

TEMASEK JUNIOR COLLEGE
2025 JC2 PRELIMINARY EXAMINATION
Higher 2



CHEMISTRY

9729/01

Paper 1 Multiple Choice

17 September 2025

1 hour

Additional Materials: Multiple Choice Answer Sheet (OMS)
Data Booklet

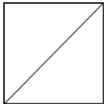
READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.

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

Write your name & Civics Group on the Answer sheet. Shade your index number in the appropriate boxes.

Name	_____		Use only 2B pencil for all entries on this sheet. Shade the bubble completely. Rub out errors thoroughly. Do not make any stray mark on this sheet.
Class	_____		
Test Name	_____		
Subject	_____		

First 2 characters are your class. Next 2 characters are your class index number.
Example:
JC students: write and shade **0501** for CG05 & index number 01.
IP students: write and shade **1A01** for IP1A & index number 01.

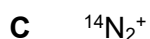
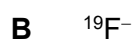
Write		Shade appropriate bubbles															
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
Index Number	0	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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.

1 Which ion would undergo the greatest deflection in an electric field?



2 An isolated gaseous species has paired electrons in at least one of its 3d orbitals and a fully filled 4s subshell.

What could be the identity of the species?



3 Which of the following **cannot** be explained by hydrogen bonding?

A The existence of the hydrogen-difluoride anion, HF_2^{-} .

B The difference in volatility between pentan-1-ol and hexan-1-ol.

C The difference in melting point between 2-nitrophenol and 4-nitrophenol.

D The higher than expected relative molecular mass of ethanoic acid in benzene.

4 Four substances have the physical properties shown.

Which substance exists as a simple molecular solid at room temperature?

	melting point / $^{\circ}\text{C}$	electrical conductivity	solubility in water
A	-7	does not conduct	slightly soluble
B	46	does not conduct	insoluble
C	420	conducts	insoluble
D	782	does not conduct	soluble

5 Which species contain dative (co-ordinate) bonding?

- 1 CO
- 2 N_2H_4
- 3 N_2O_4

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

6 10 cm^3 of a hydrocarbon was mixed with 50 cm^3 of oxygen and combusted completely. After the resulting gas mixture was cooled and passed through aqueous sodium hydroxide, the volume of the residual gas mixture was found to be $\frac{1}{4}$ the volume of the original gas mixture before combustion. All volumes were measured at room temperature and pressure.

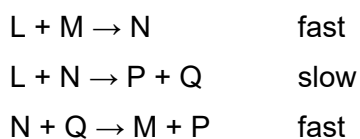
What is the formula of the hydrocarbon?

- A** C_2H_4
- B** C_2H_6
- C** C_3H_6
- D** C_3H_8

7 Which species contains a different number of electrons from the other three?

- A** C/O_4^-
- B** H_2SO_4
- C** SO_4^{2-}
- D** Sn^{2+}

10 Consider the following mechanism.

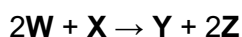


What can be deduced from the mechanism?

- 1 The unit for the rate constant, k , in the rate equation is $\text{mol}^{-1} \text{dm}^3 \text{s}^{-1}$.
- 2 The overall equation is $2\text{L} + \text{N} \rightarrow 2\text{P}$.
- 3 M is a catalyst and Q is an intermediate.

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

11 The kinetics of a reaction was investigated, and the following results were obtained.



run	[W] / mol dm^{-3}	[X] / mol dm^{-3}	initial rate / $\text{mol dm}^{-3} \text{s}^{-1}$
1	0.020	0.015	6.40×10^{-3}
2	0.020	0.030	2.56×10^{-2}
3	0.030	0.030	3.84×10^{-2}

What is the numerical value of the rate constant for this reaction?

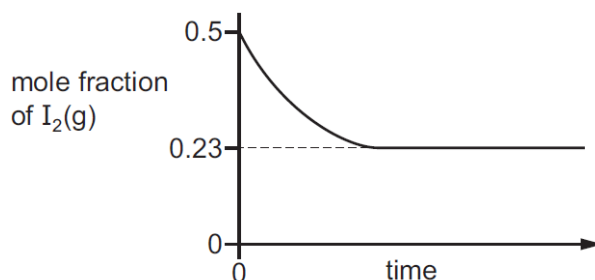
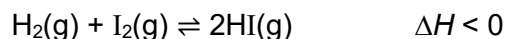
A 0.213 **B** 0.320 **C** 21.3 **D** 1420

12 When an evacuated tube of volume 400 cm^3 is filled with gas at 300 K and 101 kPa, the mass of the tube increases by 0.65 g.

