ANDERSON SERANGOON JUNIOR COLLEGE

2023 JC2 PRELIMINARY EXAMINATION

NAME:_____ (   )   **CLASS:** 23 /_____

CHEMISTRY   **9729/01**

Paper 1 Multiple Choice   **21 September 2023**

                                                                   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 and register number on the Answer Sheet.

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.
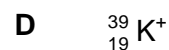
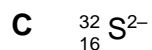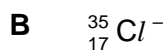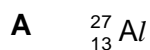Shade the NRIC / FIN number.

Exam Title: JC2 PRELIM

Exam Details: H2 Chemistry / Paper 1

Date: 21/09/2023

This document consists of **14** printed pages and **2** blank pages.

1 In which species are the number of protons, neutrons and electrons all different?

A $^{27}_{13}Al$ **B** $^{35}_{17}Cl^{-}$ **C** $^{32}_{16}S^{2-}$ **D** $^{39}_{19}K^{+}$

2 The ionisation energies, IE, of five elements are given in the table.

	second IE /kJ mol^{-1}	third IE /kJ mol^{-1}	fourth IE /kJ mol^{-1}
B	2420	3660	25000
F	3370	6040	8410
Na	4560	6940	9540
Mg	1450	7740	10500
Al	1820	2740	11600

Which statement is correct?

A The 2nd IE of F is higher than the 3rd IE of Al because Al^{2+} has a higher nuclear charge than F^{+}.

B The 2nd IE of Mg is lower than 2nd IE of Na because there is inter-electronic repulsion between the paired electrons in Mg^{+}.

C The 4th IE of B is higher than the 4th IE of Al because the electron to be removed from Al^{3+} is further away from the nucleus.

D The successive IE of these elements increase because the shielding effect increases.

3 Which statement about the electrons in a ground state germanium atom is correct?

A Electrons are present in four different energy levels.

B There are more electrons in d orbitals than there are in p orbitals.

C The occupied orbital of highest energy is spherical.

D The occupied orbital of lowest energy is spherical.

4 Which species contains three π bonds?

    1   Al_2Cl_6

   2 SO_3

    3   CH_3CH_2COOH

    4   CH_2CHCH_2CN

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

5 The shape and polarity of four molecules are shown in the following table.

Which row is correct?

|	molecule	molecular shape	polarity
A	beryllium chloride	bent	non-polar
B	phosphorus trichloride	trigonal pyramidal	non-polar
C	carbon dioxide	linear	polar
D	tribromomethane	tetrahedral	polar

6 Water, methanol and sulfur dioxide have similarly shaped molecules.
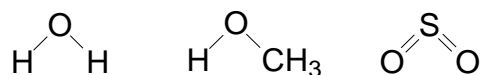
What is the strongest intermolecular force in water, methanol and sulfur dioxide?

	H_2O	CH_3OH	SO_2
A	hydrogen bonds	hydrogen bonds	permanent dipoles
B	hydrogen bonds	hydrogen bonds	induced dipoles
C	permanent dipoles	permanent dipoles	induced dipoles
D	hydrogen bonds	permanent dipoles	induced dipoles

