

# RIVER VALLEY HIGH SCHOOL JC 2 PRELIMINARY EXAMINATION

CANDIDATE NAME												
CLASS	2	0	J									
CENTRE NUMBER	S						INDEX NUMBE	R				
H1 CHEM	IIST	RY								88	873/	01
Paper 1 Multiple Choice									23	Sep 2 1 ł	2021 nour	

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, centre number and index number 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.

#### This document consists of 14 printed pages.

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**1** When potassium chlorate(V)  $KClO_3$ , is heated at its melting point, it disproportionates to potassium chlorate(VII)  $KClO_4$ , and potassium chloride.

What is the maximum number of moles of potassium chlorate(VII) which could be produced from 0.200 mol of potassium chlorate(V)?

**A** 0.200 **B** 0.150 **C** 0.100 **D** 0.0500

2 Methane was burned in an incorrectly adjusted Bunsen burner. The methane was converted into a mixture of carbon dioxide and carbon monoxide in the ratio 99:1, together with water vapour.

What will be the volume of oxygen consumed when y dm<sup>3</sup> of methane is burned?

**A** 
$$2y \quad \theta.01ydym^{3}$$
  
**B**  $2y \quad -\frac{0.01y}{2}m^{3}$   
**C**  $\frac{1}{7} - \frac{0.01y}{2}m^{3}$   
**D**  $\frac{1}{7} \quad \theta.01ydym^{3}$ 

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

Iron in the form of magnetite,  $Fe_3O_4$ , is extracted from ores in iron mines. The ore contains 69.9% by mass of iron.

What percentage of the ore contains Fe<sub>3</sub>O<sub>4</sub> by mass, if it is the only iron-containing component present?

- **A** 3.40%
- **B** 69.9%
- **C** 96.6%
- **D** 100%

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

The table shows the fifth, sixth, seventh, eighth and ninth ionisation energies of three elements in the third period.

	Ionisation energy/ kJ mol <sup>-1</sup>							
	5 <sup>th</sup> 6 <sup>th</sup> 7 <sup>th</sup> 8 <sup>th</sup> 9 <sup>th</sup>							
Element A	6274	21267	25431	29872	35905			
Element B	7004	8496	27107	31719	36621			
Element D	6542	9362	11018	33604	38600			

Which statements are correct?

- 1 The first ionisation energy of **A** is lower than that of **B**.
- 2 The atom of element **A** will be isoelectronic with **D**<sup>2+</sup>.
- 3 **A** and **D** forms an ionic solid **AD**<sub>3</sub>.
- A 1 and 3 only B 2 and 3 only C 1 only D 2 only
- 5 In which order are the electrons lost in forming Ga<sup>4+</sup> ion?

	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
Α	3d	4p	4s	4s
В	3d	4s	4s	4р
С	4p	4s	3d	3d
D	4p	4s	4s	3d

- 6 Which of the following statements is correct?
  - **A** Dative bonding is present in the NH<sub>4</sub><sup>+</sup> ion.
  - **B**  $A/Cl_3$  is able to conduct electricity because it is ionic.

  - **D** SiC has a giant molecular structure whereas SiO<sub>2</sub> has a simple molecular structure.

- 7 Which pair of liquids, when mixed, will give out heat?
  - **A**  $CH_2Cl_2$  and  $CH_3COCH_2CH_3$
  - B CH<sub>2</sub>Cl<sub>2</sub> and C<sub>6</sub>H<sub>12</sub>
  - C CF<sub>4</sub> and COCl<sub>2</sub>
  - **D** CC $l_4$  and C<sub>10</sub>H<sub>21</sub>OH

**8** A molecule of  $BCl_3$  is planar, whereas a molecule of  $PH_3$  is pyramidal.

Which statements are responsible for the difference in shapes?

- 1 The repulsion between chlorine atoms is greater than that between hydrogen atoms.
- 2 The boron atom in BC*l*<sub>3</sub> has six electrons in its valence shell, whereas the phosphorus atom in PH<sub>3</sub> has eight.
- 3 The atomic radius of phosphorus is greater than that of boron.
- **A** 1 only **B** 2 only **C** 1 and 3 only **D** 2 and 3 only
- **9** Which of the following equations best define the term *bond energy of C–H bond?* 
  - $\textbf{A} \qquad CH_3CH_2CH_2CH_3(I) \rightarrow 4C(s) + 5H_2(g)$
  - **B**  $CH_3CH_2CH_3(I) \rightarrow 3C(s) + 8H(g)$
  - $\textbf{C} \qquad CH_3CH_3(g) \rightarrow 2C(g) + 6H(g)$
  - $\mathbf{D} \qquad \frac{1}{4} \operatorname{CH}_4(g) \to \frac{1}{4} \operatorname{C}(g) + \operatorname{H}(g)$

**10** When water is stirred with glucose, strong hydrogen bonds are initially formed between glucose molecules and water molecules.