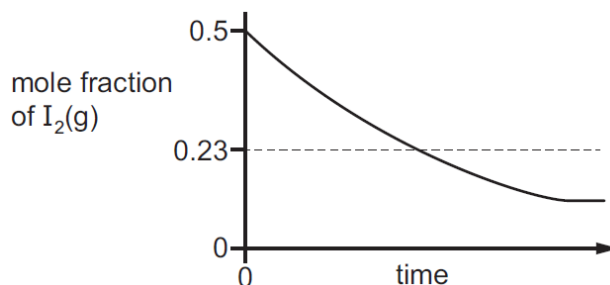
What is the identity of the gas?

A argon **B** helium **C** krypton **D** neon

- 13** Equal amounts of $\text{H}_2(\text{g})$ and $\text{I}_2(\text{g})$ are mixed and the composition of the mixture is monitored. A graph of the results is shown below.



The experiment is repeated with a change in condition and the following graph of results is obtained.



Which of the following is a possible change made in the second experiment?

- A** A catalyst is used in the second experiment.
- B** $\text{H}_2(\text{g})$ and $\text{I}_2(\text{g})$ are mixed in a ratio of 2 : 1 in the second experiment.
- C** The second experiment is conducted at a higher pressure compared to the first experiment.
- D** The second experiment is conducted at a lower temperature compared to the first experiment.

- 14 **X**, **Y** and **Z** represent elements in the Periodic Table.

The first ionisation energy of **X** is greater than the first ionisation energy of **Y**.

The melting point of **Z** is higher than that of **Y**.

Which row shows the possible identities of **X**, **Y** and **Z**?

	X	Y	Z
A	N	P	Al
B	B	Al	P
C	Ga	Al	P
D	As	P	Al

- 15 Which statement about the halogens or halide ions is correct?

- A** Chloride ions are stronger reducing agents than iodide ions.
- B** Bromine does not oxidise chloride ions when added to sodium chloride solution.
- C** A yellow precipitate that is partially soluble in aqueous ammonia is formed when iodine is added to silver nitrate solution.
- D** A pink solution is obtained when one drop of potassium manganate(VII) is added to aqueous sodium bromide solution.

- 16 An aqueous solution containing 0.10 mol dm^{-3} zinc sulfate and 0.10 mol dm^{-3} of copper(II) sulfate is saturated with hydrogen sulfide, H_2S , at 15°C . The concentration of $\text{S}^{2-}(\text{aq})$ in the solution is $10^{-35} \text{ mol dm}^{-3}$.

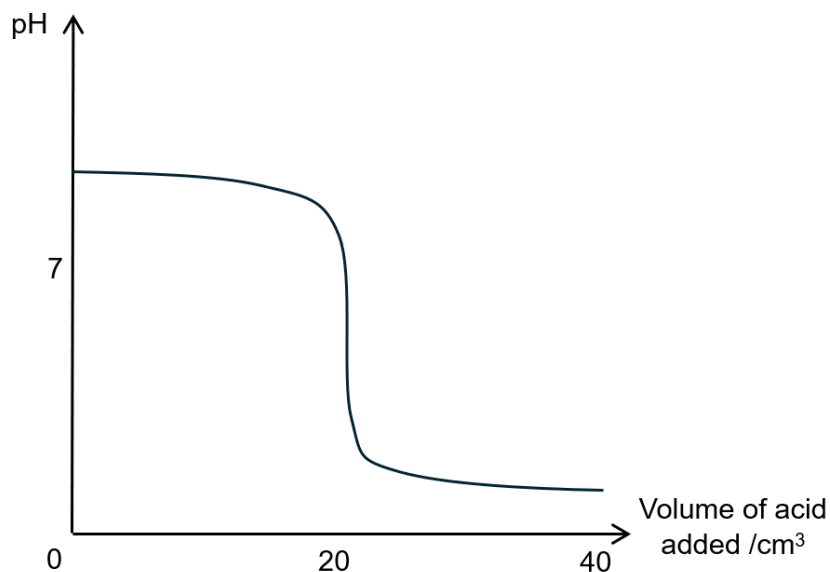
The solubility product, K_{sp} , of zinc sulfide and copper(II) sulfide at 15°C is given below.