7 Which graph correctly describes the behaviour of two ideal gases **P** and **Q**, both having the same mass, where **P** has a larger M_r than **Q**?
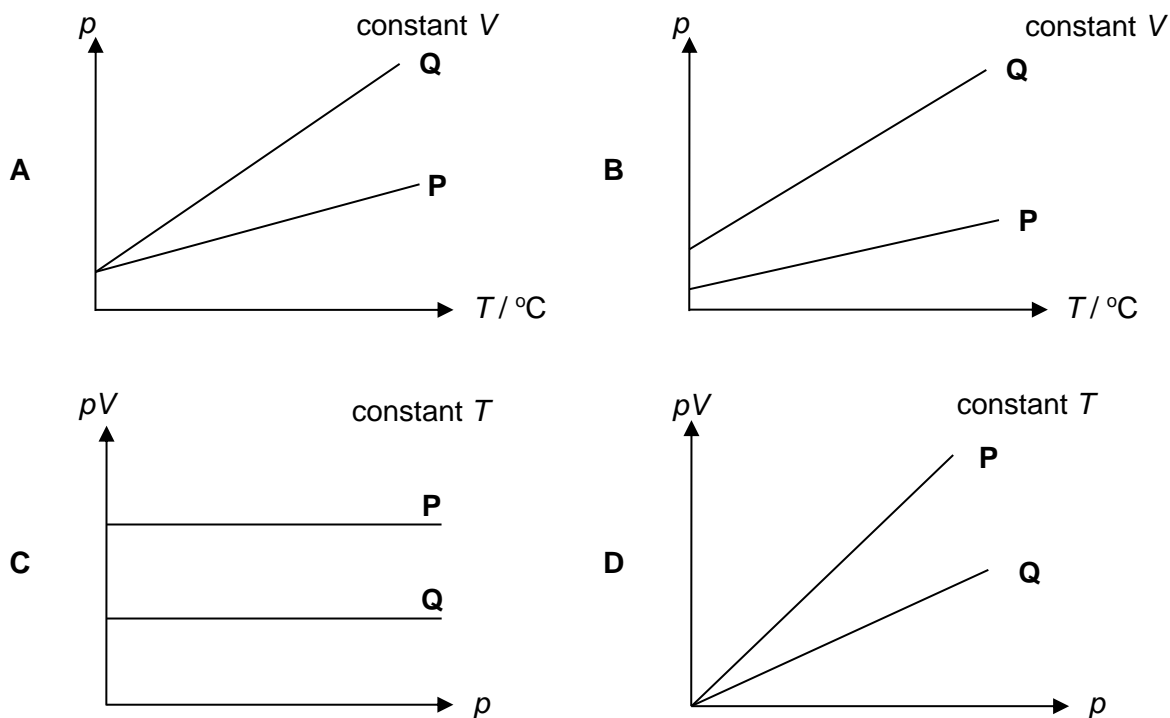
8 Which gas shows the greatest deviation from ideality?

    A CH_4 **B** SO_3 **C** C_2H_2 **D** CO_2

9 When 25 cm^3 of 0.5 mol dm^{-3} hydrochloric acid is reacted with an equal volume of 0.5 mol dm^{-3} potassium hydroxide, the temperature of the mixture rose by 3.4 ^oC.

What will be the temperature change if 50 cm^3 of 1 mol dm^{-3} hydrochloric acid is mixed with an equal volume of 1 mol dm^{-3} potassium hydroxide?

    A   1.7 ^oC **B**   3.4 ^oC **C**   6.8 ^oC **D**   13.6 ^oC

10 Which equation corresponds to the enthalpy change stated?

    A $H_2SO_4(aq) + 2KOH(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$ $\Delta H^{\theta}_{neutralisation}$

    B $Na^+(s) + aq \rightarrow Na^+(aq)$ $\Delta H^{\theta}_{hydration}(Na^+)$

    C $Al_2O_3(s) \rightarrow 2Al^{3+}(g) + 3O^{2-}(g)$ $\Delta H^{\theta}_{lattice\ energy}(Al_2O_3)$

    D $O_2(g) \rightarrow 2O(g)$ $2\Delta H^{\theta}_{atomisation}(O_2)$

11 Given the following data in kJ mol^{-1}

enthalpy change of atomisation of Na(s)	+109
electron affinity of Cl atom	–364
enthalpy change of formation of NaCl(s)	–411
enthalpy change of atomisation of Cl(g)	+121
1st ionisation energy of Na atom	+494

What is the lattice energy of NaCl(s) in kJ mol^{-1}?

