precipitate is formed?
[K_{sp} of $\text{CaC}_2\text{O}_4 = 2.27 \times 10^{-9} \text{ mol}^2 \text{ dm}^{-6}$]
- | | |
|---|---|
| A $3.5 \times 10^{-5} \text{ g}$ | B $1.0 \times 10^{-6} \text{ g}$ |
| C $2.5 \times 10^{-7} \text{ g}$ | D $2.3 \times 10^{-9} \text{ g}$ |
- 21 Benzylamine has the formula $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$ and is a common precursor in organic synthesis.
- Which statements about benzylamine is correct?
- A** It can be formed by the reduction of $\text{C}_6\text{H}_5\text{CH}_2\text{CN}$.
- B** It reacts with $\text{CH}_3\text{CO}_2\text{H}$ to form $\text{C}_6\text{H}_5\text{CH}_2\text{NHCOCH}_3$.
- C** It is formed by the reaction between $\text{C}_6\text{H}_5\text{NO}_2$ and tin in concentrated HCl , followed by NaOH .
- D** It reacts with excess $\text{CH}_3\text{CH}_2\text{Cl}$ under heat to form the compound, $\text{C}_{13}\text{H}_{22}\text{NCl}$.

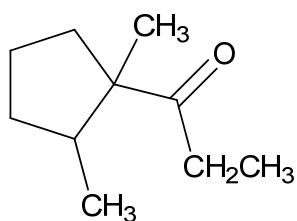
- 22 When a 1,2-diol is treated with a dilute acid, the protonated diol undergoes the following pinacol rearrangement.



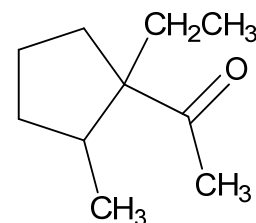
Which structure is **not** formed when diol **Z** undergoes pinacol rearrangement?



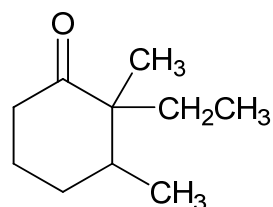
A



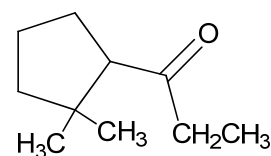
B



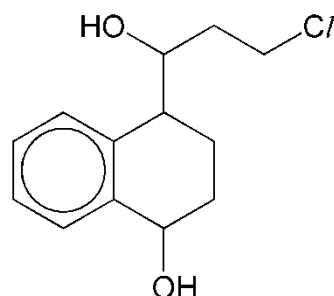
C



D



- 23 What is the total number of possible stereoisomers exhibited by the products when the following compound reacts with excess concentrated H_2SO_4 ?



A 2

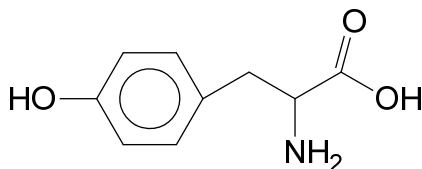
B 4

C 6

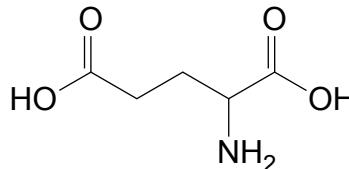
D 8

- 24 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 move towards the anode.

With a buffer at pH 4, which statement is true?



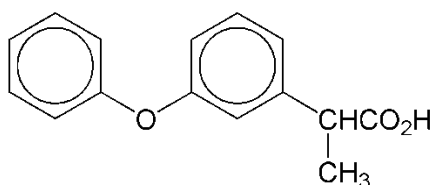
Tyrosine (pI = 5.7)



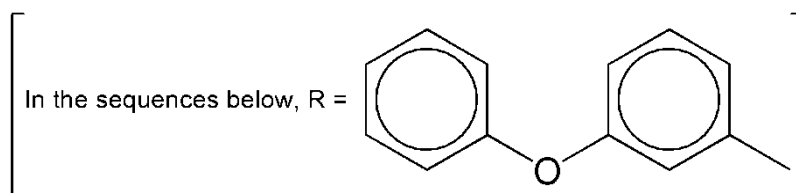
Glutamic acid (pI = 3.2)

- A Both species move towards the anode
- B Both species move towards the cathode.
- C Tyrosine moves towards the anode, glutamic acid moves towards the cathode.
- D Tyrosine moves towards the cathode, glutamic acid moves towards the anode.

