TAMPINES MERIDIAN JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATION

H2 CHEMISTRY **9729/01**

Paper 1 Multiple Choice **19 September 2024**

1 hour

Additional materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Write your name, class and register number on the Answer Sheet in the spaces provided.

There are **thirty** questions in 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 use of the Answer Sheet very carefully.

You are advised to fill in the Answer Sheet as you go along. No additional time will be given for the transfer of answers once the examination has ended.

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.

Use of the Answer Sheet

Ensure you have written your name, class register number and class on the Answer Sheet.
Use a **2B** pencil to shade your answers on the Answer Sheet; erase any mistakes cleanly. Multiple shaded answers to a question will not be accepted.
For **shading of class register number** on the Answer Sheet, please follow the given examples:
If your register number is **1**, then shade **01** in the index number column.
If your register number is **21**, then shade **21** in the index number column.

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

A stream of gaseous $^{40}_{20}Ca^{2+}$ charged ions was passed through an electric field between two oppositely charged plates and the Ca^{2+} ions were deflected at an angle of +15.0°.

Under the same electric field, a stream of unknown gaseous $\mathbf{X}^{3-}$ ion was deflected at an angle of −29.0°. What is a possible atomic number of **X**?

A 15

B 24

C 31

D 34

2 Which statements correctly describe an electron shell with the principal quantum shell number n = 2?

1 A total of 10 electrons can be accommodated in this shell.

2 An orbital from this shell must be dumb-bell in shape.

3 The energy level of the orbitals in this shell is higher than that in n = 1.

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

3 The table identifies the shape and polarity of four molecules.

Which row is correct?

	molecule	molecular shape	polarity
A	bromine trifluoride	bent	polar
B	phosphorus trichloride	trigonal pyramidal	polar
C	sulfur dichloride	linear	non-polar
D	trifluoromethane	tetrahedral	non-polar

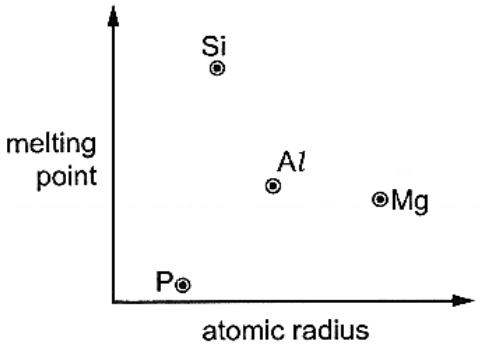
4 The table shows four species with their corresponding physical properties. Which species does **not** correspond to its description of physical properties?

	species	physical properties
A	copper	high melting point, conducts electricity when solid and when molten
B	silicon dioxide	high melting point, does not conduct electricity in any state
C	aluminium bromide	high melting point, conducts electricity when molten but not when solid
D	phosphorus pentachloride	low melting point, does not conduct electricity in any state

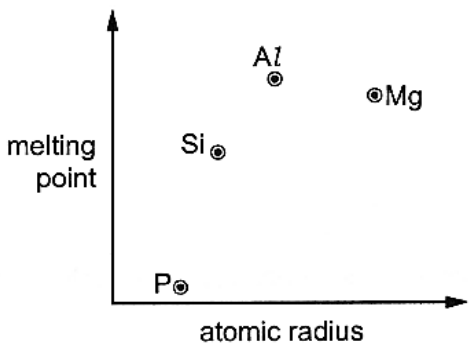
5 *Use of the Data Booklet is relevant to this question.*

Which of the following shows the correct trends when the melting points of the elements, Mg, A*l*, Si and P are plotted against their atomic radii?

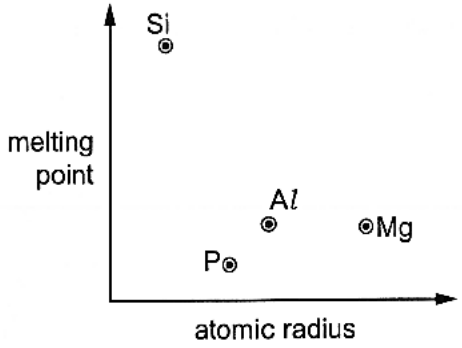
A



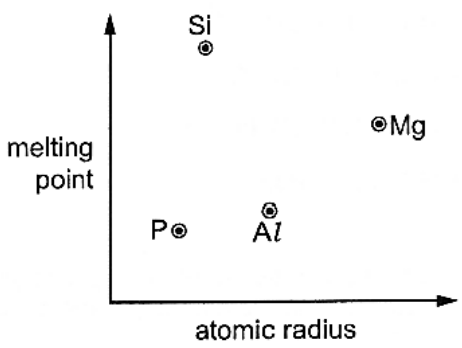
B



C



D



6 Which statement is correct about the halogens (X_2) chlorine, bromine and iodine as well as their corresponding hydrogen halides (HX)?