A –771 **B** –892 **C** –1269 **D** –1499

12 The equation describes the equilibrium between solid silver chromate and its aqueous ions.

$$Ag_2CrO_4(s) \rightleftharpoons 2Ag^+(aq) + CrO_4^{2-}(aq)$$
$\Delta H^{\ominus} = +61$ kJ mol^{-1}
$\Delta S^{\ominus} = -30$ J K^{-1} mol^{-1}
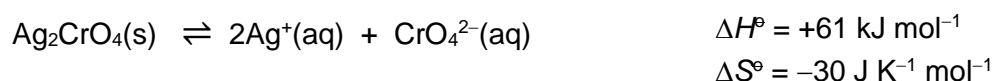
What can be deduced from the information about this equilibrium?

1 At 25 °C, $\Delta G^{\ominus}$ is negative.

2 At 25 °C, silver chromate is insoluble in water.

3 At 95 °C, silver chromate is more soluble in water than at 25 °C.

A 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

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

Bronze is an alloy of copper and tin. The following information is obtained for a sample of bronze.
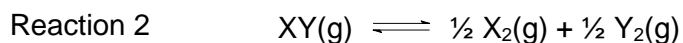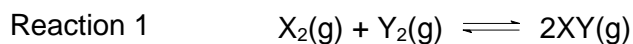
mass number	63	65	118
% composition	f	68 – f	32

Naturally occurring copper contains only two isotopes, ^{63}Cu and ^{65}Cu.

Given the ratio of ^{63}Cu and ^{65}Cu in naturally occurring copper is the same as that in bronze, what is the value of f?

A   17

B   25

C   51

D   75

14 Two reactions are shown.

Reaction 1 $X_2(g) + Y_2(g) \rightleftharpoons 2XY(g)$

Reaction 2 $XY(g) \rightleftharpoons \frac{1}{2} X_2(g) + \frac{1}{2} Y_2(g)$
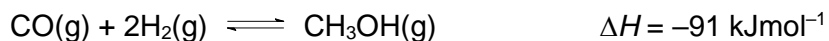
The equilibrium constant, K_p, for Reaction 1 is 0.0052.

What is the value of K_p for Reaction 2?

A 2.6×10^{-3}

B   13.9

C   192.3

D   384.6

15 Methanol, CH_3OH, can be produced industrially by reacting CO with H_2.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \qquad \Delta H = -91 \text{ kJmol}^{-1}$$

The process can be carried out at 4×10^3 kPa and 1150K.

Which statements of about this reaction are correct?

1 Increasing the temperature will increase the rate of reaction because more frequent effective collisions will occur.

2 Lowering the temperature will reduce the rate of reaction because the forward reaction is exothermic.

3 Increasing the pressure will reduce the rate of reaction because there are a larger number of moles on the left-hand side of the equation.
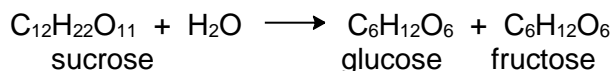
A 1 only

