ANDERSON SERANGOON JUNIOR COLLEGE



2022 JC 2 PRELIMINARY EXAMINATION

NAME:	()	CLASS: 22 /

CHEMISTRY

Paper 1 Multiple Choice

9729/01 21 September 2022

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: <u>H2 Chemistry / Paper 1</u>

Date: <u>21/09/2022</u>

This document consists of **16** printed pages.

1 In two separate experiments, a beam of protons and electrons, travelling at the same velocity is passed through an electric field as shown.



Which statement is correct?

- A The proton beam is deflected in a parabolic path to a larger extent than the electron beam.
- **B** The proton beam travels in a straight path towards the negatively charged plate.
- **C** The electron beam travels in a straight path towards the negatively charged plate.
- **D** The proton beam is deflected in a parabolic path towards the negatively charged plate.
- 2 Use of the Data Booklet is relevant to this question.

The table below shows the fifth, sixth, seventh, eighth and ninth ionisation energies of an element **D** ($Z \le 20$) in the Periodic Table.

	5th	6th	7th	8th	9th
ionisation energy / kJ mol ⁻¹	6530	9353	11 019	33 606	38 676

What can be inferred about the element from the above data?

- **A** It is in the second period of the Periodic Table.
- **B** It has a valence electronic configuration of ns²np⁴.
- **C** Its 5th and 6th electrons are removed from different subshells.
- **D** It is likely to form an ionic compound Mg_3D_2 with magnesium.

3 Which pair of molecules have a greater permanent dipole in molecule I than in molecule II?



- A 1 and 2 only
- **B** 3 and 4 only
- **C** 2, 3 and 4 only
- **D** 1, 3 and 4 only
- 4 Four substances have the physical properties as shown.

Compound	Melting point/°C	Electrical conductivity of solid	Electrical conductivity of molten substance
E	-72	poor	poor
F	801	poor	good
G	842	good	good
Н	1710	poor	poor

Which of the following shows the correct type of structures for each compound?

	E	F	G	Н
A	simple molecular structure	giant ionic structure	giant metallic structure	giant molecular structure
в	giant molecular structure	giant metallic structure	giant ionic structure	giant molecular structure
с	giant molecular structure	simple molecular structure	giant metallic structure	giant ionic structure
D	simple molecular structure	giant ionic structure	giant molecular structure	giant metallic structure

5 The value of $\frac{pV}{RT}$ is plotted against *p* for one mole of each of the two gases, **J** and **K**, where *p* is the pressure, V is the volume and T is the temperature of the gas.



Which of the following statements is true about gases J and K?

- A Gas J is N₂ and gas K is O₂ because there is stronger instantaneous dipole-induced dipole interactions between N₂ molecules than O₂.
- **B** Gas **J** is HBr and gas **K** is HI because there is stronger instantaneous dipole-induced dipole interactions between HI molecules than HBr.
- **C** Gas **J** is HBr and gas **K** is H₂O because there is stronger permanent dipole-permanent dipole interactions between HBr molecules than the weaker instantaneous dipole-induced dipole interactions between H₂O molecules.
- **D** Gas **J** is HBr and gas **K** is F₂ because there is stronger permanent dipole-permanent dipole interactions between HBr molecules than the weaker instantaneous dipole-induced dipole interactions between F₂ molecules.

6 Use of Data Booklet is relevant to this question.

At 800 K, the following compounds all behave as ideal gases.

 NH_3 CH_3Cl CH_2Cl_2 HCOOH

Which of the following diagram is correct for a given mass of each of these gases at constant pressure?



7 Use of Data Booklet is relevant to this question.

What is the correct order of the lattice energies of magnesium oxide, magnesium chloride and sodium chloride, starting with the highest numerical value?

- **A** MgO > NaCl > MgC l_2
- **B** MgO > MgC l_2 > NaCl
- $\textbf{C} \qquad MgCl_2 > MgO > NaCl$
- **D** $MgCl_2 > NaCl > MgO$

- 8 Which quantity would best indicate the relative strengths of the intermolecular forces of attraction between the molecules in liquid hydrogen halides?
 - **A** Bond dissociation energies
 - **B** Enthalpy changes of vapourisation
 - **C** Enthalpy changes of formation
 - **D** Enthalpy changes of atomisation
- **9** Sucrose undergoes an acid–catalysed hydrolysis according to the following equation.

 $\begin{array}{ccc} C_{12}H_{22}O_{11} + H_2O \longrightarrow C_6H_{12}O_6 + C_6H_{12}O_6 \\ \text{sucrose} & \text{glucose} & \text{fructose} \end{array}$

The following results were obtained using hydrochloric acid as the catalyst.

experiment	initial [HC <i>I</i>] / mol dm ⁻³	initial [sucrose] / mol dm ⁻³	initial rate / mol dm ⁻³ s ⁻¹
Ι	0.10	0.10	0.024
II	0.10	0.15	0.036
III	0.30	0.10	0.072

The half–life of sucrose in experiment I was 3.0 s.

