

PIONEER JUNIOR COLLEGE  
JC2 PRELIMINARY EXAMINATION  
HIGHER 1

CANDIDATE  
NAME

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CT  
GROUP

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INDEX  
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**CHEMISTRY**

**8872/01**

Paper 1 Multiple Choice

**22 September 2017**  
**50 minutes**

Additional Materials:      Multiple Choice Answer Sheet  
   Data Booklet

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**READ THESE INSTRUCTIONS FIRST**

Write your name, CT group and index number in the spaces provided.

Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **thirty** questions in 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.

This document consists of **13** printed pages.

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## Section A

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

- 1 20 cm<sup>3</sup> of a gaseous hydrocarbon was mixed with 100 cm<sup>3</sup> of oxygen and the mixture sparked so that the hydrocarbon was completely burnt. The volume of gas remaining at the end of the combustion was 70 cm<sup>3</sup>. After passing over soda lime, this volume was reduced by 60 cm<sup>3</sup>. All gases were measured at 25°C and at the same pressure.

Determine the molecular formula of the hydrocarbon.

- A C<sub>2</sub>H<sub>4</sub>  
 B C<sub>2</sub>H<sub>6</sub>  
 C C<sub>3</sub>H<sub>6</sub>  
 D C<sub>3</sub>H<sub>8</sub>
- 2 Carbon monoxide, CO, is a colourless, odourless and toxic gas. It is formed as a result of partial oxidation of carbon-containing compounds. The maximum safe toleration level of CO in air is 50 ppm. (1 ppm = 1 mg kg<sup>-1</sup>)

How many molecules of CO gas are present in 1 kg of air at this toleration level?

- A  $\frac{50 \times 10^{-3} \times 6.02 \times 10^{23}}{28}$   
 B  $50 \times 10^{-3} \times 28 \times 6.02 \times 10^{23}$   
 C  $\frac{50 \times 6.02 \times 10^{-3}}{28}$   
 D  $50 \times 28 \times 6.02 \times 10^{23}$
- 3 Equimolar amounts of ClO<sub>2</sub> and OH<sup>-</sup> ions react to produce three products: water, chlorate(III) ions ClO<sub>2</sub><sup>-</sup> and another chloro-oxy anion, ClO<sub>x</sub><sup>-</sup>

What is the oxidation state of chlorine in the chloro-oxy anion, ClO<sub>x</sub><sup>-</sup>?

- A +1                      B +2                      C +5                      D +7

- 4 Which of the following particles would, on losing an electron, have a half-filled set of p orbitals?

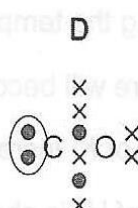
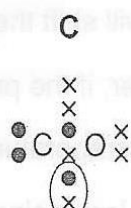
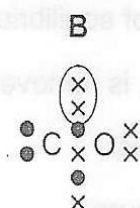
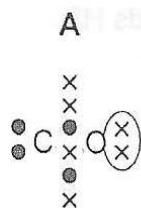
A  $O^+$

B  $O^-$

C N

D  $N^-$

- 5 Which circled pair of electrons represents a co-ordinate bond?



- 6 Which molecules contain within their structure three atoms arranged in a straight line?

A  $ICl_3$

B  $SO_4^{2-}$

C  $CCl_4$

D  $H_2S$

- 7 Consider the following four isoelectronic compounds.

1  $(CH_3)_3CH$

2  $CH_3CH_2CH_2CH_3$

3  $CH_3CH_2CH_2OH$

4  $CH_3CH_2Cl$

What is the order of decreasing boiling point of these compounds?

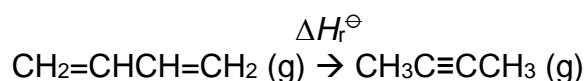
A  $1 \rightarrow 2 \rightarrow 4 \rightarrow 3$

B  $3 \rightarrow 4 \rightarrow 1 \rightarrow 2$

C  $3 \rightarrow 4 \rightarrow 2 \rightarrow 1$

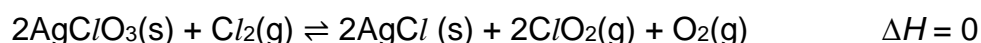
D  $4 \rightarrow 3 \rightarrow 2 \rightarrow 1$

- 8 Given the following thermochemical data, what is the standard enthalpy change of the reaction,  $\Delta H_r^\ominus$ .



