JURONG PIONEER JUNIOR COLLEGE JC2 PRELIMINARY EXAMINATION 2020

CHEMISTRY

Higher 2

9729/01

Paper 1 Multiple Choice

24 September 2020 1 hour

Candidates answer on separate paper.

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 exam index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** or **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 **12** printed pages.

1 When 20 cm³ of a gaseous hydrocarbon was completely burnt in 130 cm³ of oxygen, the volume of gas remaining after the reaction was 100 cm³. This volume was decreased to 40 cm³ when the resulting mixture was passed through aqueous NaOH. All measurements were made at room temperature and pressure.

What is the formula of this hydrocarbon?

- **A** C₂H₂
- **B** C₃H₆
- $C \quad C_3H_8$
- **D** C₄H₁₀
- **2** 25.0 cm³ of 0.05 mol dm⁻³ KC lO_4 (aq) required 50.0 cm³ of 0.20 mol dm⁻³ TiC l_3 (aq) to reach the end-point. Given that titanium(III) is oxidised to titanium(IV) in this reaction, which of the following formulae correctly represents the reduction product of the ClO_4^- ion?
 - **A** Cl^- **B** ClO_2^- **C** ClO_3^- **D** OCl^-
- 3 Alpha particles, ⁴₂He²⁺, are commonly emitted by larger radioactive nuclei during radioactive decay. The diagram below shows the path of a mixture of a charged species **X**, ⁷₃Li⁺ and alpha particles after passing through an electric field.



Which of the following statements are true?

- 1 X could be an electron.
- 2 Plate **Y** is positive.
- 3 The angle of deflection of alpha particles is 3.5 times of the angle of deflection of Li⁺.
- A 1 and 2 only
- **B** 1 and 3 only
- C 2 and 3 only
- **D** 1, 2 and 3

- 3
- 4 Which element has the largest atomic radius?
 - **A** Br **B** In **C** K **D** Rb
- **5** In which of the following pairs does the second compound have a higher boiling point than the first?
 - **A** P_4 Cl_2
 - B CaO Na₂O
 - C CH₃OH CH₃ONa
 - $\textbf{D} \quad CH_3CH_2OH \quad CH_3CH_2SH$
- **6** Which of the following pairs of species have the same shape?
 - A
 PC l_3 BF₃

 B
 NO 2^+ NO2

 C
 Bec l_2 NH 2^-

 D
 SO 3^{2^-} NH3
- 7 Which of the following pairs contain molecules that are **both** polar?

	Molecule I	Molecule II
Α	C_2H_5Cl	CHCl ₃
В	CCl_4	CFCl ₃
С	CHCl ₃	C_2Cl_4
D	C_2H_5Cl	C_2Cl_4

8 Which graph is obtained when pV is plotted against p for a fixed amount of an ideal gas at constant temperature?



9 The values of some ΔH terms for anhydrous MgC l_2 are given in the table below.

lattice energy of MgCl ₂	−2526 kJ mol ⁻¹
enthalpy change of hydration of Mg ²⁺	−1890 kJ mol ⁻¹
enthalpy change of hydration of Cl ⁻	−384 kJ mol ⁻¹

What is the enthalpy change of solution of anhydrous $MgCl_2$, in kJ mol⁻¹?

Α	+132	В	+252
С	-132	D	+5184

10 The decomposition of hydrogen peroxide in aqueous solution is a first order process.

If 10 % of the hydrogen peroxide in a solution of concentration 0.1 mol dm⁻³ decomposes in 5 minutes at a certain temperature, what percentage of the hydrogen peroxide in a solution of concentration 0.2 mol dm⁻³ would decompose in 5 minutes at the same temperature?

A	5 %	В	10 %	С	19 %	D	20 %
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5

11 The rate of the decomposition of the diazonium cation,

 $C_6H_5N_2{}^+ + H_2O \rightarrow C_6H_5OH + H^+ + N_2$

can be followed by measuring the time taken for the same volume of N_2 to be produced from a range of diazonium cation concentrations.

To find the order of the reaction with respect to the diazonium cation, which would be the most suitable graph to plot using the data?

- **A** $[C_6H_5N_2^+]$ against 1/time
- **B** $[C_6H_5N_2^+]$ against time
- **C** volume of N₂ against 1/time
- **D** volume of N₂ against time
- **12** The following equation represents the conversion of Y_2 to Y.

$$Y_2(g) \rightleftharpoons 2Y(g)$$

The conversion was studied using a fixed amount of Y_2 in a reaction vessel. At different times during the experiment, changes were made to the conditions in the reaction vessel. The change in the concentrations in the equilibrium mixture with time is given by the graph below:



Which one of the following statements is correct?

- A A catalyst was added at T₁.
- **B** There was a decrease in volume of the reaction vessel at T₂.
- **C** There was an increase in temperature at T₂.
- **D** More Y_2 was introduced at T_2 .

13 The graphs below show the variation of the percentage of gaseous products present at equilibrium, with temperature and pressure.