What is the half-life of sucrose in experiment II and in experiment III?

	experiment II	experiment III
Α	3.0	3.0
в	3.0	1.0
С	2.0	1.0
D	2.0	3.0

	rate equation	suggested mechanism
1	rate = $k_1 [H_2O_2] [I^-]$	$H_2O_2 + I^2 \xrightarrow{slow} H_2O + OI^2$
		OI⁻ + H⁺ fast HOI
		HOI + H ⁺ + I ⁻ $\xrightarrow{\text{fast}}$ I ₂ + H ₂ O
2	rate = k_2 [H ₂] [I ₂]	H ₂ 2H
		$2H + I_2 \xrightarrow{\text{fast}} 2HI$
3	rate = k_3 [HBr] ² [O ₂] ^{1/2}	2HBr + O ₂ ► 2HBrO
		HBrO + HBr $\xrightarrow{\text{slow}}$ H ₂ O + Br ₂

10 Which suggested mechanism is consistent with the experimentally obtained rate equation?

- A 1 and 2 only
- B 1 only
- C 1 and 3 only
- D 2 and 3 only
- 11 In the presence of gold wire as a catalyst, 25.0 kPa of dinitrogen oxide, N₂O, decomposes in a closed container according to the equation below.

$$2N_{2}^{}O(g)\rightarrow 2N_{2}^{}(g)+O_{2}^{}(g)$$

The units of the rate constant was found to be s^{-1} .

Which of the following remains constant during the experiment?

- **A** The rate of the reaction.
- **B** The total pressure of the reaction mixture.
- **C** The value of rate constant in the absence of gold.
- **D** The time taken for the pressure of N_2O to drop by half.

12 The rates of the reversible reaction to produce ammonia in a closed vessel can be affected by changing the pressure of reactants or adding a catalyst.

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

Which of the following statements about the system are correct?

- 1 Increasing partial pressure of nitrogen increases the rate of the forward reaction.
- 2 Decreasing the partial pressure of nitrogen increases the rate of the reverse reaction.
- 3 Adding a catalyst does not affect the value of the rate constant, *k*.
- 4 Adding a catalyst reduces the activation energies for both the forward and reverse reaction.
- **A** 1, 2 and 4
- **B** 2, 3 and 4
- **C** 2 and 3
- **D** 1 and 4 only
- **13** Aqueous HF is a weak acid. Magnesium fluoride is sparingly soluble.

Which graph below shows how the solubility of MgF_2 in water will vary with pH at constant temperature?



Tempera	ture/ °C	K _w / mol² dm⁻ ⁶
25	5	1.00 x 10 ⁻¹⁴
50)	5.50 x 10 ⁻¹⁴
62	2	1.00 x 10 ⁻¹³

14 The variation of the ionic product of water, K_{w} , with temperature is given in the table.

What can be deduced from this information?

- A The ionisation of water is an exothermic process.
- **B** [H⁺] is more than [OH⁻] as temperature increases.
- **C** pH of water at 10 °C is higher than at 25 °C.
- **D** The equilibrium position lies furthest to the right at 25 °C.
- **15** Aqueous ethanenitrile, CH₃CN, has no effect on litmus but aqueous ethylamine, CH₃CH₂NH₂, turns litmus blue.

Which statements below can be used to explain this observation?

- 1 Delocalisation of the lone pair of electrons on the nitrogen atom of CH_3CN over the C=N group strengthens the C-N bond.
- 2 Lone pair of electrons on the nitrogen atom of C≡N are in an sp hybridised orbital which is closer to the nucleus than the lone pair of electrons on the sp³ hybridised nitrogen atom of the NH₂ group.
- 3 The ethyl group in ethylamine is a stronger electron donating group than the methyl group in ethanenitrile as it has one more carbon atom.
- **A** 1, 2 and 3 **B** 1 only **C** 2 and 3 **D** 2 only
- **16** 1 mol each of an aliphatic alkane and an alkene with the same number of carbon atoms per molecule, are separately burned.

Which statement about the complete combustion of these hydrocarbons is always correct?

- A The volume of gas produced at 298 K is the same for both reactions.
- **B** The volume of oxygen required for combustion of the alkane is twice that required for the alkene.
- **C** The volume of steam produced from the alkene is twice the volume of carbon dioxide at 400 K.
- **D** The volume of oxygen required for the alkane is directly proportional to the number of carbon atoms present in the molecule.

17 Two isomers, L and M, of cyclohexane-1,2-diol are shown below.



Which statements are correct?

- 1 L and M are a pair of cis-trans isomers.
- 2 Both isomers L and M rotate plane-polarised light.
- 3 An equimolar mixture of L and M forms a racemic mixture.
- **A** 1, 2 and 3 **B** 2 and 3 **C** 1 only **D** 3 only
- **18** Which of the following pairs of compounds can be distinguished from each other when heated with aqueous acidified KMnO₄?