Standard enthalpy change of combustion of $\text{CH}_3\text{C}\equiv\text{CCH}_3(\text{g})$	= $-2577 \text{ kJ mol}^{-1}$
Standard enthalpy change of formation of carbon dioxide	= $-394 \text{ kJ mol}^{-1}$
Standard enthalpy change of formation of water	= $-286 \text{ kJ mol}^{-1}$
Standard enthalpy change of formation of $\text{CH}_2=\text{CHCH}=\text{CH}_2(\text{g})$	= $+110 \text{ kJ mol}^{-1}$

- A**  $-253 \text{ kJ mol}^{-1}$                       **B**  $-33 \text{ kJ mol}^{-1}$   
**C**  $+33 \text{ kJ mol}^{-1}$                       **D**  $+253 \text{ kJ mol}^{-1}$
- 9 Which one of the following equations correctly represents the standard enthalpy change of formation of water?
- A**  $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{l})$   
**B**  $\text{H}_2(\text{g}) + \frac{1}{2} \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$   
**C**  $\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$   
**D**  $2\text{H}(\text{g}) + \text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$
- 10 Chlorine dioxide,  $\text{ClO}_2$ , is a yellow gas which can be synthesised in the laboratory by the following reaction:



Which of the following statements about the above reaction is correct?

- A** Adding more  $\text{AgClO}_3(\text{s})$  increases the equilibrium yield of  $\text{ClO}_2$ .  
**B** The equilibrium constant changes when temperature changes.  
**C** Decreasing the pressure decreases the equilibrium yield of  $\text{ClO}_2$ .  
**D** The addition of a catalyst increases the rates of both the forward and the reverse reactions.

- 11 The values for the ionic product of water,  $K_w$ , at two different temperatures are given below.

Temperature / °C	$K_w$ / mol <sup>2</sup> dm <sup>-6</sup>
25	$1.00 \times 10^{-14}$
30	$1.44 \times 10^{-14}$

Which of the following is correct for pure water at 30°C?

- A  $[H^+] = 1.44 \times 10^{-7}$  mol dm<sup>-3</sup>
- B  $[H^+] > [OH^-]$
- C pH = 7
- D pH < 7
- 12 A solution was made by mixing 0.002 mol of H<sub>2</sub>SO<sub>4</sub>(aq) and 0.005 mol of KOH(aq). Water was added until the volume of the solution was 1 dm<sup>3</sup>.

What is the pH of the solution at 25°C?

- A 12.0
- B 11.7
- C 11.5
- D 11.0
- 13 The decomposition  $2N_2O_5 \rightarrow 4NO_2 + O_2$  is first order with respect to N<sub>2</sub>O<sub>5</sub>.
- In an experiment, 0.10 mol of pure N<sub>2</sub>O<sub>5</sub> was put into an evacuated flask. It was found that there was 0.025 mol of N<sub>2</sub>O<sub>5</sub> left 34 minutes later.

Which statement is true?

- A It took 17 minutes for the amount of NO<sub>2</sub> to rise from 0 mol to 0.10 mol.
- B There was 0.0625 mol of N<sub>2</sub>O<sub>5</sub> left after 17 minutes.
- C There was 0.0125 mol of N<sub>2</sub>O<sub>5</sub> left after 68 minutes.
- D The amount of NO<sub>2</sub> in the flask went up by four times in the first 34 minutes.

- 14** A piece of magnesium ribbon was added to 25cm<sup>3</sup> of 0.100 moldm<sup>-3</sup> of dilute hydrochloric acid. The magnesium was completely dissolved and the total volume of hydrogen gas evolved was measured.

In a second experiment, an identical piece of magnesium ribbon was added to solution **X**. Solution **X** is prepared by adding 25cm<sup>3</sup> of 0.100 moldm<sup>-3</sup> of dilute hydrochloric acid to 25cm<sup>3</sup> of 0.0200 moldm<sup>-3</sup> of hydrochloric acid. The total volume of hydrogen evolved was measured.

How will the initial rate of reaction and total volume of hydrogen evolved in the second experiment compare to the first experiment?