Α	$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$	$\Delta H = -92 \text{ kJ mol}^{-1}$
В	$3O_2(g) + 4NH_3(g) \rightleftharpoons 2N_2(g) + 6H_2O(g)$	$\Delta H = -1248 \text{ kJ mol}^{-1}$
С	$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O \ (g)$	ΔH = +82 kJ mol ⁻¹
D	$CO_2(g) + C(s) \rightleftharpoons 2CO(g)$	∆ <i>H</i> = +173 kJ mol ⁻¹

- 14 Which of the following statements about acids, bases and salts is correct?
 - A 10 cm³ of 1.0 mol dm⁻³ of NaOH reacts with 5 cm³ of 1.0 mol dm⁻³ CH₃CO₂H to produce an alkaline buffer.
 - **B** 10 cm³ of 1.0 mol dm⁻³ of NH₃ reacts with 5 cm³ of 1.0 mol dm⁻³ HC*l* to produce an alkaline buffer.
 - **C** 1.0 mol dm⁻³ of aqueous CH_3CO_2Na has lower pH than 1.0 mol dm⁻³ of aqueous NH_4Cl .
 - **D** 1.0 mol dm⁻³ of CH₃CO₂H has higher pH than 1.0 mol dm⁻³ of aqueous CH₃CO₂Na.
- **15** A sample of waste solution at pH 1 is found to contain 0.100 mol dm⁻³ zinc(II) nitrate and 0.100 mol dm⁻³ lead(II) nitrate. Solid sodium hydroxide is slowly added until the pH is 5.

The solubility product of zinc(II) hydroxide is 3.00 x 10^{-17} mol³ dm⁻⁹ and that of lead(II) hydroxide is 1.42 x 10^{-20} mol³ dm⁻⁹.

Which statement describes what happens in the solution?

- A No precipitate is formed.
- **B** Only lead(II) hydroxide is precipitated.
- **C** Only zinc(II) hydroxide is precipitated.
- **D** Both zinc(II) hydroxide and lead(II) hydroxide are precipitated.

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

The standard reduction potentials of some vanadium species are tabulated below.

half-reaction	<i>E</i> ° / V
V²+(aq) + 2e⁻ ़ ∨(s)	-1.20
V ³⁺ (aq) + e [−] → V ²⁺ (aq)	-0.26
$VO^{2+}(aq) + 2H^{+}(aq) + e^{-} \rightleftharpoons V^{3+}(aq) + H_2O(l)$	+0.34

Which of the following metal(s), when added in excess, will reduce VO²⁺ to V³⁺?

- A Sn only
- B Sn & Zn
- C Sn & Pb
- D Zn & Pb
- 17 Which of the following explain why an aqueous solution of aluminium chloride is acidic?
 - 1 Cl^{-} ions react with water to form hydrochloric acid.
 - 2 Aluminium ions have a high charge density.
 - 3 The H–O bonds are weaker in $[A/(H_2O)_6]^{3+}$ than in H₂O.
 - **A** 1, 2 and 3
 - **B** 1 and 2 only
 - C 2 and 3 only
 - D 3 only
- **18** Element **A**, which is from Period 3, has the highest fourth ionisation energy among all the elements in Period 3.

A student came up with the statements below to describe the properties of element **A**. However, not all the statements is/ are true.

Which of the following statements is/ are **not** true?

- 1 Element **A** has the highest melting point among the elements in Period 3.
- 2 The chloride of **A** reacts with water to form an acidic solution.
- 3 The oxide of **A** reacts with both aqueous hydrochloric acid and aqueous sodium hydroxide.
- A 1 and 2 only
- **B** 1 and 3 only
- C 2 and 3 only
- D 1 only

19 The shape of the unsaturated hydrocarbon molecules can be explained in terms of hybridisation of orbitals.

Which bond is not present in 1-penten-3-yne, $CH_3C=CCH=CH_2$?

- **A** π bond formed by 2p–2p overlap
- **B** σ bond formed by 1s-2sp overlap
- **C** σ bond formed by 2sp-2sp² overlap
- **D** σ bond formed by 2sp-2sp³ overlap
- **20** Which of the following molecules **cannot** be formed from the termination step of the free radical substitution of ethane with bromine?
 - A HBr
 - **B** CH₃CH₂CH₂CH₃
 - C CH₃CH₂Br
 - D Br₂
- A sample of ethene was added to a solution of Br₂(aq) and NaC*l*(aq).Which of the following products is **not** likely to be found in the reaction mixture?
 - **A** $CH_2(OH)CH_2Br$ **B** CH_2BrCH_2Br **C** CH_2BrCH_2Cl **D** $CH_2(OH)CH_2Cl$
- 22 A student wishes to synthesise compound Y from methylbenzene.



compound \boldsymbol{Y}

Which of the following routes would give the maximum yield of compound Y?

- A oxidation \rightarrow nitration \rightarrow bromination \rightarrow reduction
- $\textbf{B} \qquad \text{oxidation} \rightarrow \text{nitration} \rightarrow \text{reduction} \rightarrow \text{bromination}$
- $\textbf{C} \qquad \text{bromination} \rightarrow \text{nitration} \rightarrow \text{reduction} \rightarrow \text{oxidation}$
- **D** bromination \rightarrow oxidation \rightarrow nitration \rightarrow reduction

23 When sodium iodide in propanone is added to an optically active sample of 2–bromobutane, a sodium bromide precipitate formed after 10 minutes upon heating.