19 Ethers are cleaved by HI via an S_N2 mechanism.



Which of the following is the most likely product for the following reaction?



20 Compound P is a steroid medication used to reduce inflammation and treat certain allergies.

 \mathbf{P} can be reduced to compound \mathbf{Q} by NaBH₄ in ethanol.



compound P

How many chiral centres exist for **P** and for **Q**?

	Р	Q
Α	6	7
В	6	9
С	7	8
D	7	10

21 Equal amounts of two organic compounds, Y and Z, were added to water and the pH values of both solutions were determined. It was found that the pH of the aqueous solution of Y is higher.

		Y	z
	1	(CH ₃) ₂ NH	CH ₃ NH ₂
	2	$CH_3COCH_2NH_2$	$CH_3CH_2CONH_2$
	3	C ₆ H₅O⁻Na⁺	$C_6H_5CO_2^-Na^+$
1, 2 a	and 3	B 1 and 2	C 2 and 3

Α

22 K, C_2H_3OCl , produces a grey-black solid with Tollens' reagent.

K can be converted into N as shown.



23 In some organic reactions, the reactive carbon atom is tetrahedral in the reactant molecule but **not** tetrahedral in the organic intermediate.

To which of the following reactions does this statement apply?



24 Cyclohexene reacts with cold, concentrated sulfuric acid in an addition reaction to produce alkyl hydrogensulfate.



Which of the following statements best explain why benzene does not react in a similar way?

- **A** The π electron cloud of the benzene repels the HSO₄⁻ ion.
- **B** Steric hindrance by benzene prevents SO₃H⁺ from reacting with it.
- **C** The concentrations of the ions produced from the dissociation of concentrated H_2SO_4 are too low.
- **D** Reacting with sulfuric acid in an addition reaction prevents the continuous overlap of the p orbitals of all the six carbon atoms in the benzene ring.
- **25 R** can be synthesized in the laboratory by heating ethanol and carboxylic acid **P** in the presence of concentrated sulfuric acid as shown.



What could be **P** and a by-product of this reaction?



26 Element Z is a solid with a very low electrical conductivity at room temperature. It forms only one chloride, which is a liquid at room temperature and is a non–conductor of electricity. The chloride hydrolyses in water forming a white solid and a strongly acidic solution.

Which of the following could be Z?

- **A** Aluminium
- **B** Magnesium
- C Phosphorus
- D Silicon
- 27 Prussian blue is a deep blue insoluble pigment that is used as a dye for paper and ink.

It is made up of Fe^{3+} cations and octahedral $[Fe(CN)_6]^{4-}$ complex anions, with the chemical formula $Fe_4[Fe(CN)_6]_3$.

It can be prepared in two methods.

Method 1: mixing aqueous solutions of FeCl₃ and K₄Fe(CN)₆

Method 2: mixing aqueous solutions of FeCl₂ and K₃Fe(CN)₆

Which of these statements are correct?

- 1 Method 1 involves a redox reaction.
- 2 Method 2 involves a ligand exchange reaction.
- 3 Both methods will produce blue ppt and a colourless solution.
- A 1, 2 and 3
- **B** 1 and 2
- **C** 2 and 3
- D 2 only

28 Which statement explains why an aqueous solution of silver(I) nitrate is colourless?

- A Silver is a transition element.
- **B** There is no d-orbital splitting in silver(I) ion.
- **C** The 4d subshell of silver(I) ion is fully filled.
- **D** The size of the energy gap between the non-degenerate d-orbitals is too big.

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

A voltaic cell is made up of Mg²⁺/Mg half-cell and Fe³⁺/Fe²⁺ half-cell.

Which one of the following statements is correct?

- **A** The Mg^{2+}/Mg half-cell is the positive electrode.
- **B** Increasing the size of Mg electrode has no effect on the e.m.f. of the cell.
- **C** Addition of water to the Fe^{3+}/Fe^{2+} half-cell decreases the e.m.f. of the cell.
- **D** Decreasing the pressure of the voltaic cell would increase the e.m.f. of the cell.

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

The primary source of oxygen gas in modern submarines comes from the electrolysis of seawater. Typically, seawater contains less than 1 mol of sodium chloride in 1 dm³ of seawater.

In an experiment, a sample of seawater was electrolysed over a period of 120 hours, and no additional seawater was introduced during this period.

A graph was plotted to show how the concentration of chloride ions changes as the reaction proceeds.



Which of these statements is incorrect?

- **A** At 90 h, Cl^- is preferentially oxidised to Cl_2 gas.
- **B** Concentration of Cl^- increases linearly as the H₂O is reacted away.
- **C** At 60 h, the volume of gas collected at cathode and anode is the same.
- **D** Purple litmus solution added at 20 h would turn red and blue at the anode and the cathode respectively.