ANDERSON SERANGOON JUNIOR COLLEGE
2024 JC 2 PRELIMINARY EXAMINATION

NAME:_____ (   )   **CLASS:** 24 / ___

CHEMISTRY   **8873/01**

Paper 1 Multiple Choice   **17 September 2024**

                                                                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 and class 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.

Multiple Choice Answer Sheet

Write your name, class and NRIC / FIN number, **including** the reference letter.

Shade the NRIC / FIN number.

Exam Title: JC2 Preliminary Exam

Exam Details: H1 Chemistry / Paper 1

Date: 17/09/2024

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

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

A proton and a helium nucleus both move at the same speed perpendicular to a uniform electric field.

Which row describes the behaviour of the proton and the helium nucleus?

A They are deflected in opposite directions. The helium nucleus is deflected most.

B They are deflected in opposite directions. The proton is deflected most.

C They are deflected in the same direction. The helium nucleus is deflected most.

D They are deflected in the same direction. The proton is deflected most.

2 Which of these atomic orbitals possesses the highest relative energy?

A $2p_z$

B $3p_x$

C $3p_y$

D 4s

3 The 7th, 8th, 9th and 10th ionisation energies of an element are shown.

7th ionisation energy / kJ mol^{-1}	8th ionisation energy / kJ mol^{-1}	9th ionisation energy / kJ mol^{-1}	10th ionisation energy / kJ mol^{-1}
9941	18 580	21 610	25 180

Which group does this element belong to?

A 15 **B** 16 **C** 17 **D** 18

4 Silicon carbide, SiC, is a shiny, hard, chemically inert material with a very high melting point. It can be used to sharpen knives and make crucibles.

Which type of structure does silicon carbide have?

A a giant structure with covalent bonds between silicon and carbon atoms

B a giant structure containing strong electrostatic forces of attraction between oppositely charged ions

C a giant layered structure with covalent bonds between atoms and instantaneous dipole – induced dipole forces between layers

D a simple molecular structure with covalent bonds between the atoms of silicon and carbon

5 Compared with the HCl molecule, the bond ….**X**..... of the HI molecule is ….**Y**…..

Which pairs of words correctly complete the above sentence?

	X	Y
1	energy	greater
2	length	longer
3	polarity	lower

A 1, 2 and 3

B 1 and 2 only

C 2 and 3 only

D 1 only

6 The diagram below shows the structure of part of a crystal of ice.
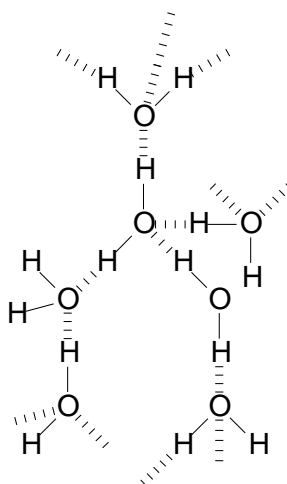
Which statement is correct?

A All the bond angles surrounding each oxygen atom are 120°.

B Four electrons from each oxygen are involved in forming hydrogen bonds.

C The hydrogen bonds, shown by the dotted lines, are stronger than the O–H covalent bonds.

D The open structure of ice causes ice to be denser than water.

7 The ionic product of water, K_w, is affected by temperature.

Temperature / °C	K_w x 10^{-14} / mol^2 dm^{-6}
10	0.293
40	2.92

Which statement describes what happens as the temperature of water is increased from 10 °C to 40 °C?

A pH of water decreases and $[H^+] = [OH^-]$.

B pH of water decreases and $[H^+]$ is greater than $[OH^-]$.

C pH of water increases and $[H^+] = [OH^-]$.

D pH of water increases and $[H^+]$ is less than $[OH^-]$.

8   25.0 cm³ of 0.100 mol dm⁻³ phosphoric acid, H_3PO_4, is titrated against 0.100 mol dm⁻³ NaOH. The following pH value is recorded.

Volume of NaOH added/ cm³	pH
25.00	4.70

The table below shows the pH range for colour change for some acid-base indicators.

indicator	range of pH for colour change
bromocresol green	3.8 – 5.4
phenol red	6.8 – 8.4
phenolphthalein	8.3 – 10.0

Which indicator can be used to identify the titration end-point?