	Initial rate of reaction	Total volume of hydrogen evolved
<b>A</b>	Decrease	Increase
<b>B</b>	Decrease	no change
<b>C</b>	Increase	Increase
<b>D</b>	Increase	no change

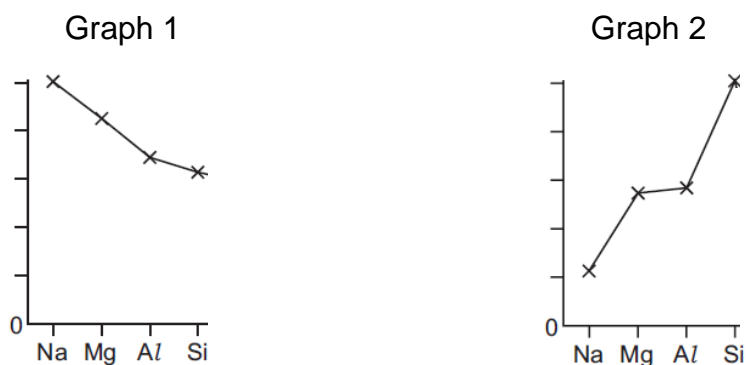
- 15** Water was poured into a mixture containing solid oxides of elements **A**, **B** and **C**. The mixture was filtered to obtain a colourless solution with a pH of 2 and a residue.

The residue was then treated with excess hot concentrated sodium hydroxide and all the residue dissolved.

What are the identities of elements **A**, **B** and **C**?

	Element <b>A</b>	Element <b>B</b>	Element <b>C</b>
<b>A</b>	aluminium	silicon	phosphorus
<b>B</b>	aluminium	silicon	sodium
<b>C</b>	magnesium	aluminium	sulfur
<b>D</b>	magnesium	silicon	phosphorus

- 16 The graphs below show the variation in two properties of the elements Na to Si.



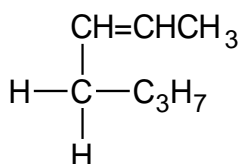
Which properties are illustrated in Graphs 1 and 2?

**Graph 1**

**Graph 2**

- |          |                   |                         |
|----------|-------------------|-------------------------|
| <b>A</b> | electronegativity | melting point           |
| <b>B</b> | electronegativity | electrical conductivity |
| <b>C</b> | atomic radius     | melting point           |
| <b>D</b> | atomic radius     | electrical conductivity |

- 17 The compound shown below has the following structure:

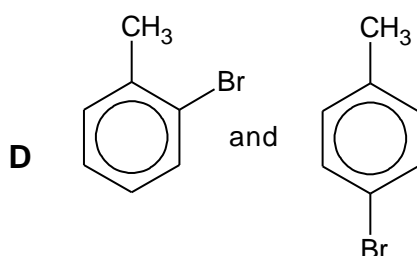
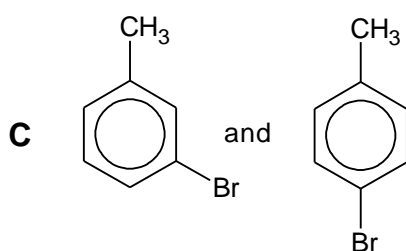
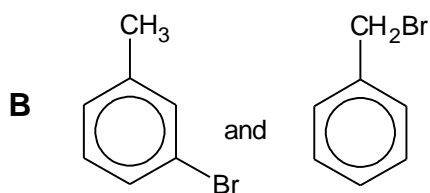
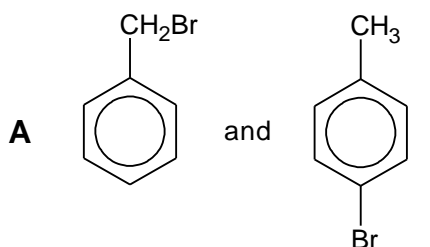


How many isomers does this compound have?

- A** 2                      **B** 4                      **C** 8                      **D** 16
- 18 How many different alkenes, including geometric isomers, could be produced by the removal of HBr from  $(\text{CH}_3)_2\text{CBrCH}_2\text{CH}_3$  ?
- A** 2                      **B** 3                      **C** 4                      **D** 5

- 19 A student placed a stoppered conical flask containing iron powder, bromine and methylbenzene in cupboard. The flask was removed when no further change was observed.

Which of the following are likely to be the main products formed?



- 20 Chlorodifluoromethane, R-22, is a type of hydrochlorofluorocarbon. It is commonly used as a refrigerant and propellant. Its use is being phased out as it contributes to ozone depletion.