As more water is added, these hydrogen bonds are broken. Which of these graphs best represents the observed temperature changes?



11 Aqueous sodium chlorate(I), NaOC*l*, is used to keep swimming pool water free of harmful bacteria. It is the HOC*l* molecules formed when NaOC*l* reacts with water that kill bacteria.

$$OCl^{-}(aq) + H_2O \ll OH^{-}(aq) + HOCl(aq)$$

The  $OCl^{-}$  ion is broken down by ultra-violet light from the sun.

$$OCl^{-}(aq) + uv \text{ light} \rightarrow Cl^{-}(aq) + \frac{1}{2}O_{2}(g)$$

What could be done to maintain the highest concentration of HOC1?

- A acidify the pool water B add a solution of chloride ions
- **C** add a solution of hydroxide ions **D** bubble air through the water

**12** The equilibrium constant  $K_c$  for the reaction

$$\mathbf{G}(g) + 2\mathbf{H}(g) \rightleftharpoons \mathbf{J}(g)$$

is found to vary with temperature T as shown in the diagram below.



Which of the following statements about the reaction is correct?

- **A** The forward reaction is exothermic.
- **B** The yield will decrease at higher pressure.
- **C** Addition of a catalyst will cause the graph to be steeper at higher temperature.
- **D** The equilibrium mixture contains a higher proportion of **J** at higher temperature.
- **13** The gases, X<sub>2</sub> and Y<sub>2</sub> react as follows,

$$X_2(g) + Y_2(g) \ll 2XY(g)$$

A mixture containing 1.0 mol of  $X_2$  and 0.8 mol of  $Y_2$  is heated in a closed container and the reaction is allowed to reach equilibrium. The graph below shows the variation of the number of moles of each gas with time.



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**14** Nitrogen oxide reacts with hydrogen gas as shown in the equation below.

$$2NO(g) + 2H_2(g) \rightarrow N_2(g) + 2H_2O(g)$$

The reaction was determined to be second order with respect to NO and first order with respect to H<sub>2</sub>. In an experiment, 2.0 mol dm<sup>-3</sup> of excess NO was used to react with H<sub>2</sub>, the concentration of H<sub>2</sub> decreased to 6.25% of its original value in 24 minutes.

How many minutes will it take for the concentration of H<sub>2</sub> to decrease to 6.25% of its original value if the experiment was repeated using an excess of 4.0 mol dm<sup>-3</sup> of NO?

**A** 1.5 **B** 4.5 **C** 6.0 **D** 9.0

**15** The diagram shows the Maxwell-Boltzmann energy distribution curves for molecules of a sample of a gas at two different temperatures.

Which letter on the axes represents the proportion of molecules with the most probable energy at the lower temperature?



temperature/ °C	K <sub>w</sub> / mol <sup>2</sup> dm <sup>−6</sup>
25	$1.0  imes 10^{-14}$
62	$1.0  imes 10^{-13}$

**16** The value of the ionic product of water,  $K_{w}$ , varies with temperature.

What can be deduced from this information?

- A Water is acidic at 62 °C.
- **B** The ionic dissociation of water increases by a factor of 5 between 25 °C and 62 °C.
- **C** The ionic dissociation of water is an endothermic process.
- **D** Concentration of OH<sup>-</sup> at 62 °C is  $5.0 \times 10^{-14}$  mol dm<sup>-3</sup>.
- **17** The following reaction occurs when light is shone for a fixed period into a solution of CH<sub>2</sub>ICH<sub>2</sub>I and I<sub>2</sub> in tetrachloromethane at 100 °C.

$$CH_2ICH_2I \rightarrow CH_2\text{=}CH_2\text{ + }I_2$$

The initial rate of reaction is dependent on the relative initial concentrations of CH<sub>2</sub>ICH<sub>2</sub>I, I<sub>2</sub> and relative light intensity.