A   Phenolphthalein

B   Bromocresol green

C   Phenol red

D   There is no suitable indicator.

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

Using the apparatus shown, chlorine gas was passed through the tube. After a short time, some observable changes were seen during the experiment.
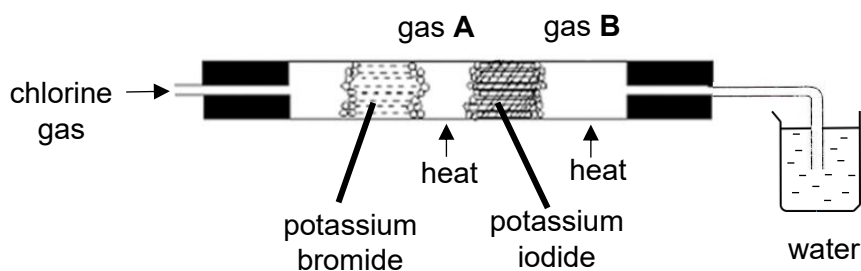
What are the colours observed for gas **A,** gas **B** and of the water in the beaker during the experiment?

	Colour of gas **A**	Colour of gas **B**	Colour of water in the beaker
A	reddish-brown	brown	purple
B	reddish-brown	purple	brown
C	colourless	purple	colourless
D	brown	brown	orange

10   How do the properties for Group 1 elements and their ionic compounds change down the group?

	Reducing Power	Ionisation Energy	Strength of ionic bonding in Group 1 oxides
A	increases	increases	increases
B	decreases	increases	decreases
C	increases	decreases	increases
D	increases	decreases	decreases

11   Element **X** is in Period 3 of the Periodic Table. The following four statements were made about the properties of element **X** or its compounds.

Three statements are correct descriptions. One of the statements is not correct because it does not fit with the other three.

Which statement is **not** correct?

A   Element **X** forms a chloride XCl_3, which reacts with more chlorine to give XCl_5.

B   Element **X** is a solid at room temperature.

C   The oxide of **X** reacts with water to give an acidic solution.

D   Adding NaOH(aq) to the solution resulting from the reaction of XCl_5 with water produces a white precipitate which is soluble in an excess of NaOH(aq).

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

Gallium is widely used to make alloys.

From its position in the Periodic Table, which properties will it be expected to possess?

1   In the vapour phase, the chloride has the formula Ga_2Cl_6.

2   Its oxide dissolves in aqueous acid.

3   Its oxide dissolves in aqueous base.

4   It has a giant molecular structure.

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

13 *Use of the Data Booklet is relevant to this question.*
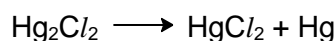
Which statement is correct?

A   1 mol of ethane contains 6 mol of atoms.

B   1 mol of deuteride, $^2H^-$, contains 2 g of neutrons.

C   148.3 g of magnesium nitrate contains $2 \times 6.02 \times 10^{23}$ ions.

D   135.8 dm^3 of neon gas, ^{20}Ne, measured at s.t.p., contains 3.6×10^{25} electrons.

14 10 cm^3 of a gaseous hydrocarbon was completely burnt in 100 cm^3 of oxygen. The volume of residual gas obtained was 80 cm^3. When the residual gas was shaken with aqueous potassium hydroxide, its volume decreased by 60 cm^3.

Which of the following is the molecular formula of the hydrocarbon? All volumes are measured at room temperature and pressure.

A C_3H_4 **B** C_3H_8 **C** C_6H_6 **D** C_6H_8

15 In leaded petrol, there is an additive composed of lead, carbon and hydrogen only. This compound contains 29.7% carbon and 6.19% hydrogen by mass.

What is the empirical formula of the compound?

A PbC_3H_6

B PbC_8H_{10}

C $PbC_{10}H_{20}$

D PbC_8H_{20}

16 Mercurous chloride, Hg_2Cl_2, decomposes upon exposure to ultraviolet light as shown below.

$$Hg_2Cl_2 \longrightarrow HgCl_2 + Hg$$

Which of the following statements regarding this reaction are correct?