B 1 and 2

C 1 and 3

D 2 and 3

16 The decomposition of HI is a second order reaction.

Which graph correctly describes the kinetics of this reaction?
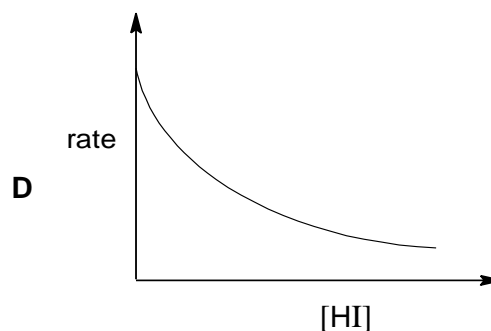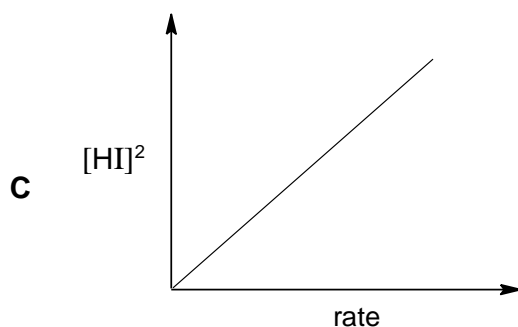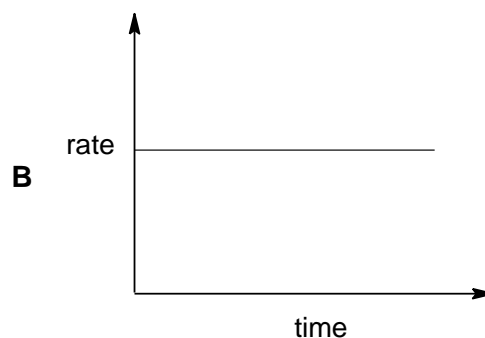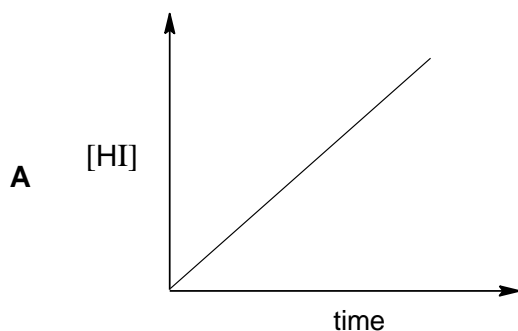
17 Sucrose has been used as a feedstock in the production of alcohol for use as a motor fuel. The initial reaction is its hydrolysis:

$$C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6$$
sucrose   glucose   fructose

This reaction can be catalysed either by dilute acid or by an enzyme which occurs in yeast. The following results were obtained using hydrochloric acid as the catalyst.

Experiment	Initial [HCl] / mol dm^{-3}	Initial [sucrose] / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
I	0.10	0.10	0.024
II	0.20	0.10	0.048

The order of reaction with respect to HCl and sucrose are both one and the half-life of sucrose in experiment I was 3.0 s.

Predict the half-life of sucrose in experiment II.

A 1.5 s

B 2.0 s

C 2.5 s

D 3.0 s

18 Solutions **E**, **F**, **G** and **H** contain a strong monobasic acid, a weak monobasic acid, a strong base and a salt of the weak monobasic acid, but not necessarily in the same order. The concentration and pH at 25 °C for each solution are shown below.
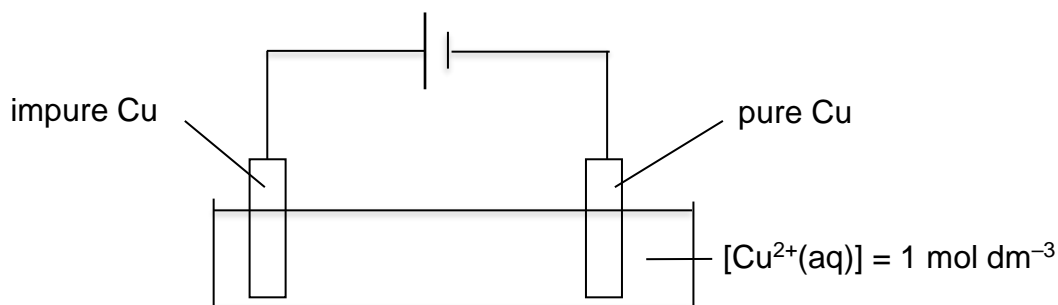
Solution	Concentration /mol dm^{-3}	pH
E	1.0	4.0
F	1.0	9.4
G	0.01	12.0
H	0.01	2.0

Which one of the following produces an acidic buffer?

A   Mixing 10 cm^3 of **E** and 50 cm^3 of **G**

B   Mixing 10 cm^3 of **E** and 50 cm^3 of **H**

C   Mixing 10 cm^3 of **F** and 1 dm^3 of **H**

D   Mixing 10 cm^3 of **F** and 1 dm^3 of **G**

19 An electrolytic cell is set up for the purification of a mass of impure copper as shown.

The sample of impure Cu is known to contain nickel and silver as minor impurities.

Using which of the following in a larger quantity will result in more pure copper deposit on the cathode?