	$K_{\text{sp}} / \text{mol}^2 \text{ dm}^{-6}$
zinc sulfide	10^{-24}
copper(II) sulfide	10^{-40}

Which statement describes what happens in the solution?

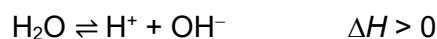
- A** Only zinc sulfide is precipitated.
- B** Only copper(II) sulfide is precipitated.
- C** Copper(II) sulfide is precipitated, followed by zinc sulfide.
- D** More precipitate is observed by lowering the pH of the mixture.

- 17 The graph below shows the change in pH when an acid is gradually added to 10 cm³ of a base.



Which pair of acid and base will give the graph above?

- A 0.1 mol dm⁻³ HCl(aq) and 0.1 mol dm⁻³ NH₃(aq)
 B 0.2 mol dm⁻³ HCl(aq) and 0.2 mol dm⁻³ Ba(OH)₂(aq)
 C 0.1 mol dm⁻³ HCl(aq) and 0.2 mol dm⁻³ NH₃(aq)
 D 0.1 mol dm⁻³ CH₃CO₂H(aq) and 0.2 mol dm⁻³ NaOH(aq)
- 18 Water dissociates as shown.

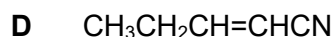
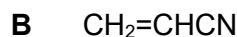
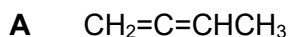


At 25 °C, the concentration of water is given as 55.6 mol dm⁻³.

Which of the following statements are correct?

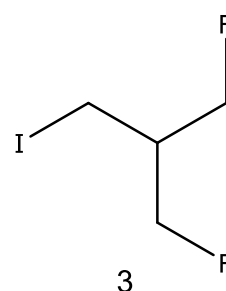
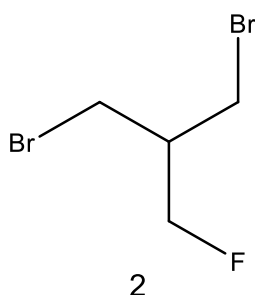
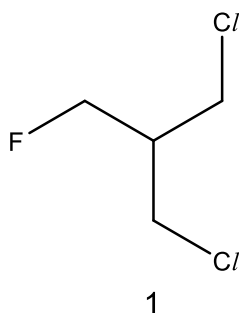
- 1 At 25 °C, the pK_a of water is 14.
 - 2 At 25 °C, the value of pH < pK_w < pK_a of water.
 - 3 At 50 °C, the value of pK_w is lower than 14.
- A 1 and 2 only
 B 1 and 3 only
 C 2 and 3 only
 D 3 only

19 Which molecule contains one sp hybridised and two sp^3 hybridised carbon atoms?

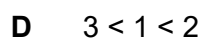
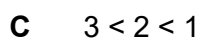
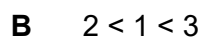
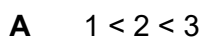


20 The presence of a halogen in an organic compound may be detected by heating the organic compound with ethanolic silver nitrate.

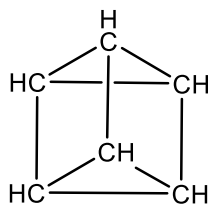
The following three compounds are heated with ethanolic silver nitrate.



Which of the following shows the correct time taken, from the shortest to the longest, for the compounds to produce a precipitate?



21 In 1869, Ladenburg suggested a structure for benzene, C_6H_6 , in which one hydrogen atom is attached to each carbon atom.



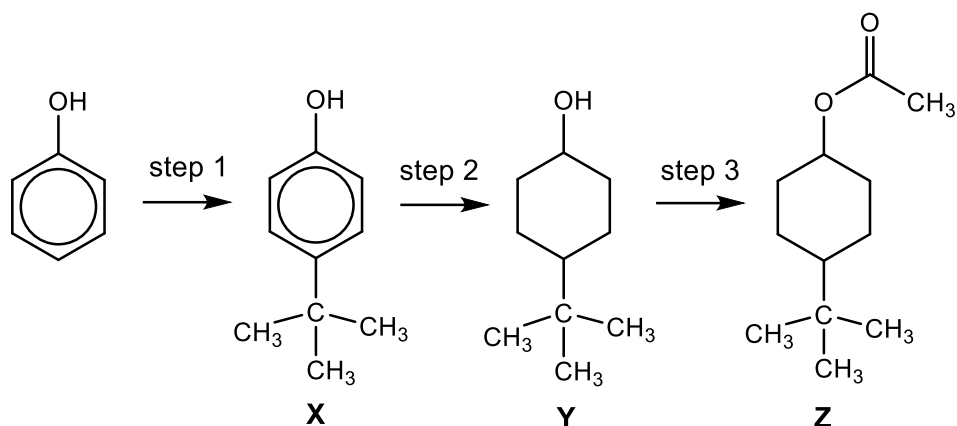
Ladenburg structure

A compound, $C_6H_3Cl_3$, could be formed with the same carbon skeleton as the Ladenburg structure.