1   Hg_2Cl_2 is reduced to Hg.

2   Hg in $HgCl_2$ has an oxidation state of +2.

3   There is no change to the oxidation state of Cl.

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

17 0.001 mol of a gaseous oxide, YO_x, reacted exactly with 50 cm^3 of 0.02 mol dm^{-3} acidified potassium manganate(VII) solution.

Given that the oxidation state of **Y** in the product is +6, what is the initial oxidation state of **Y** in YO_x?

[x can be any integer]

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

18 The enthalpy change of formation of solid potassium chloride can be calculated by considering some of the following enthalpy changes shown in the table.

	Enthalpy change / kJ mol^{-1}
$K(s) \longrightarrow K(g)$	+90
$Cl_2(g) \longrightarrow 2Cl(g)$	+242
$K(g) \longrightarrow K^+(g) + e^-$	+418
$Cl(g) + e^- \longrightarrow Cl^-(g)$	−355
$Cl(g) \longrightarrow Cl^+(g) + e$	+1260
$K^+(g) + Cl^-(g) \longrightarrow KCl(s)$	−710

What is the enthalpy change of formation of $KCl(s)$?

A −155 kJ mol^{-1}

B −436 kJ mol^{-1}

C +824 kJ mol^{-1}

D +945 kJ mol^{-1}

19 A student mixed 25.0 cm^3 of 1.50 mol dm^{-3} ethanedioic acid, $(COOH)_2$ with an equal volume of 3.00 mol dm^{-3} sodium hydroxide.

$$\tfrac{1}{2}\,(COOH)_2 + NaOH \longrightarrow \tfrac{1}{2}\,(COO^-Na^+)_2 + H_2O$$
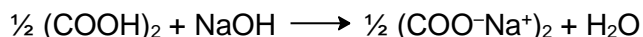
The initial temperature of both solutions was 15.0 ^oC. The maximum temperature recorded was 25.0 ^oC. It was found that 15 % of the heat produced during the experiment was lost to the surroundings.

Assume that the specific heat capacity of the solution is 4.18 J g^{-1} $^oC^{-1}$ and that the density of the solution is 1.00 g cm^{-3}.

Using these results, what is the enthalpy change of neutralisation in kJ mol^{-1}?

A $-\dfrac{(50)(1)(4.18)(10)(0.85)}{(37.5)}$

B $-\dfrac{(50)(1)(4.18)(10)(0.85)}{(75)}$

C $-\dfrac{(50)(1)(4.18)(10)}{(0.85)(75)}$

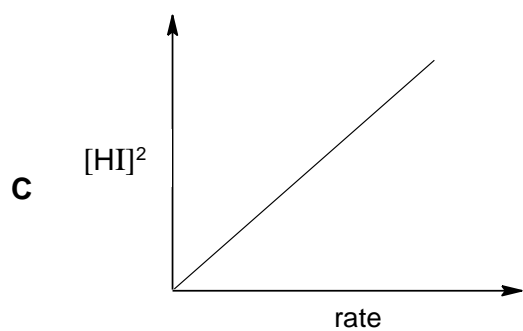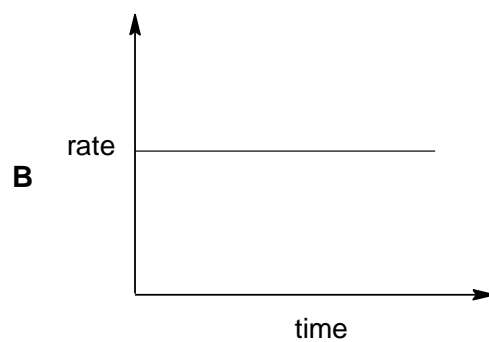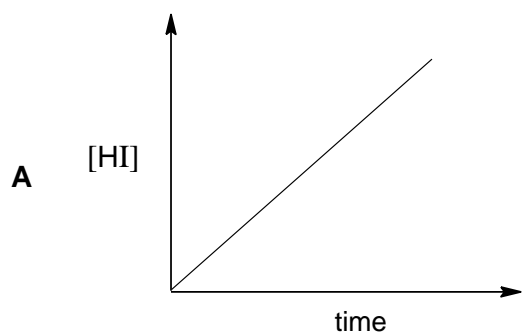**D** $-\dfrac{(50)(1)(4.18)(373)(0.15)}{(75)}$