- 25 *Fenoprofen* is an anti-arthritic agent.



Which of the following could be part of a reaction sequence for synthesising *Fenoprofen*?



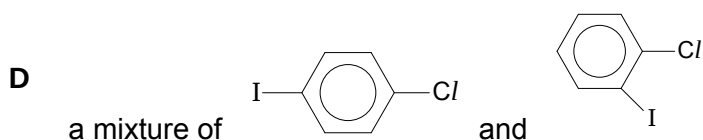
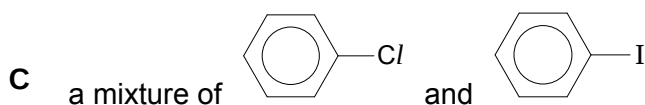
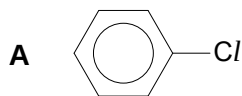
- A $\text{RCHBrCH}_3 \xrightarrow[\text{heat}]{\text{NaCN(ethanolic)}} \text{Intermediate} \xrightarrow[\text{heat}]{\text{H}^+(\text{aq})} \text{Fenoprofen}$
- B $\text{RCH(CH}_3)_2 \xrightarrow[\text{heat}]{\text{KMnO}_4, \text{OH}^-(\text{aq})} \text{Intermediate} \xrightarrow{\text{H}^+(\text{aq})} \text{Fenoprofen}$
- C $\text{RCHOC(=O)CH}_3 \xrightarrow[\text{warm}]{\text{I}_2, \text{OH}^-(\text{aq})} \text{Intermediate} \xrightarrow{\text{H}^+(\text{aq})} \text{Fenoprofen}$
 $\quad \quad \quad |$
 $\quad \quad \quad \text{CH}_3$
- D $\text{RCH(OH)CH}_3 \xrightarrow[\text{heat}]{\text{KMnO}_4, \text{OH}^-(\text{aq})} \text{Intermediate} \xrightarrow{\text{H}^+(\text{aq})} \text{Fenoprofen}$

- 26 Chlorofluorocarbons (CFCs) are commonly used as aerosols, propellants and refrigerants. However in the stratosphere, CFCs can damage the ozone layer through a radical chain reaction.

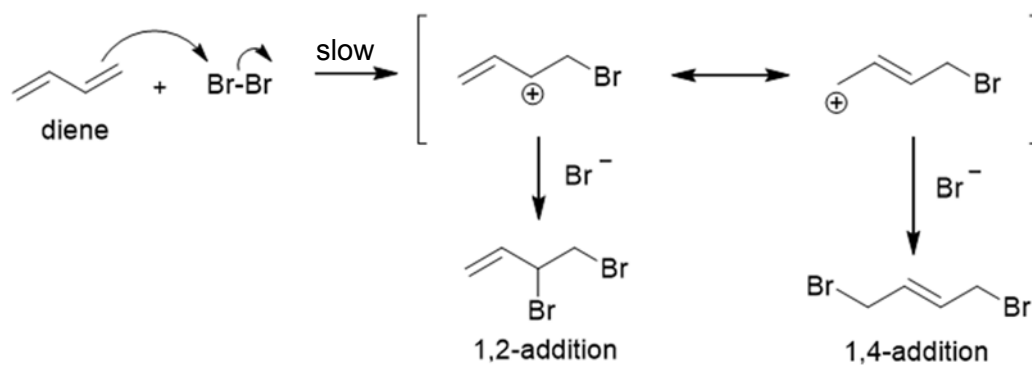
In which sequence are the following compounds listed in increasing order of their ability to destroy ozone?