A The colour intensity of the halogens decreases from Cl_2 to I_2.

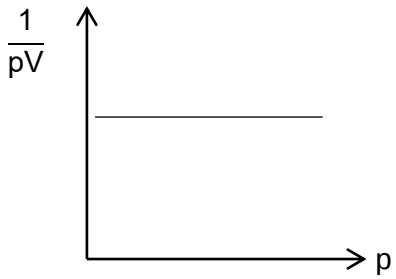
B The oxidising power of the halogens decreases from Cl_2 to I_2.

C The thermal stability of HX increases from HCl to HI.

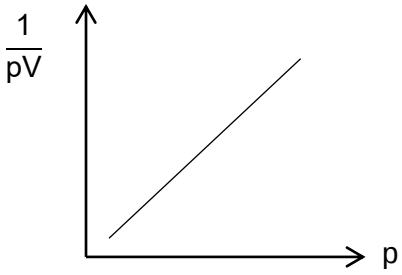
D The volatility of HX increases from HCl to HI.

7 Which graph correctly represents the relationship between $\left(\frac{1}{pV}\right)$ and pressure for an ideal gas at constant temperature?

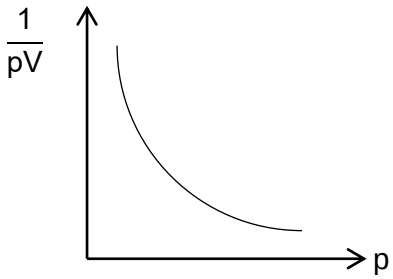
A



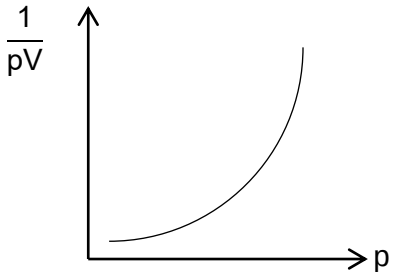
B



C



D



8 1 dm^3 of a gaseous hydrocarbon was mixed with excess oxygen. When the mixture undergoes complete combustion, the volume contracted by 2 dm^3. When the resultant mixture was passed through concentrated sodium hydroxide, the gas volume further decreased by 2 dm^3. All volumes were measured at room temperature and pressure.

What is the empirical formula of the hydrocarbon?

A CH

B CH_2

C C_2H_3

D C_3H_4

9 Substances **X** and **Y** react to form product **Z**.

$$2\mathbf{X} + \mathbf{Y} \rightarrow 2\mathbf{Z}$$

The reaction was studied and the following data were obtained.

experiment	[**X**] / mol dm^{-3}	[**Y**] / mol dm^{-3}	initial rate / mol dm^{-3} min^{-1}
1	0.10	0.10	0.020
2	0.20	0.10	0.080
3	0.15	0.23	0.045

What is the order of reaction with respect to **X** and **Y**?

A First order with respect to **X** and zero order with respect to **Y**.

B Second order with respect to **X** and first order with respect to **Y**.

C First order with respect to **X** and first order with respect to **Y**.

D Second order with respect to **X** and zero order with respect to **Y**.

10 The following enthalpy changes of the following substances are provided.

	/ kJ mol^{-1}
standard enthalpy change of combustion of graphite	–394
standard enthalpy change of formation of water	–286
standard enthalpy change of formation of liquid ethanol	–277

What is the standard enthalpy change of combustion of liquid ethanol?

A –403 kJ mol^{-1}

B –957 kJ mol^{-1}

C –1369 kJ mol^{-1}

D –1865 kJ mol^{-1}

11 Which processes result in an increase in entropy?

1 crystallisation of salt from its saturated solution

2 condensation of steam to water

3 combustion of hydrogen gas

4 mixing of two miscible liquids

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

12 Consider the following equilibrium reaction:

$$H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g) \qquad \Delta H < 0$$

Which of the following changes will decrease the equilibrium yield of HCl?

A adding more $H_2(g)$

B adding a suitable catalyst

C decreasing the volume of the system

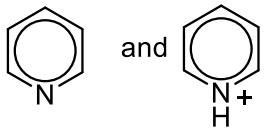
D increasing the temperature

13 Which of the following is **not** an acid-conjugate base pair?

A HCl and NaCl

B Na_2HPO_4 and H_3PO_4

C H_2O_2 and HO_2^-

D  and

14 Values of ionic product, K_w, for water at different temperatures are given below.

temperature / ºC	0	25	100
K_w / mol^2 dm^{-6}	1.1 x 10^{-15}	1.0 x 10^{-14}	5.1 x 10^{-13}

Which statement is true?

