



RIVER VALLEY HIGH SCHOOL

JC 2 PRELIMINARY EXAMINATION

CANDIDATE
NAME

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CLASS

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CENTRE
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H2 CHEMISTRY

9729/01

Paper 1 Multiple Choice

25 September 2025

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, centre number and index 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.

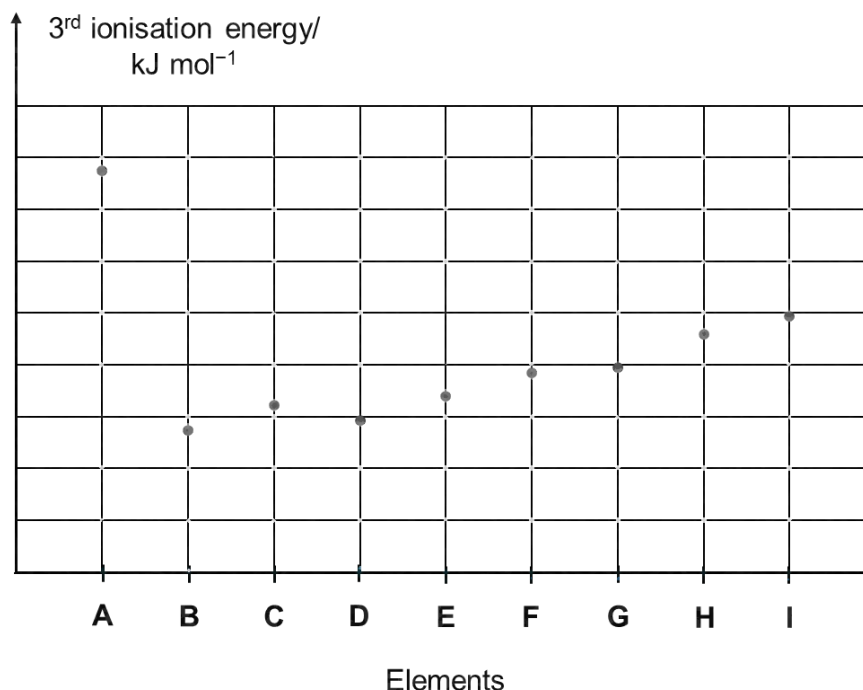
Any rough working should be done in this booklet.

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

This document consists of **15** printed pages and **1** blank page.

- 1 The graph below shows the variation in the third ionisation energies for the consecutive elements **A** to **I**, all with atomic numbers smaller than 20.

The symbols **A** to **I** do not represent actual elements.



Which of the following can be deduced from the information given?

- A** **B**²⁺ is smaller than **C**²⁺.
- B** In an electric field, **H**⁺ is deflected to a smaller extent than **I**⁺.
- C** The decrease in 3rd ionisation energy from **C** to **D** on graph is due to coulombic repulsion.
- D** **G** has noble gas electronic configuration.
- 2 A 50.00 cm³ of a solution of 0.300 mol dm⁻³ MoO_x²⁻ was reduced to Mo³⁺ using Zn powder. The filtrate required 45.00 cm³ of 0.200 mol dm⁻³ acidified KMnO₄ to revert to its original form of MoO_x²⁻.

What is the value of x?

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

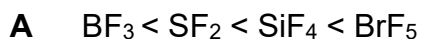
- 3 When 20 cm^3 of a gaseous hydrocarbon was completely burnt in 120 cm^3 of oxygen, there is a contraction of 50 cm^3 . On further treatment with aqueous potassium hydroxide, the volume decreases by 60 cm^3 .

Which could be the formula of the organic compound?

All volumes being measured at the room temperature and pressure.

- A** C_2H_2 **B** C_2H_4 **C** C_3H_6 **D** C_3H_8

- 4 What is the order of increasing bond angle for four molecules?



- 5 Nitrogen atoms undergo the same type of hybridisation as carbon atoms.