How many constitutional isomers would this compound have?



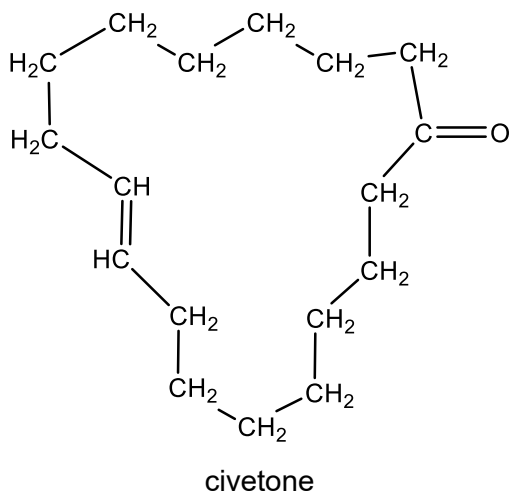
- 22** Compound **Z** is responsible for the pleasant aroma of apples. It can be prepared from phenol by the following 3-step synthesis.



Which row shows the correct information?

	reagent used in step 1	type of reaction occurring in step 2	reagent used in step 3
A	$(\text{CH}_3)_3\text{CCl}$	oxidation	CH_3COCl
B	$(\text{CH}_3)_3\text{CCl}$	reduction	CH_3COOH
C	$(\text{CH}_3)_3\text{COH}$	oxidation	CH_3COCl
D	$(\text{CH}_3)_3\text{COH}$	reduction	CH_3COOH

- 23** The naturally-occurring molecule civetone, $C_{17}H_{30}O$, is found in a gland of the African civet cat and has been used in perfumery.

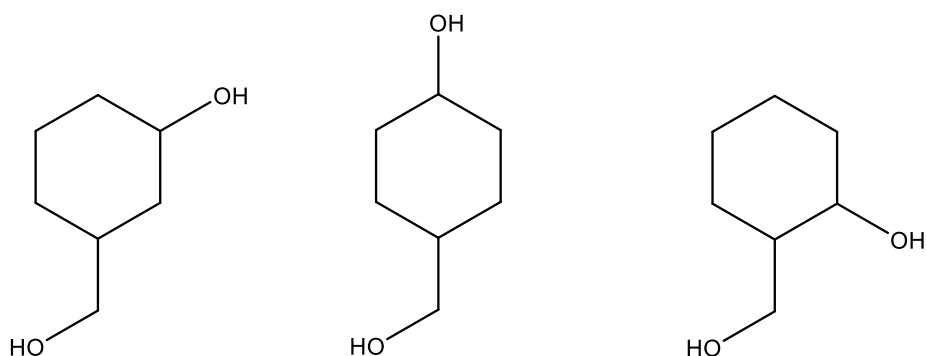


Which statements about civetone are correct?

- 1** Civetone can exhibit stereoisomerism.
- 2** It reacts with Br_2 in CCl_4 to form a product with molecular formula, $C_{17}H_{32}OBr_2$.
- 3** Hydrogen bonding does not exist between molecules of civetone.

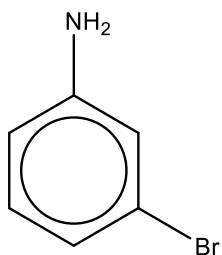
A 1, 2 and 3 **B** 1 and 3 only **C** 2 and 3 only **D** 1 only

- 24** The following three compounds below are heated with excess concentrated H_2SO_4 . How many of these compounds can form more than one final product with the molecular formula, C_7H_{10} ?