A pOH + pK_w = 14 at 0 ºC.

B At temperatures higher than 25 ºC, $[H^+] > [OH^-]$.

C The pH of water is expected to be 6.1 at 100 ºC.

D The dissociation of water is an exothermic process.

15 What is the largest mass of sodium ethanedioate, $Na_2C_2O_4$ (M_r = 134.0) that can be added to 25 cm^3 of 1.1 × 10^{-3} mol dm^{-3} solution of calcium nitrate, $Ca(NO_3)_2$ before a precipitate forms? [K_{sp} of CaC_2O_4 = 2.50 × 10^{-9} mol^2 dm^{-6}]

A 2.5 × 10^{-5} g

B 7.6 × 10^{-6} g

C 7.5 × 10^{-9} g

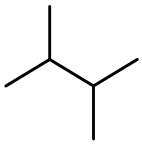
D 2.5 × 10^{-9} g

16 When reacted with chlorine, hydrocarbon **X** undergoes free radical substitution. In a propagation step, the free radical **Y•** is formed.

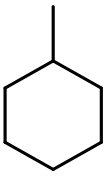
$$\mathbf{X} + Cl\bullet \rightarrow \mathbf{Y}\bullet + HCl$$

What is a likely structure of hydrocarbon **X** if there are 5 possible constitutional isomers of **Y•**?

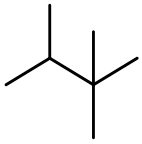
A



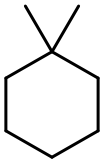
B



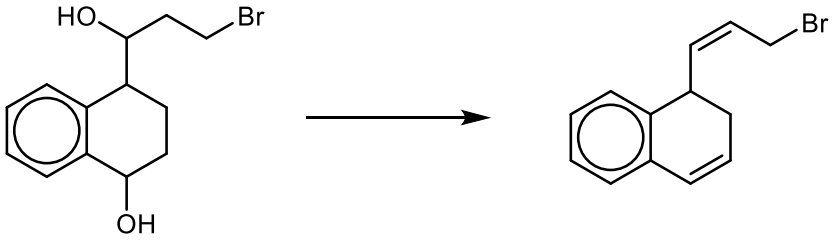
C



D



17 Compound **J** reacts with excess concentrated sulfuric acid to form compound **K**.

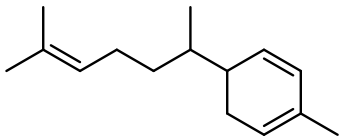


J **K**

How many stereoisomers exist for **J** and for **K**?

	J	**K**
A	4	4
B	4	8
C	8	4
D	8	8

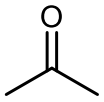
18 The compound zingiberene gives ginger its distinct flavour.



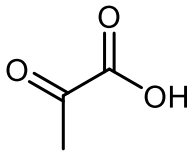
zingiberene

Which of the following compound is **not** produced from the reaction between zingiberene and hot acidified $KMnO_4$?

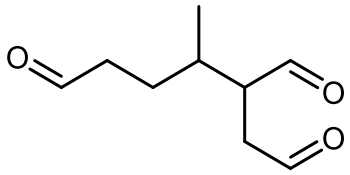
A



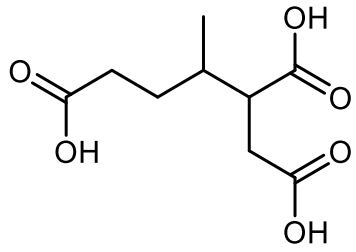
B



C



D



19 The molecular formula of alcohol **V** is $C_5H_{12}O$.

Alcohol **V**:

- can be dehydrated to form two alkenes only.
- reacts with alkaline aqueous iodine to form yellow ppt.

What could be the identity of **V**?

A $CH_3C(CH_3)_2CH_2OH$

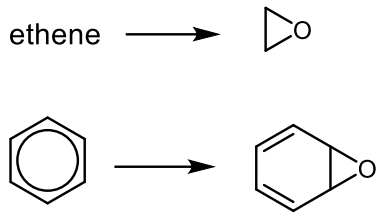
B $(CH_3)_2C(OH)CH_2CH_3$

C $(CH_3)_2CHCH(OH)CH_3$

D $CH_3CH_2CH_2CH(OH)CH_3$

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

Epoxidation of ethene occurs much more readily than epoxidation of benzene.



Which statements explain the above observation?