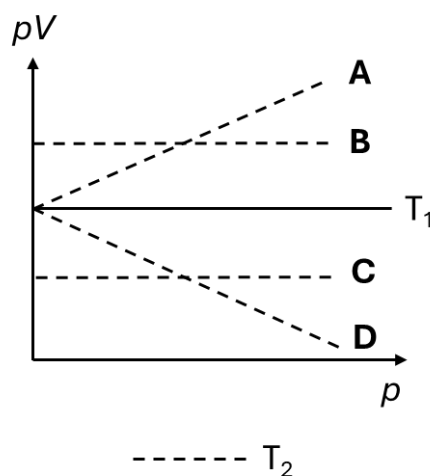
Which species contains the shortest nitrogen-oxygen bond length?



- 6 The volumes and pressures of a fixed mass of gas are investigated, at different temperatures.

The results are plotted on a graph of pV against p at a temperature of T_1 . The gas behaves as an ideal gas under the conditions chosen.

Which plot shows the results for a lower temperature, T_2 ?



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

When 0.860 g of ethanol undergoes complete combustion below a beaker containing 300 g of water, the temperature of the water rises by 18 °C.

The theoretical enthalpy change of combustion of ethanol is $-1367 \text{ kJ mol}^{-1}$.

What is the efficiency of the process?

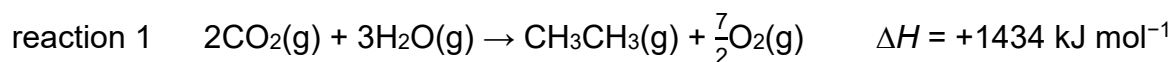
- A 2%
- B 7%
- C 31%
- D 88%

- 8 Using the enthalpy changes below, calculate the standard enthalpy change of formation of gaseous hydrogen chloride.

	enthalpy change/ kJ mol^{-1}
$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightarrow 2\text{NH}_3(\text{g})$	-92
$\text{N}_2(\text{g}) + 4\text{H}_2(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{NH}_4\text{Cl}(\text{s})$	-629
$\text{NH}_3(\text{g}) + \text{HCl}(\text{g}) \rightarrow \text{NH}_4\text{Cl}(\text{s})$	-176

- A $-46.3 \text{ kJ mol}^{-1}$
- B $-92.5 \text{ kJ mol}^{-1}$
- C -180 kJ mol^{-1}
- D -361 kJ mol^{-1}

9 Consider the following reactions.



The standard enthalpy change of combustion of ethane is $-1542 \text{ kJ mol}^{-1}$.

Which statements are correct?

1 y is +36

2 At 373 K, ΔS for reaction 2 is $\frac{y}{373} \text{ kJ mol}^{-1} \text{ K}^{-1}$.

3 Reaction 1 is spontaneous only at high temperatures.

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

10 The half-life of a radioactive isotope **P** is twice that of another radioactive isotope **Q**. In a sample of rock, it is found that the number of atoms of **Q** is 4 times that of **P**.

What will be the ratio of the number of atoms of **P** to the number of atoms of **Q** in the rock after two half-lives of **P**?