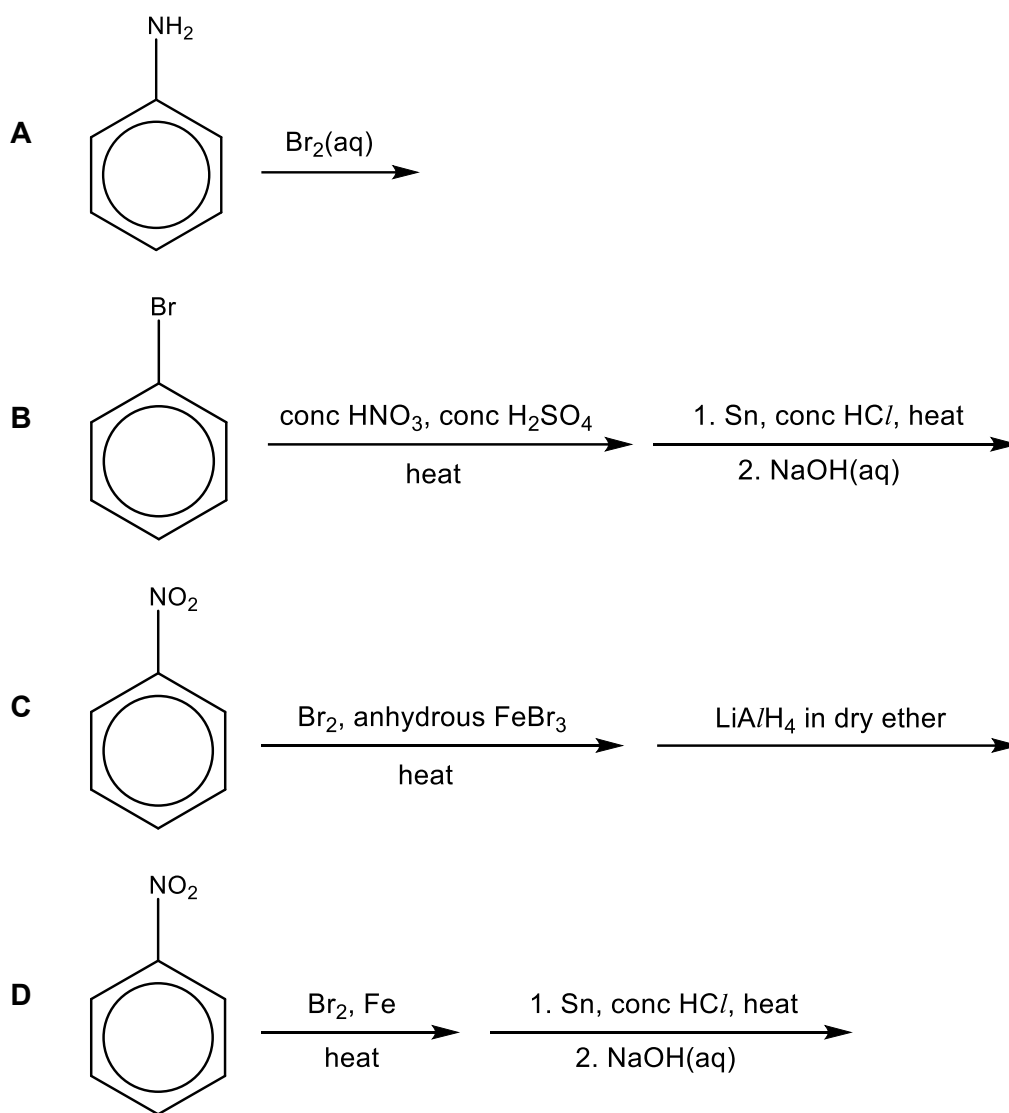


- A** All three compounds **B** Two compounds
C One compound **D** None of the compounds

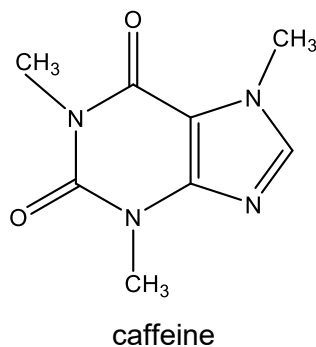
25 Which reaction scheme produces the highest yield of 3-bromophenylamine?



3-bromophenylamine



- 26** Caffeine is a natural stimulant found in coffee, tea, and cacao plants.