A concentration of Cu^{2+} electrolyte

B mass of impure Cu

C temperature

D current

20 An electric current is passed through two cells connected in series. One cell contains gold(III) chloride and the other contains aqueous copper(II) sulfate. If 4.00 g of gold is formed in the cell containing gold(III) chloride, what is the mass of copper deposited in the other cell?

A 0.64 g   **B** 0.86 g   **C** 1.29 g   **D** 1.93 g

21 Which statement about Group 2 elements and their compounds is **incorrect**?

A Barium loses its valence electrons more easily than calcium hence it is a stronger reducing agent.

B The melting point of magnesium oxide is higher than calcium oxide due to the higher polarising power of Mg^{2+}.

C Magnesium carbonate decomposes at a lower temperature than calcium carbonate.

D Beryllium chloride can behave as a Lewis acid because there are only four bonding electrons around beryllium.

22 Due to its radioactive nature, the properties of astatine, At, have to be estimated based on its position in the Periodic Table.

Which predictions concerning At or its compounds are correct?

    1   Astatine forms diatomic molecules which dissociate into atoms less readily than iodine molecules.

    2   Astatine is a weaker oxidising agent than iodine.

    3   Astatine is a solid at room temperature.

    4   Hydrogen astatide has a higher decomposition temperature than hydrogen iodide.

A   1, 2 and 4

B   2, 3 and 4

C   2 and 3

D   1 and 4

23 How many chiral carbon atoms are there in one molecule of 2,2,4,5-tetramethylhexan-3-ol?

A   1

B   2

**C**   3

D   4

24
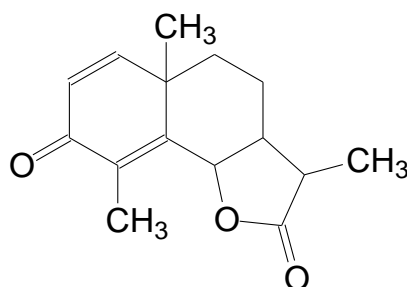
Santonin

Santonin is first heated with dilute H_2SO_4. The product of this reaction is treated with cold dilute acidified $KMnO_4$. A final product **Q** is obtained.

How many atoms of hydrogen in each molecule of product **Q** will react with sodium metal?

A   2

B   4

C   5

D   6

25 When dichlorodifluoromethane, CCl_2F_2, is released into the atmosphere, it accumulates in the upper part of the atmosphere where it reacts to form free radicals due to the action of ultraviolet light.

One of the chain reactions which can occur is shown, where $X\bullet$ represents the halogen radical.

$$X\bullet + O_3 \rightarrow XO\bullet + O_2$$
$$2XO\bullet + O_2 \rightarrow 2X\bullet + 2O_2$$
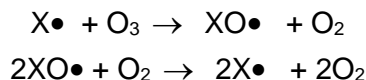
Which statement is correct?

A $F\bullet$ and $\bullet CCl_2F$ are the major free radical products made during the initiation step.

B The halogen radical acts as a catalyst in the breakdown of ozone.

C The halogen radical is formed during the termination step.

D The initiation step is exothermic in nature.

26 Compound **B**, $C_6H_{12}O_6$, is an important biomolecule abundant in the brain as it mediates cell signal transduction in response to a variety of hormones and neurotransmitters.

All the atoms (besides the hydrogen atoms) in **B** are sp^3 hybridised.

On adding excess sodium to **B**, hydrogen gas is liberated.

Which of the following statements about compound **B** is true?

A Compound **B** forms a purple colouration with neutral iron(III) chloride solution.

B Compound **B** forms a yellow precipitate with warmed alkaline iodine solution.

C Compound **B** forms a bright orange precipitate with 2,4-dinitrophenylhydrazine.

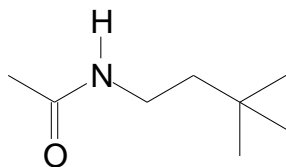**D** Compound **B** forms a brick-red precipitate with Fehling's solution.