A $\frac{1}{16}$

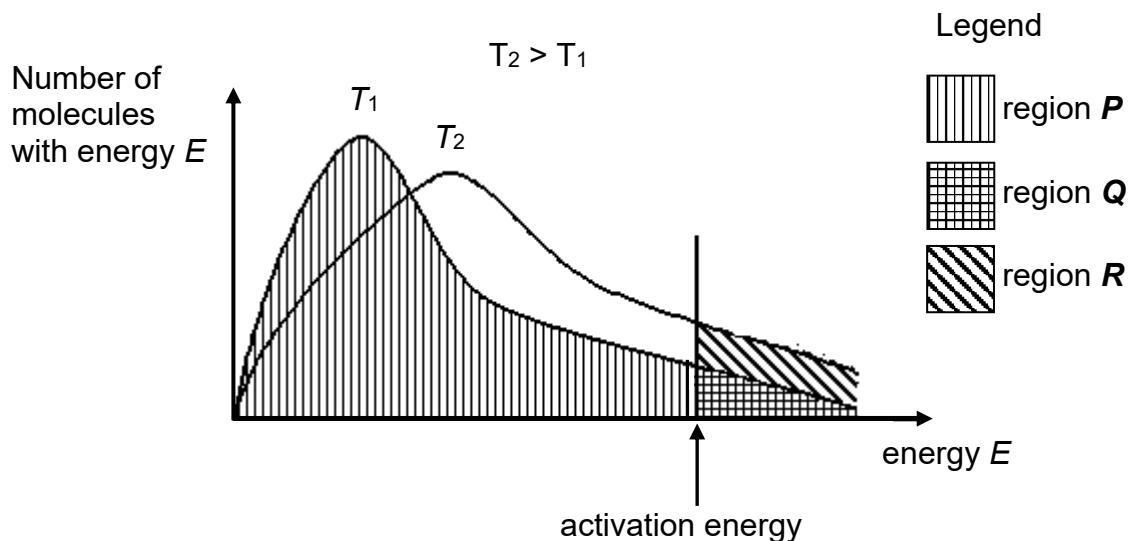
B $\frac{1}{4}$

C $\frac{1}{2}$

D 1

- 11 The distribution of the number of molecules with energy E is given in the sketch for two temperatures, T_1 and T_2 .

The letters **P**, **Q**, **R** refer to the separate and differently shaded areas. The activation energy is marked on the energy axis.



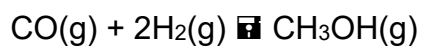
Which expression gives the fraction of the molecules present which have at least the activation energy at the higher temperature T_2 ?

- A $\frac{Q}{P}$ B $\frac{Q+R}{P}$ C $\frac{Q+R}{P+Q}$ D $\frac{Q+R}{P+Q+R}$

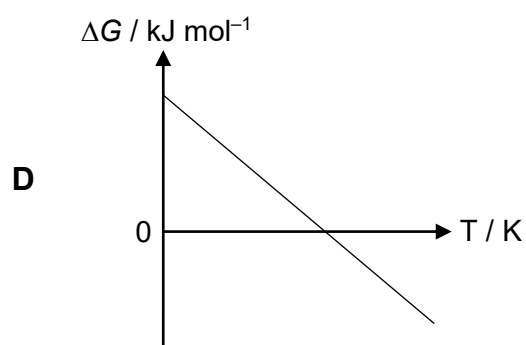
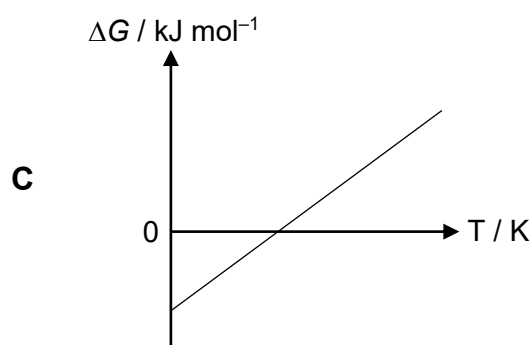
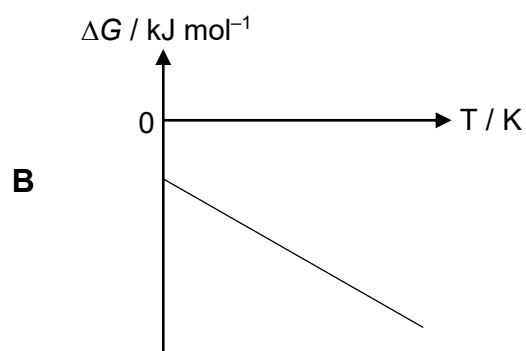
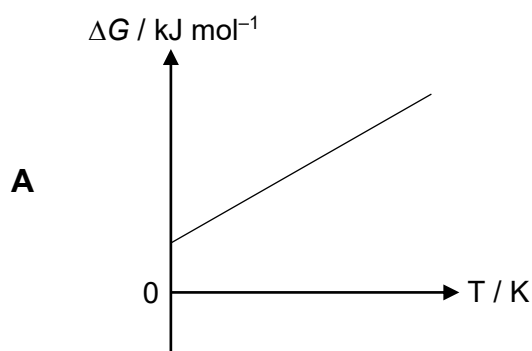
- 12 Sulfur is converted to SF_6 by fluorine, to SCl_2 by chlorine and to S_2Br_2 by bromine. Which trend does this information best provide evidence for?