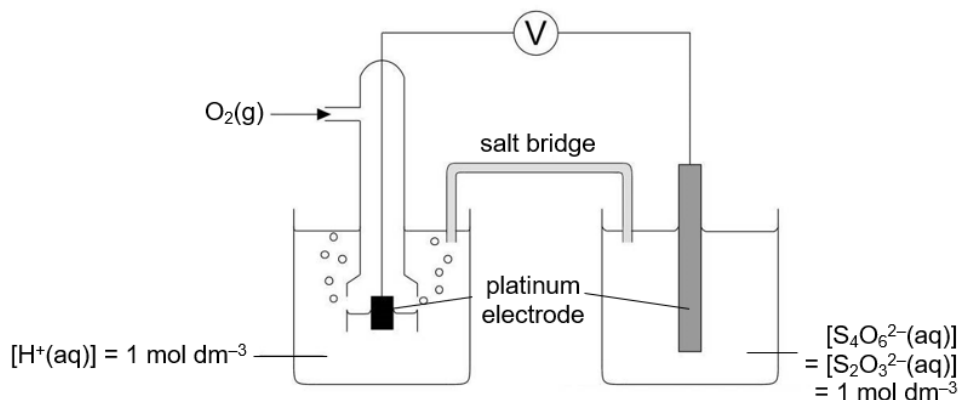


Which statement about the caffeine molecule is correct?

- A** It reacts with NaBH_4 .
 - B** It reacts with ethanoyl chloride to give white fumes.
 - C** It reacts with hot NaOH(aq) to give an alkaline gas.
 - D** 1 mole of caffeine reacts with 4 moles of HCl(aq) at room temperature.
- 27** Which statement about the anodising of an aluminium object is correct?
- A** The aluminium object is placed at the cathode.
 - B** Water is reduced at the cathode to produce H_2 gas.
 - C** Anodising increases the thickness of the aluminium layer of the object.
 - D** A current of 3.2 A is required to form 0.01 mol of coating on the object for 30 minutes.

28 Use of the Data Booklet is relevant to this question.

A cell is set up under standard conditions as shown below.



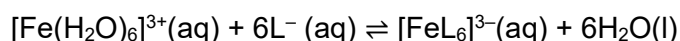
Which changes would decrease the cell potential?

- 1 Adding water to the $S_4O_6^{2-}(aq) / S_2O_3^{2-}(aq)$ half-cell.
- 2 Adding iodine crystals to the $S_4O_6^{2-}(aq) / S_2O_3^{2-}(aq)$ half-cell.
- 3 Using $O_2(g)$ at 0.5 bar.

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

- 29** A stability constant is an equilibrium constant for the formation of a complex relative to its aqua complex in solution.

Consider the formation of $[\text{FeL}_6]^{3-}(\text{aq})$ in solution:



where L^{-} can be either F^{-} or CN^{-} .

The equilibrium constant, K_{stab} , of the above reaction is

$$K_{\text{stab}} = \frac{[\text{FeL}_6^{3-}]}{[\text{Fe}(\text{H}_2\text{O})_6^{3+}][\text{L}^{-}]^6}$$

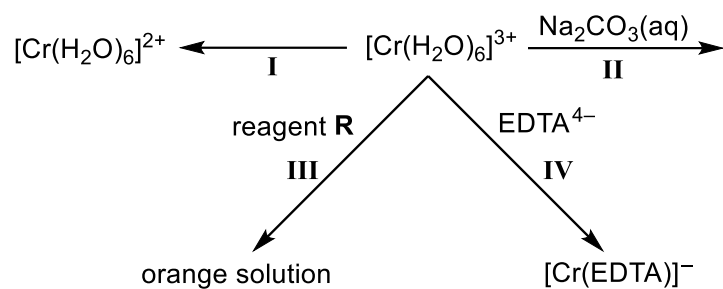
The table below shows the values of the stability constants and colours of some iron complexes.

complex	K_{stab}	colour
$[\text{FeF}_6]^{3-}$	2×10^{15}	colourless
$[\text{Fe}(\text{CN})_6]^{3-}$	1×10^{31}	orange red

What would be observed when $\text{NaCN}(\text{aq})$ is added to a solution of $\text{Fe}(\text{NO}_3)_3$, followed by adding $\text{NaF}(\text{aq})$?

- A** The yellow solution turns orange red and remains orange red.
- B** The yellow solution turns orange red and then to colourless.
- C** The green solution turns orange red and remains orange red.
- D** The green solution turns orange red and then to colourless.

- 30** A reaction scheme involving $\text{Cr}^{3+}(\text{aq})$ ions is shown.



Which statement about the reaction scheme is correct?

- A** Reactions **I** and **II** are redox reactions.
- B** The observations of reaction **II** are a grey-green precipitate and effervescence.
- C** Reagent **R** could be zinc metal.
- D** The ΔS for reaction **IV** is negative.