27 An amide, **M**, has the empirical formula $C_8H_{17}ON$. Molecules of **M** are chiral. When **M** is hydrolysed by heating under reflux with dilute hydrochloric acid, a carboxylic acid with empirical formula C_2H_4O is obtained as one of the products.
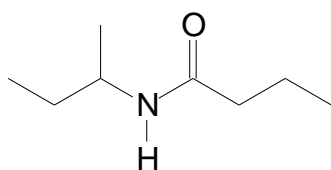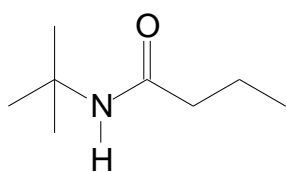
What could be the formula of **M**?
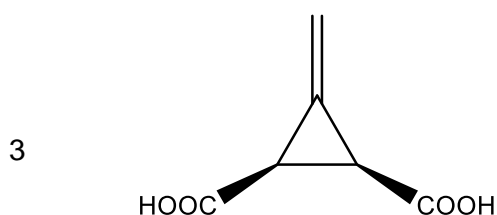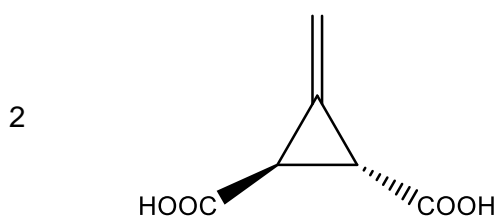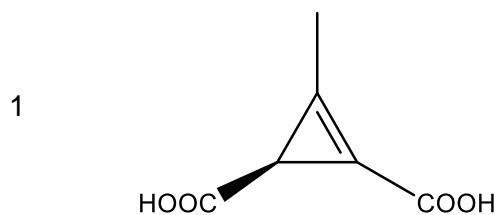
A
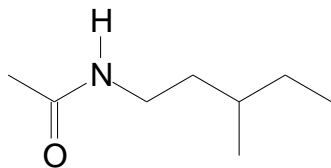
B

C

D

28 In 1893, a new compound Feist's acid was discovered and found to be optically active.

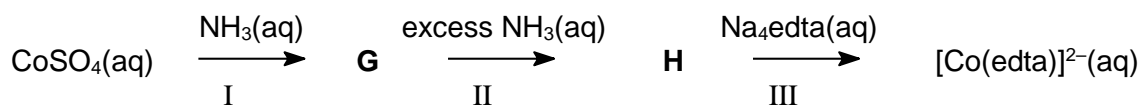Based on the above information, which of the following could be the structures of Feist's acid?

1

2

3

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

29 A compound of chromium with the general formula $CrCl_3.6H_2O$ forms an aqueous solution. When this solution is treated with an excess of aqueous silver nitrate, only one third of the total chloride present is precipitated as $AgCl$.

What is the structure of the chromium ion present in the original compound?

A $Cr^{3+}(aq)$

B $[Cr(H_2O)_6]^{3+}$

C $[Cr(H_2O)_5Cl]^{2+}$

D $[Cr(H_2O)_4Cl_2]^{+}$

30 A reaction scheme starting from aqueous cobalt(II) sulfate solution is shown below.

Both **G** and **H** are cobalt–containing species. **G** appears as a blue precipitate while **H** is a yellow brown solution, $[Co(NH_3)_6]^{2+}$.

$$CoSO_4(aq) \xrightarrow[\text{I}]{NH_3(aq)} \textbf{G} \xrightarrow[\text{II}]{\text{excess } NH_3(aq)} \textbf{H} \xrightarrow[\text{III}]{Na_4edta(aq)} [Co(edta)]^{2-}(aq)$$

Which of the following statements is correct?

A NH_3 is a ligand in reaction I.

B Reaction II is a ligand exchange reaction.

C Oxidation state of cobalt in $[Co(edta)]^{2-}$ is +6.

D The entropy of the system decreases when reaction III occurs.

15

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