- A bond energy: $\text{Cl}_2 > \text{Br}_2 > \text{F}_2$
 B electronegativity: $\text{F} > \text{Cl} > \text{Br}$
 C first ionisation energy: $\text{F} > \text{Cl} > \text{Br}$
 D oxidising ability: $\text{F}_2 > \text{Cl}_2 > \text{Br}_2$

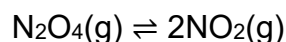
- 13 Methanol can be synthesised from carbon monoxide and hydrogen according to the equation.



A higher yield of methanol can be achieved at a lower temperature. Which graph corresponds to the forward process?

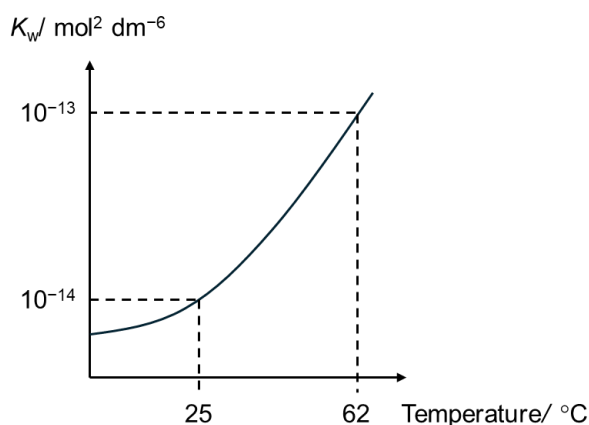


- 14** 1.00 mol of N_2O_4 and 0.200 mol of NO_2 are added to a sealed vessel of fixed volume at 298 K. When the system reaches equilibrium, 0.680 mol of NO_2 is present in the vessel.



Which statement about this equilibrium is correct?

- A** 0.240 mol of N_2O_4 is present at equilibrium.
- B** The value for the equilibrium constant, K_c , is 0.608.
- C** The pressure in the vessel at equilibrium is the same as the pressure before the reaction started.
- D** The pressure in the vessel at equilibrium is higher than the pressure before the reaction started.
- 15** The value of the ionic product of water, K_w , varies with temperature.



Which statement is correct?

- A** The ionic dissociation of water is an exothermic process.
- B** The ionic dissociation of water increases 100 times between 25 °C and 62 °C.
- C** Water becomes acidic as temperature increases.
- D** $[\text{OH}^-]$ increases as temperature increases.

- 16 Pyruvic acid, $\text{CH}_3\text{COCO}_2\text{H}$, and acetylsalicylic acid, $\text{C}_6\text{H}_5\text{COOH}$, are weak acids. Both acids dissociate in aqueous solutions as follows, where α is the degree of dissociation.



The dissociation constants, K_a of $\text{CH}_3\text{COCO}_2\text{H}$ and K_a of $\text{C}_6\text{H}_5\text{COOH}$, are given in the table below.

	$\text{CH}_3\text{COCO}_2\text{H}$	$\text{C}_6\text{H}_5\text{COOH}$
Dissociation constant/ mol dm^{-3}	1.4×10^{-4}	3.4×10^{-4}

Which statement is correct?

- 1 The pH of 1 mol dm^{-3} of $\text{CH}_3\text{COCO}_2\text{H}$ is lower than that of 1 mol dm^{-3} of $\text{C}_6\text{H}_5\text{COOH}$.
 - 2 The value of dissociation constant in terms of initial concentration C and degree of dissociation is $K_a = \frac{\alpha^2}{C(1-\alpha)}$.
 - 3 The pK_b of $\text{CH}_3\text{COCO}_2^-$ is smaller than that of $\text{C}_6\text{H}_5\text{COO}^-$.
- A** 1 and 2 only **B** 1 only **C** 2 and 3 only **D** 3 only

- 17 Which statement about phosphoric(V) acid, H_3PO_4 , ($pK_a = 2.0$) is **incorrect**?