**20** Which of the following equations could have the energy level diagram shown?
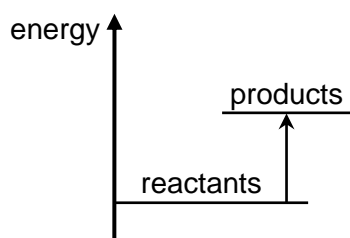
A $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$

B $NaF(s) \rightarrow Na^+(g) + F^-(g)$

C $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$

D $H(g) + F(g) \rightarrow HF(g)$

21 The decomposition of HI is a second order reaction.

Which graph correctly describes the kinetics of this reaction?

A [HI] vs time — straight line through origin, positive slope

B rate vs time — horizontal line

C [HI]^2 vs rate — straight line through origin, positive slope

D rate vs [HI] — decreasing curve
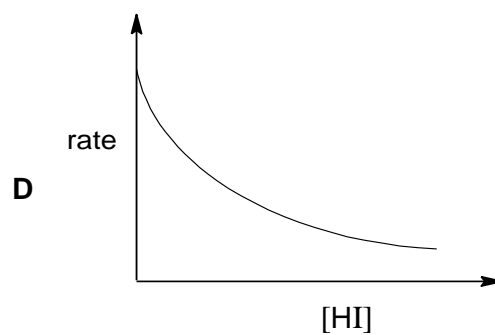
22 The initial rate of the slow reaction between potassium bromate(V), $KBrO_3$ and potassium bromide, KBr under acidic conditions can be studied using phenol. The equations for the reactions are as follows.

$$BrO_3^-(aq) + 5Br^-(aq) + 6H^+(aq) \longrightarrow 3Br_2(aq) + 3H_2O(l) \quad \text{reaction 1}$$
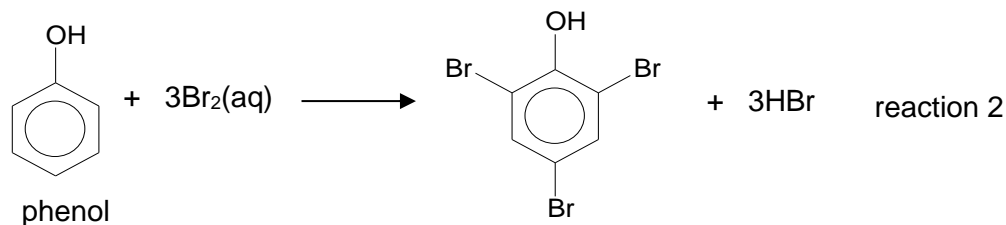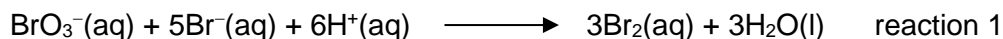
A small amount of phenol and three drops of methyl red indicator was added into each experiment mixture to study the progress of reaction. The bromine produced by reaction 1 will immediately react with phenol in reaction 2, until all the phenol is consumed. Any additional bromine that is produced will bleach the indicator completely. The time taken, t, for the complete disappearance of the red colour of the indicator is measured.

Expt no	Volume of $KBrO_3$ / cm^3	Volume of KBr / cm^3	Volume of HCl / cm^3	Volume of phenol / cm^3	Volume of water / cm^3	Time, t / s
1	5	25	30	2	40	80
2	5	25	60	2	10	20
3	10	25	60	2	5	10
4	5	50	15	2	30	160

Which of the following statements is correct?

A The order of reaction with respect to H^+ is 1.

B The overall order of reaction is 3.

C The units of the rate constant are $mol^{-3}\,dm^9\,s^{-1}$.

D Increasing the concentration of phenol added will result in a smaller value of t.

23 The equation for a reversible reaction is shown below. The addition of a catalyst **W** increases the rates of both the forward and reverse reactions.

$$\textbf{X}(g) \rightleftharpoons \textbf{Y}(g) \qquad \Delta H = +21 \text{ kJ mol}^{-1}$$

The activation energy of the uncatalysed forward reaction is higher than that of the catalysed forward reaction by 78 kJ mol^{-1}.