 $NaI + CH_3CHBrCH_2CH_3 \rightarrow CH_3CHICH_2CH_3 + NaBr(s)$

The rate equation was found to be as follows.

Rate =
$$k$$
[CH₃CHBrCH₂CH₃][NaI]

Which of the following statement is incorrect?

- **A** A racemic mixture is formed.
- **B** The reaction is bimolecular.
- **C** The reaction involves nucleophilic substitution.
- **D** A similar experiment, using 1-bromobutane, will produce precipitate in less than 10 minutes.
- **24** *Putrescine* is used in the production of *Nylon-4,6*. It can be synthesised from ethene by the following reactions.

 $CH_2=CH_2 \xrightarrow{\mathbf{I}} \mathbf{Y} \xrightarrow{\mathbf{II}} NCCH_2CH_2CN \xrightarrow{\mathbf{III}} H_2NCH_2CH_2CH_2CH_2NH_2$ Putrescine

Which of the following gives the correct reagents and conditions for steps I to III?

	Ι	II	III
Α	Br ₂	KCN in ethanol, heat	H ₂ , Ni, 200 °C
В	Br ₂	HCN, trace NaCN, 15 °C	LiA <i>I</i> H₄, dry ether
С	cold, alkaline KMnO4	KCN in ethanol, heat	LiA <i>I</i> H₄, dry ether
D	cold, alkaline KMnO4	HCN, trace NaCN, 15 °C	H ₂ , Ni, 200 °C

The following is a method of synthesising tartaric acid which is found in wine. 25



Which statements are the correct reagents and conditions for steps X, Y and Z?

- 1 Cold KMnO₄(aq), NaOH(aq) is used for step X.
- 2 Hot KMnO₄(aq), $H_2SO_4(aq)$, is used for step **Y**.
- 3 K₂Cr₂O₇(aq), H₂SO₄(aq), heat is used for step **Z**.
- Α 1 only
- В 1 and 2 only
- С 1 and 3 only
- D 2 and 3 only
- 26 Compound P, C₃H₈O₂, is an alcohol containing two –OH groups per molecule. It can be oxidised in stages to compound Q, C₃H₆O₂, which reacts with 2,4-dinitrophenylhydrazine but not with Fehling's solution. Compound Q is then further oxidised to \mathbf{R} , $C_3H_4O_3$ which reacts with aqueous sodium carbonate.

Which of the following about the properties of P, Q and R is correct?

	reacts with alkaline aqueous iodine to give tri-iodomethane	has chiral centre		
A	P only	P, Q and R		
В	P, Q and R	P only		
С	P and Q	Q only		
D	Q and R	P and Q		

27 Tartaric acid, a common acid found in wine, has the following structure below.



Which of the following reacts completely with 1 mol of tartaric acid?

- **A** 2 mol of SOC l_2 **B** 4 mol of Na₂CO₃
- C 4 mol of Na

D 4 mol of aqueous KOH

28 Equimolar quantities of compounds **W**, **X**, **Y** and **Z** are separately shaken with 100 cm³ of water. The pH of each resultant solution is then measured.

CH ₃ CH ₂ CO ₂ H	CH ₃ CH ₂ COCl	CICH2CH2CO2H	BrCH ₂ CH ₂ CO ₂ H
W	X	Y	Z

Which of the following shows the correct order of decreasing pH of the solutions formed?

- A W, Y, Z, X
 B W, Z, Y, X
 C X, W, Z, Y
- D X, Z, Y, W

29 Ergonovine is a medication that is used to cause contractions of the uterus to treat heavy vaginal bleeding in women after giving birth.

The structure of an isomer of ergonovine is given below.



Which of the following statement is correct?

- A An orange precipitate is observed when 2,4-dinitrophenylhydrazine is added.
- **B** A pale-yellow precipitate is formed with aqueous alkaline iodine.
- **C** There exists a total of 8 enantiomers for the isomer of ergonovine.
- **D** It reacts with both dilute hydrochloric acid and dilute potassium hydroxide at room temperature.
- **30** An octapeptide was analysed in the chemistry laboratory by treating it with enzymes. The following fragments were obtained after the partial hydrolysis that is catalysed by the enzymes.

ser-arg-pro cys-pro pro-ser pro-ala-phe-gly

Which of the following is the correct sequence of the octapeptide?

- **A** ser-arg-pro-ala-phe-gly-cys-pro
- **B** pro-ser-arg-pro-ala-phe-gly-cys
- **C** cys-pro-ser-arg-pro-ala-phe-gly
- **D** cys-pro-ala-phe-gly-ser-arg-pro

End of paper

Answers					
1	В	11	Α	21	D
2	Α	12	D	22	D
3	D	13	D	23	Α
4	D	14	В	24	Α
5	С	15	В	25	Α
6	D	16	С	26	В
7	Α	17	С	27	С
8	В	18	D	28	В
9	С	19	В	29	С
10	В	20	Α	30	С