- A** PO_4^{3-} can react as a base.
B H_3PO_4 has a higher K_a than HPO_4^{2-} .
C A buffer of pH 2.0 can be prepared using equal amount of H_3PO_4 and HPO_4^{2-} .
D HPO_4^{2-} has a higher K_b value than H_2PO_4^- .

- 18 Chromium(III) hydroxide, $\text{Cr}(\text{OH})_3$, is sparingly soluble.

What is the minimum pH required to precipitate chromium(III) hydroxide from chromium(III) nitrate solution given that the concentration of chromium(III) ion in the solution is less than 1.5×10^{-15} ?

The numerical value of the solubility product of $\text{Cr}(\text{OH})_3$ is 6.3×10^{-31} .

- A** 5.13 **B** 6.09 **C** 7.91 **D** 8.87

- 19 Two students separately are given equal volumes of $0.100 \text{ mol dm}^{-3}$ of lead(II) nitrate, sodium chromate and potassium sulfate.

The first student, on mixing the potassium sulfate and lead(II) nitrate, obtains a white precipitate. On adding sodium chromate to this mixture, the precipitate turns yellow.

The second student, on mixing the sodium chromate and lead(II) nitrate, obtains a yellow precipitate. On adding potassium sulfate to this mixture, there is no further change.

Which statements about these observations are correct?

- 1 Lead(II) chromate is insoluble.
- 2 Lead(II) sulfate is more soluble than lead(II) chromate.
- 3 Chromate can oxidise sulfate.

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

- 20 Two constitutional isomers of molecular formula $\text{C}_6\text{H}_{13}\text{OH}$ are shown.

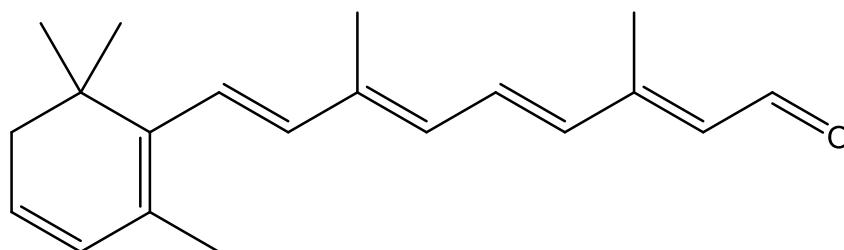


X and **Y** reacts with ethanolic KOH under reflux to form C_6H_{12} .

How many possible **constitutional** isomers each with molecular formula C_6H_{12} , could be produced by **X** and by **Y**?

	isomers formed by X	isomers formed by Y
A	2	2
B	2	3
C	3	2
D	3	3

- 21 Retinal is heated under reflux with acidified potassium manganate(VII).

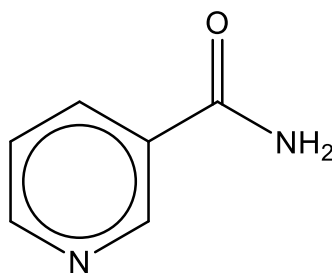


retinal

How many organic products are formed from this reaction?

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

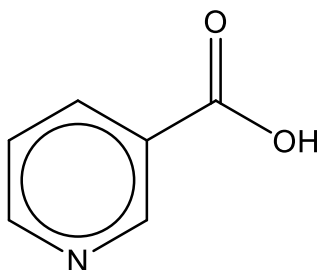
- 22 Nicotinamide, which is marketed as nicotine substitute, can be hydrolysed by aqueous sodium hydroxide.



nicotinamide

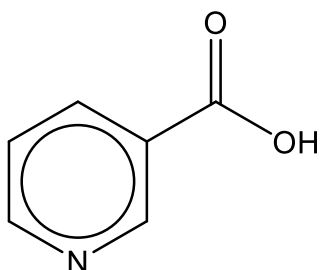
What are the products of this hydrolysis reaction?