1 The extent of delocalisation of six unbonded p electrons of benzene will decrease if benzene undergoes epoxidation.

2 The aromaticity of benzene gives it extra stability which makes epoxidation more unlikely to occur.

3 The carbon-carbon double bond of alkene is weaker than carbon-carbon bond of benzene.

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

21 A comparison is made on the rate of hydrolysis of four halogen-containing organic compounds by hot NaOH(aq).

CH_3CH_2COCl	C_6H_5Cl	$(CH_3)_3CI$	$(CH_3)_3CCl$
W	**X**	**Y**	**Z**

How would these rates compare?

	fastest ⟶ slowest			
A	**W**	**Y**	**Z**	**X**
B	**W**	**Z**	**Y**	**X**
C	**X**	**Z**	**Y**	**W**
D	**Y**	**Z**	**X**	**W**

22 Which reaction results in the **smallest** change in M_r of the organic compound?

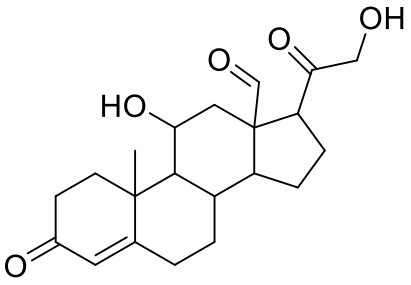
A chloroethane with hot ethanolic NaOH

B chloroethane with excess NH_3 heated in a sealed tube

C chloroethane with hot ethanolic NaCN, followed by $LiAlH_4$

D chloroethane with hot aqueous NaOH, followed by hot acidified $KMnO_4$

23 *Aldosterone* is a hormone produced in the adrenal gland and is crucial for blood pressure regulation.



Which reagent will **not** give an observable change when added to *aldosterone*?

A Fehling's reagent

B sodium carbonate

C phosphorus pentachloride

D 2,4-dinitrophenylhydrazine

24 Chiral halogenoalkanes undergo nucleophilic substitution with hot NaOH(aq) to form alcohols.

The reaction mechanism is either S_N1 or S_N2.

Which statements are correct?

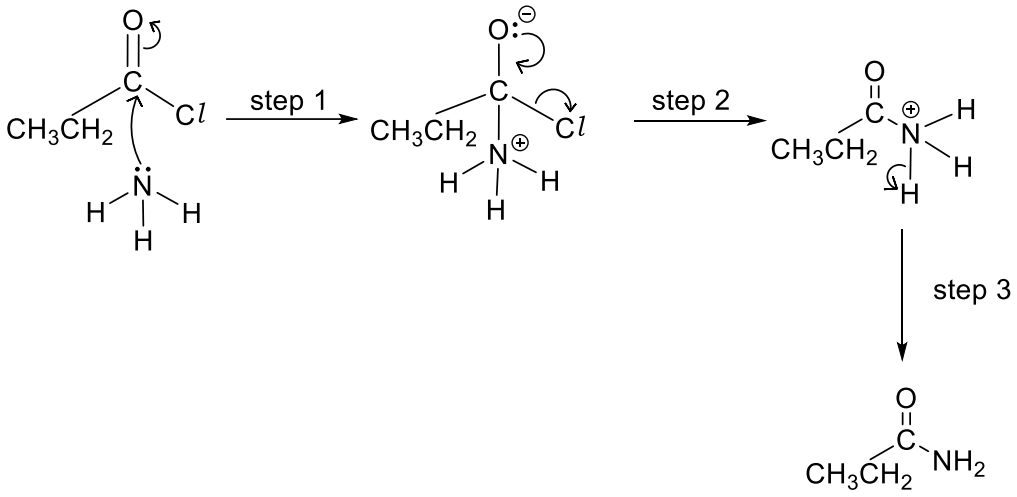
1 S_N1 mechanism involves only one step.

2 Racemisation can occur in the S_N1 mechanism.

3 Hydrolysis of a 3° halogenoalkane takes place by the S_N1 mechanism because the alkyl groups stabilise the carbocation intermediate.

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

25 Ammonia and propanoyl chloride react to form propanamide via the nucleophilic acyl substitution mechanism.



Which statement is correct about the above mechanism?

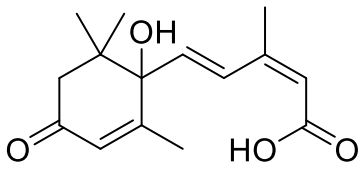
A Ammonia behaves as an electrophile.

B Propanoyl chloride behaves as a nucleophile.