- A $\text{CHClFCClF}_2 < \text{CCl}_2\text{FCCl}_2\text{F} < \text{CHClF}_2$
- B $\text{CCl}_2\text{FCCl}_2\text{F} < \text{CHClF}_2 < \text{CHClFCClF}_2$
- C $\text{CHClF}_2 < \text{CCl}_2\text{FCCl}_2\text{F} < \text{CHClFCClF}_2$
- D $\text{CHClF}_2 < \text{CHClFCClF}_2 < \text{CCl}_2\text{FCCl}_2\text{F}$

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

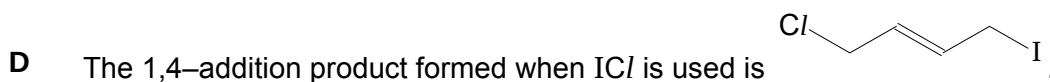
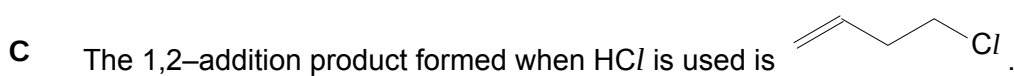


- 28 When a conjugated diene undergoes electrophilic addition with Br_2 , it forms two products through the 1,2-addition and the 1,4-addition, which is shown in the mechanism below.

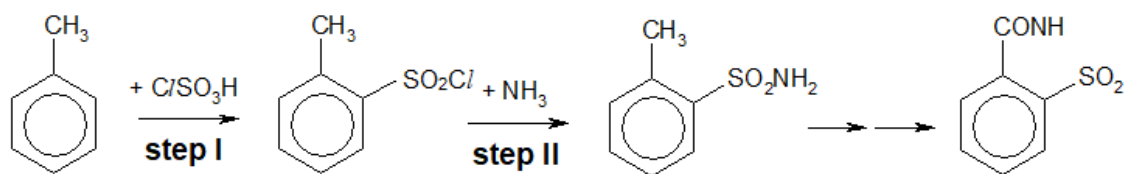


Which statement is **not** correct?

- A The overall rate law is second order.
 B The carbocation intermediates are resonance stabilised.



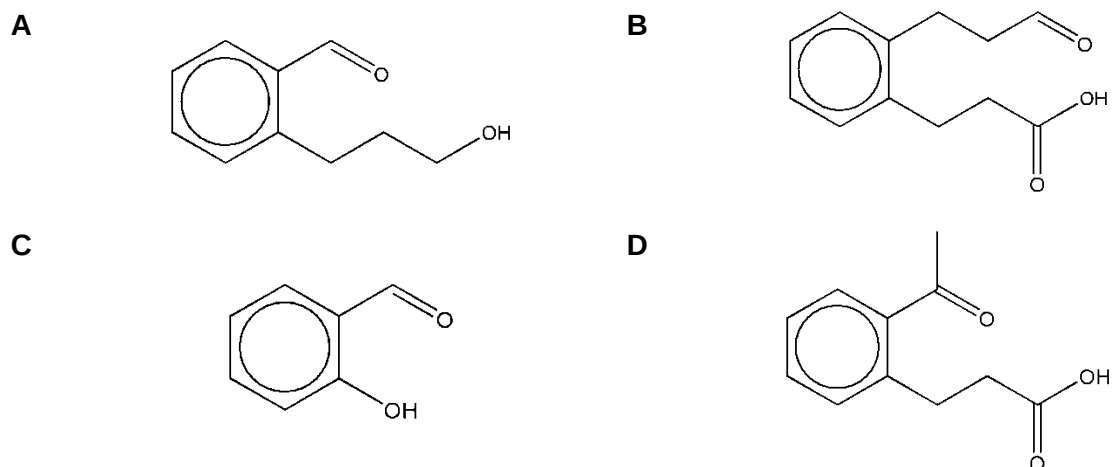
- 29 Saccharin is an artificial sweetening agent used in some soft drinks and is manufactured from methylbenzene through a four-step synthesis. Part of the reaction scheme is shown below.



What type of reaction do steps I and II illustrate?

- | | Step I | Step II |
|---|----------------------------|---------------------------|
| A | Electrophilic addition | Nucleophilic addition |
| B | Electrophilic substitution | Nucleophilic substitution |
| C | Nucleophilic addition | Elimination |
| D | Electrophilic substitution | Neutralisation |
- 30 Compound X gives a positive result when treated with $[\text{Ag}(\text{NH}_3)_2]^+$ and PCl_5 respectively but a negative result when treated with alkaline $\text{Cu}(\text{II})$ complex.

What could X be?



END of PAPER