By comparing experiments (i) 1 and 2, (ii) 3 and 4 and (iii) 1 and 3, what conclusions about the rate of formation of iodine can be drawn from the data in the table?

experiment	relative initial concentrations		relative light	relative initial rate	
	CH <sub>2</sub> ICH <sub>2</sub> I	I2	intensity	iodine	
1	2	1	4	2	
2	2	1	1	1	
3	1	1	4	1	
4	1	2	4	1	

- 1 proportional to  $\sqrt{\text{light intensity}}$
- 2 independent of initial concentration of I<sub>2</sub>
- 3 proportional to initial concentration of CH<sub>2</sub>ICH<sub>2</sub>I
- **A** 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 1 only

18 Which equations represent a Brønsted-Lowry acid-base reaction?

- 1 HNO<sub>3</sub> + CH<sub>3</sub>OH  $\rightarrow$  NO<sub>3</sub><sup>-</sup> + CH<sub>3</sub>OH<sub>2</sub><sup>+</sup>
- $2 \qquad CH_3CH_2NH_3^+ + NH_3 \rightarrow CH_3CH_2NH_2 + NH_4^+$
- 3  $CH_3CH_2^+ + Br^- \rightarrow CH_3CH_2Br$
- **A** 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3
- **19** 1 mole of ethanoic acid is diluted at constant temperature to a volume V. Which diagram shows how the pH of the acid varies with V?



**20** Two solutions were prepared by dissolving a chloride and an oxide of the elements in Period 3 of the Periodic Table in separate portions of water.

Both solutions prepared can be used to dissolve  $Al_2O_3$  but only one can be used to dissolve  $SiO_2$ .

Which of the following could be the chloride and the oxide used?

- A AlCl<sub>3</sub> and Na<sub>2</sub>O
- B PCl<sub>5</sub> and P<sub>4</sub>O<sub>10</sub>
- **C** MgCl<sub>2</sub> and MgO
- D NaCl and SO<sub>3</sub>
- 21 W, X, Y and Z are four consecutive elements in Period 3 but not necessarily in the order presented.
  - Chloride of **W** dissolves in water and turns moist blue litmus red.
  - X is a good conductor of electricity.
  - Y has the highest melting point.
  - **Z** has the largest ionic radius.

Which of the following is the correct sequence of the four elements in order of increasing atomic number?

- **A X**, **Y**, **W**, **Z**
- $\boldsymbol{\mathsf{B}} \qquad \boldsymbol{\mathsf{Y}},\, \boldsymbol{\mathsf{W}},\, \boldsymbol{\mathsf{X}},\, \boldsymbol{\mathsf{Z}}$
- C X, W, Y, Z
- D Z, Y, W, X
- 22 The high reactivity of fluorine is largely due to the low energy of the F–F bond. Which statement does **not** account for the weak F–F bond?
  - A The F–F bond is weak because of the repulsion between the non-bonding electrons.
  - **B** The F–F bond is weak because of the short bond length.
  - **C** The F–F bond is weak because of the small number of electrons in fluorine atom.
  - **D** The F–F bond is weak because of the small size of fluorine atom.

23 Compound T can be converted to a compound U as shown below.

 $\begin{array}{cccc} \mathsf{CH}_3\mathsf{COCH}_2\mathsf{COOH} \xrightarrow{\mathbf{I}} \mathsf{CH}_3\mathsf{CH}(\mathsf{OH})\mathsf{CH}_2\mathsf{COOH} \xrightarrow{\mathbf{II}} \mathsf{CH}_3\mathsf{CH}(\mathsf{OH})\mathsf{CH}_2\mathsf{CONHCH}_3 \\ \mathbf{T} & \mathbf{U} \end{array}$ 

Which of the following statements is **incorrect** with regards to the given reaction scheme?

- A Stage I involve the use of sodium borohydride, NaBH<sub>4</sub>.
- **B** Stage I involves a substitution reaction.
- **C** Stage **II** involves the use of DCC and methylamine.
- **D** Stage **II** involves a condensation reaction.
- **24** Propane-1,2,3-triol, CH<sub>2</sub>(OH)CH(OH)CH<sub>2</sub>(OH), is the raw material for many important industrial chemical processes.

Which statements about propane-1,2,3-triol are correct?