A



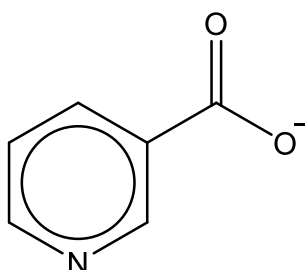
and NH_3

B



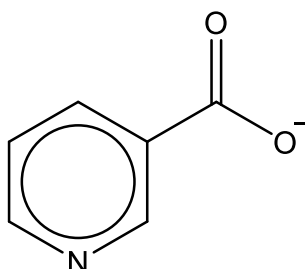
and NH_4^+

C



and NH_3

D



and NH_4^+

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

An organic acid is used as fruity taste food additive. It has the following features.

- It is dibasic.
- It is non-cyclic.
- It exhibits cis-trans isomerism.
- It has a relative molecular mass of 116.

How many carbon atoms are in one molecule of this organic acid?

- A** 3 **B** 4 **C** 5 **D** 6

24 Three compounds, benzyl chloride, phenol and chlorobenzene are separately warmed with concentrated nitric acid and concentrated sulfuric acid at appropriate temperature.

Which compound reacts the fastest and slowest respectively?

	Fastest reaction	Slowest reaction
A	benzyl chloride	chlorobenzene
B	benzyl chloride	phenol
C	phenol	chlorobenzene
D	phenol	benzyl chloride

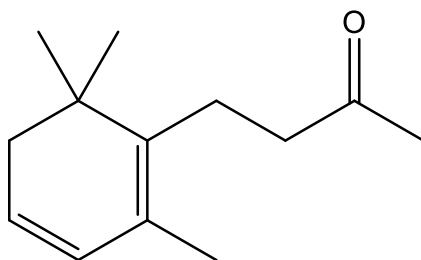
25 2-methylbut-2-ene, $\text{CH}_3\text{C}(\text{CH}_3)\text{CHCH}_3$, reacts with aqueous bromine.

What is the structure of the major organic product?

- | | |
|---|---|
| A $\text{CH}_3\text{CBr}(\text{CH}_3)\text{CHBrCH}_3$ | B $\text{CH}_3\text{CBr}(\text{CH}_3)\text{CH}(\text{OH})\text{CH}_3$ |
| C $\text{CH}_3\text{C}(\text{OH})(\text{CH}_3)\text{CHBrCH}_3$ | D $\text{CH}_3\text{C}(\text{OH})(\text{CH}_3)\text{CH}(\text{OH})\text{CH}_3$ |

- 26** α -Ionone undergoes reduction to give a single product.

The product decolourises aqueous bromine but does not give a yellow precipitate when 2,4-dinitrophenylhydrazine is added.



α -ionone

Which of the following could be a reducing agent for the reduction of α -ionone?

- 1 LiAlH_4 in dry ether
- 2 $\text{H}_2(\text{g})$, $\text{Ni}(\text{s})$, heat
- 3 NaBH_4

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

- 27** Chloroethene, chloroethane and ethanoyl chloride reacts with aqueous silver nitrate to form a white precipitate at different rates.

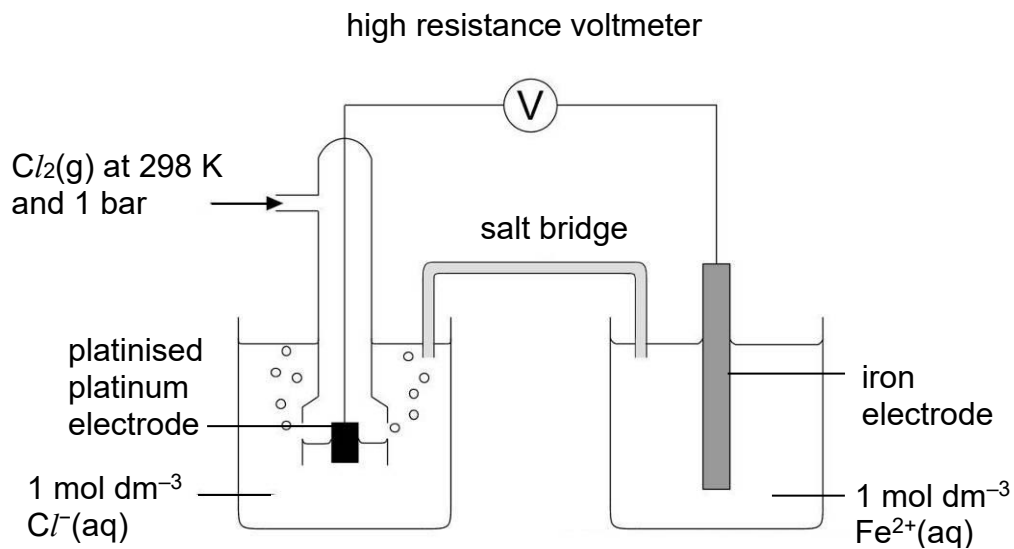
Which statements explain the difference in rate?