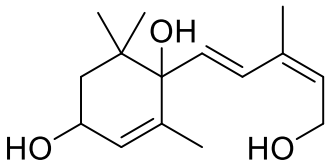
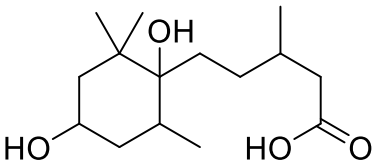
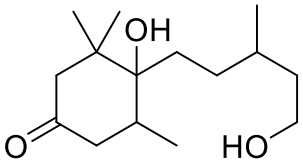
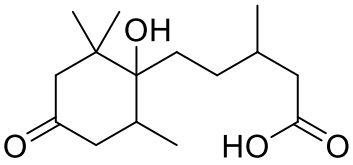
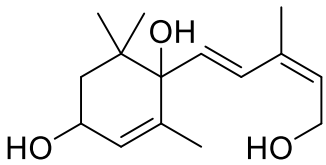
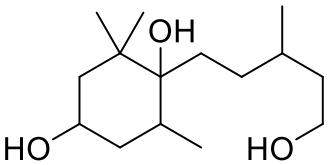
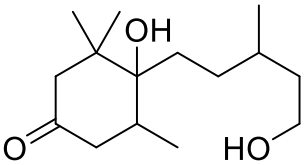
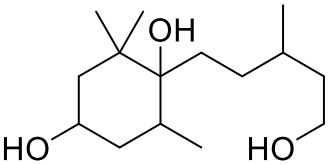
C The curly arrows in step 1 have been shown incorrectly.

D The deprotonation in step 3 has been shown incorrectly.

26 Abscisic acid is a plant hormone involved in many plant developmental processes.



Which are the products formed when abscisic acid reacts with the following reducing agents?

	$LiAlH_4$ in dry ether	H_2, Pt catalyst
A		
B		
C		
D		

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

A voltaic cell is made up of Pb^{2+}/Pb half-cell and the Fe^{3+}/Fe^{2+} half-cell. Which of the following statements are correct?

1 Adding excess solid potassium cyanide to the Fe^{3+}/Fe^{2+} half-cell affects the direction of electron flow.

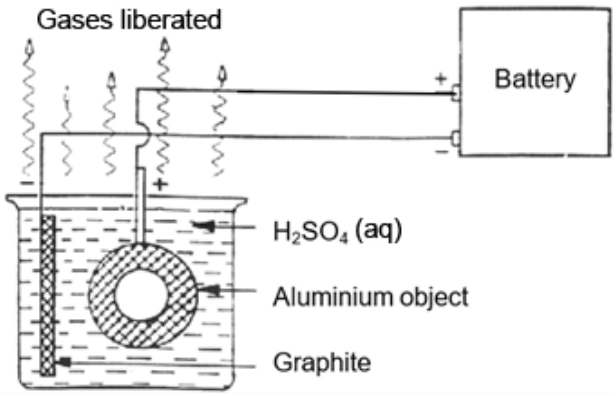
2 Adding water to the Pb^{2+}/Pb half-cell increases the cell potential.

3 Increasing the size of the electrode decreases the cell potential.

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

28 Aluminium alloys undergo a process known as anodisation to increase corrosion resistance and surface hardness.

A possible set up for the process is shown below.



Which of the following statements about anodisation of aluminium is true?

A Anodisation is a spontaneous reaction.

B Hydrogen gas and oxygen gas are liberated.

C The aluminium object will decrease in mass.

D The reaction stops when the graphite electrode is replaced with gold.

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

Which statement is true about the properties of transition metals?

A Titanium has a higher density than copper.

B Chromium in $[Cr(H_2O)_6]^{3+}$ has only one unpaired electron.

C Scandium is not a transition metal as its atom does not contain partially filled d subshells.

D Transition metal ion complexes are coloured due to the presence of ligands and splitting of d orbitals into different energy levels.

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

Peroxodisulfate, $S_2O_8^{2-}$, can oxidise tartrate ion, $C_4H_4O_6^{2-}$, to carbon dioxide and methanoate as shown in the following equation.

$$C_4H_4O_6^{2-} + 3S_2O_8^{2-} + 2H_2O \rightarrow 2CO_2 + 2HCO_2^- + 6H^+ + 6SO_4^{2-}$$

The electrode potential for the tartrate ion is

$$2CO_2 + 2HCO_2^- + 6H^+ + 6e \rightleftharpoons C_4H_4O_6^{2-} + 2H_2O \qquad E^\ominus = +0.56\ V$$

The rate of reaction can be increased with the addition of a metal ion as a catalyst. Which metal ion is **not** a suitable catalyst for this reaction?

A V^{2+}

B Mn^{3+}

C Fe^{2+}

D Co^{3+}