The activation energy for the uncatalysed reverse reaction is 163 kJ mol^{-1}.

What is the activation energy of the catalysed forward reaction?

A 85 kJ mol^{-1}

B 106 kJ mol^{-1}

C 142 kJ mol^{-1}

D 184 kJ mol^{-1}

24 The graph below shows how the percentage of product present at equilibrium varies with pressure for a reaction at constant temperature.
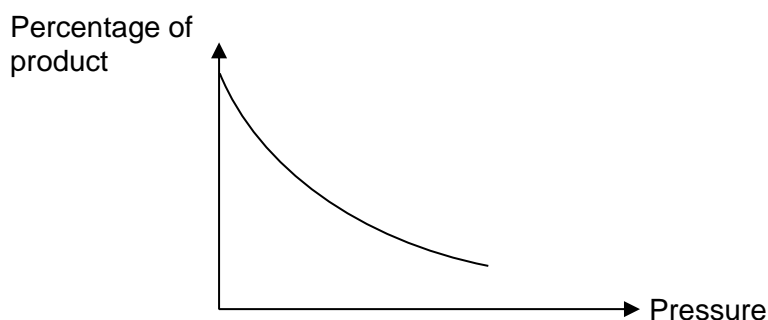
Which reaction could the graph represent?

A $4Fe(s) + 3O_2(g) \rightleftharpoons 2Fe_2O_3(s)$

B $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

C $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

D $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(s)$

25 For which of the following reactions does K_c have the units $mol^{-1} dm^3$?

   A $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

   B $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

   C $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

   D $CH_3CO_2H(l) + CH_3CH_2OH(l) \rightleftharpoons CH_3CO_2CH_2CH_3(l) + H_2O(l)$

26 Which statement is correct to describe constitutional isomers?

   A C_4H_{10} has 3 constitutional isomers.

   B But-1-ene and pent-1-ene are examples of constitutional isomers.

   C Constitutional isomers may differ in their chemical properties.

   D Constitutional isomers may have different molecular formulae.

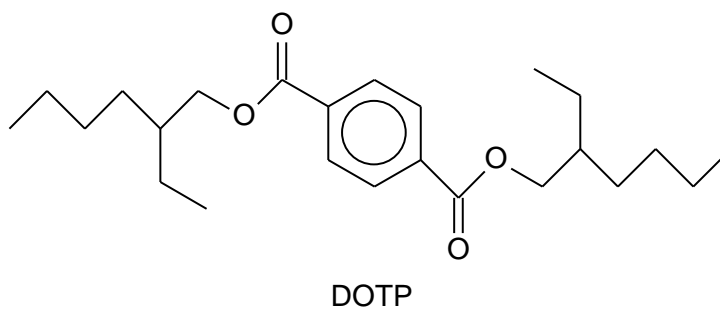27 The skeletal formula of fumaric acid is shown.
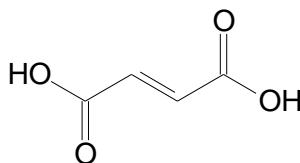
fumaric acid

What is the empirical formula of fumaric acid?

   A CHO

   B CH_2O_2

   C C_2HO_2

   D $C_4H_4O_4$

28 DOTP is used as a plasticiser to increase the fluidity of plastics such as PVC.

DOTP

Which reaction will produce DOTP under suitable conditions?

A

B

C

D

29 The compound $CH_3CH_2CH_2CONH_2$ is an amide.

Which statements about this amide are correct?

     1   When heated with NaOH(aq), it will form sodium propanoate.

     2   When heated with H_2SO_4(aq), it will form butanoic acid.

     3   It can be formed using butanoic acid and NH_3(aq) at room temperature.

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

30 Polymers are used extensively in our daily lives.

Which row best describes the most suitable polymer to use for each type of product?

	soft contact lenses	raincoats	microwavable food packaging
A	poly(vinyl alcohol)	polyamide	LDPE
B	poly(vinyl alcohol)	poly(vinyl chloride)	poly(propene)
C	poly(vinyl chloride)	poly(vinyl alcohol)	LDPE
D	poly(vinyl chloride)	polyester	poly(propene)

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