- 1 The carbon atom bonded to chlorine in ethanoyl chloride is more susceptible to nucleophilic attack.
- 2 Chloroethene reacts least readily with water.
- 3 Ethanoyl chloride is more acidic.

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

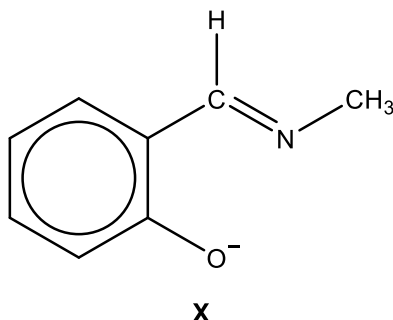
28 Use of the Data Booklet is relevant to this question.

What change to the half-cells could cause the high resistance voltmeter to show a decrease in value of cell potential?

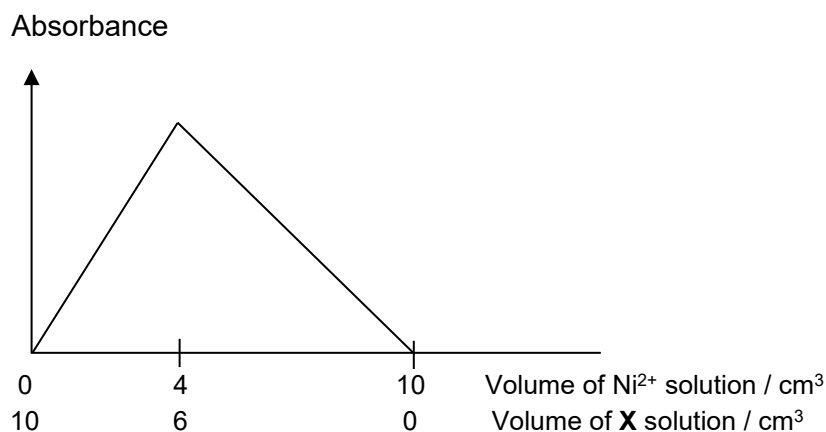


- A** Using a bigger piece of iron electrode.
- B** Adding water to the half-cell on the right.
- C** Adding aqueous AgNO_3 to the half-cell on the left.
- D** Decreasing the pressure of the chlorine gas.

- 29 The complex of nickel with ligand **X** is thermochromic, being coloured red at room temperature but changing to yellow-green when heated to 170 °C.



The following graph sketch was obtained when the absorbances of mixtures of a $4 \times 10^{-3} \text{ mol dm}^{-3}$ solution of **X** and a $3 \times 10^{-3} \text{ mol dm}^{-3}$ solution of nickel(II) chloride were measured using a colorimeter at room temperature.



What is the charge on the nickel complex?

- A** 1+ **B** 0 **C** 1- **D** 4-
- 30 Which one of the following species is unlikely to exist?
- A** $[\text{Cu}(\text{S}_2\text{O}_3)]^-$
- B** $[\text{Cr}(\text{C}_2\text{O}_4)_2(\text{H}_2\text{O})_2]^-$
- C** $[\text{Mn}(\text{CN})_6]^{2+}$
- D** $[\text{VO}(\text{H}_2\text{O})_5]^{2+}$

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