- 1 It reacts with carboxylic acids to form compounds containing up to three ester groups.
- 2 It can be oxidised to form compounds with aldehyde and ketone functional groups.
- 3 It can be oxidised to form compounds with up to three carboxylic acid groups.
- **A** 1 only **C** 1, 2 and 3
- **B** 1 and 2 only **D** none of the above

compound  $\mathbf{P} \xrightarrow{\text{NaOH (aq)}}_{\text{heat under reflux}} \text{ compound } \mathbf{Q} \xrightarrow{\text{acidified } K_2 Cr_2 O_7}_{\text{heat under reflux}} \text{ compound } \mathbf{R}$ 



Which functional groups does compound P, Q and R belongs to?

	Р	Q	R
Α	halogenoalkane	alcohol	carboxylic acid
В	halogenoalkane	alcohol	aldehyde
С	alcohol	aldehyde	carboxylic acid
D	alcohol	halogenoalkane	aldehyde

26 An amide, **M**, has the empirical formula C<sub>7</sub>H<sub>15</sub>ON. When **M** is hydrolysed by heating under reflux with dilute hydrochloric acid, a carboxylic acid with empirical formula C<sub>2</sub>H<sub>4</sub>O is obtained as one of the products.

What could be the skeletal formula of **M**?



C 2 and 3 only D 3 only

- 27 Which of the following statements about the two compounds, CH<sub>3</sub>CH<sub>2</sub>CHBrCH<sub>3</sub> and CH<sub>3</sub>CH=CHCH<sub>3</sub>, is correct?
  - A CH<sub>3</sub>CH<sub>2</sub>CHBrCH<sub>3</sub> undergoes oxidation to form CH<sub>3</sub>CH<sub>2</sub>CH(OH)CH<sub>3</sub>.
  - **B** CH<sub>3</sub>CH=CHCH<sub>3</sub> reacts with Br<sub>2</sub> in CCl<sub>4</sub> to form CH<sub>3</sub>CH<sub>2</sub>CHBrCH<sub>3</sub>.
  - **C** CH<sub>3</sub>CH<sub>2</sub>CHBrCH<sub>3</sub> is an unsaturated compound while CH<sub>3</sub>CH=CHCH<sub>3</sub> is a saturated compound.
  - **D** CH<sub>3</sub>CH=CHCH<sub>3</sub> exhibits *cis-trans* isomerism.
- 28 The structure below is that of a polymer based on N-methyl-D-glucamine.



Which of the following statements correctly describe the above polymer?

- A It is able to form hydrogen bonds with water.
- **B** It can be classified as a condensation type of polymer.
- **C** The polymer has no reaction with hot aqueous alkali.
- **D** The polymer cannot undergo oxidation with acidified KMnO<sub>4</sub>.

**29** A section of nylon–6,6 is shown below.

-CO(CH<sub>2</sub>)<sub>4</sub>CONH(CH<sub>2</sub>)<sub>6</sub>NHCO(CH<sub>2</sub>)<sub>4</sub>CONH(CH<sub>2</sub>)<sub>6</sub>NH-

Which monomers could form this polymer?

Α NH<sub>2</sub>(CH<sub>2</sub>)<sub>6</sub>NH<sub>2</sub> and  $CH_3(CH_2)_3CO_2H$ B NH<sub>2</sub>(CH<sub>2</sub>)<sub>6</sub>NHCO<sub>2</sub>H and  $CH_3(CH_2)_3CO_2H$ С  $NH_2(CH_2)_6NH_2$ and  $HO_2C(CH_2)_4CO_2H$ D CH<sub>3</sub>(CH<sub>2</sub>)<sub>5</sub>NH<sub>2</sub> and HO<sub>2</sub>C(CH<sub>2</sub>)<sub>4</sub>CONH<sub>2</sub> **30** Diallyl phthalate (DAP) has a structure shown below. As a monomer, it is used as a cross-linking agent in unsaturated polyesters. When it undergoes polymerisation to form poly(diallyl phthalate), one of the two C=C bond is first used to join up the DAP monomers into a pre-polymer. During the moulding process, the second C=C bond polymerises leading to a highly cross-linked thermoset polymer.



This polymer is used in the production of thermosetting moulding powders.

Which of the following statements is not true?

- A Cross–linkages with unsaturated polyesters are formed by the unsaturated C=C bonds of DAP monomers.
- **B** Poly(diallyl phthalate) is soft and flexible.
- **C** Poly(diallyl phthalate) is an electrical insulator.
- **D** Poly(diallyl phthalate) is resistant to high temperature.

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

Solutions

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