Which of the following statements about R-22 is **incorrect**?

- A** Ultraviolet rays can break down R-22 into chlorine radicals which will react with ozone
- B** R-22 is a gas at room temperature because of weak intermolecular forces
- C** Fluorine radicals are not formed because the C-F bond is very strong
- D** R-22 is very reactive and flammable



21 Which of the following reagents and conditions will **not** give a positive observation for ethanal?

- A LiAlH<sub>4</sub> in dry ether
- B K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>(aq), H<sub>2</sub>SO<sub>4</sub>(aq), heat
- C KMnO<sub>4</sub>(aq), H<sub>2</sub>SO<sub>4</sub>(aq), heat
- D I<sub>2</sub>(aq), NaOH(aq), warm

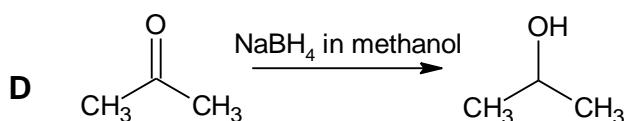
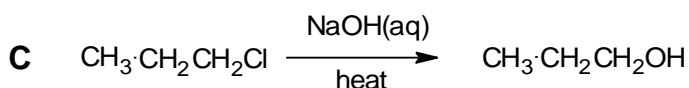
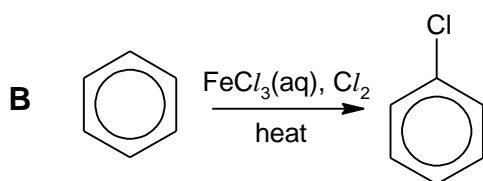
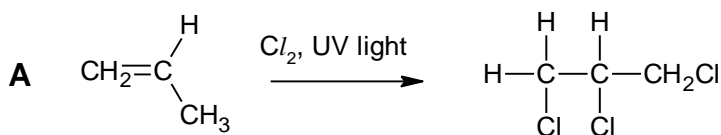
22 In an attempt to make propanoic acid, propan-2-ol was added to a solution of potassium dichromate(VI) dissolved in dilute sulfuric acid and the mixture was heated.

No propanoic acid was produced.

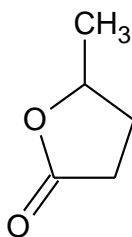
Which of the following statements explain this?

- A The sulfuric acid dehydrates the propan-2-ol to form propene.
- B The propan-2-ol forms propanal when oxidised.
- C The propan-2-ol forms propanone when oxidised
- D Potassium dichromate(VI) will not oxidise propan-2-ol.

23 What of the following reactions will **not** result in the formation of the product?



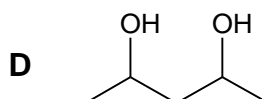
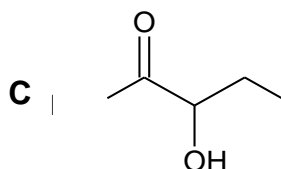
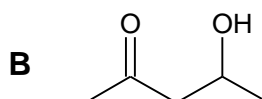
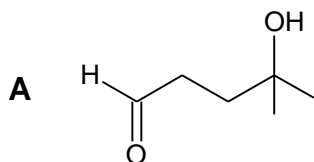
- 24 The molecule shown below is a naturally occurring organic compound found in fruits and could be a possible bio-fuel alternative to ethanol.



Which statement about this compound is **not** correct?

- A It can be prepared by warming 4-hydroxypentanoic acid,  $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$ , in the presence of an acid catalyst
- B It can decolourise hot acidified potassium manganate(VII)
- C It reacts readily with warm, aqueous alkali.
- D It reacts with 2,4-dinitrophenylhydrazine solution to give an orange solution
- 25 When treated with alkaline  $\text{I}_2(\text{aq})$ , 1 mol of compound **Y** forms 1 mol of  $\text{CHI}_3$ . Compound **Y** is formed when compound **X** is reacted with  $\text{HCN}(\text{aq})$  with a trace amount of  $\text{NaOH}$ . 1 mol of compound **X** forms  $12 \text{ dm}^3$  of gas when reacted with sodium metal but 1 mol of compound **Y** forms  $24 \text{ dm}^3$  of gas.

Which of the following could be compound **X**?



### Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

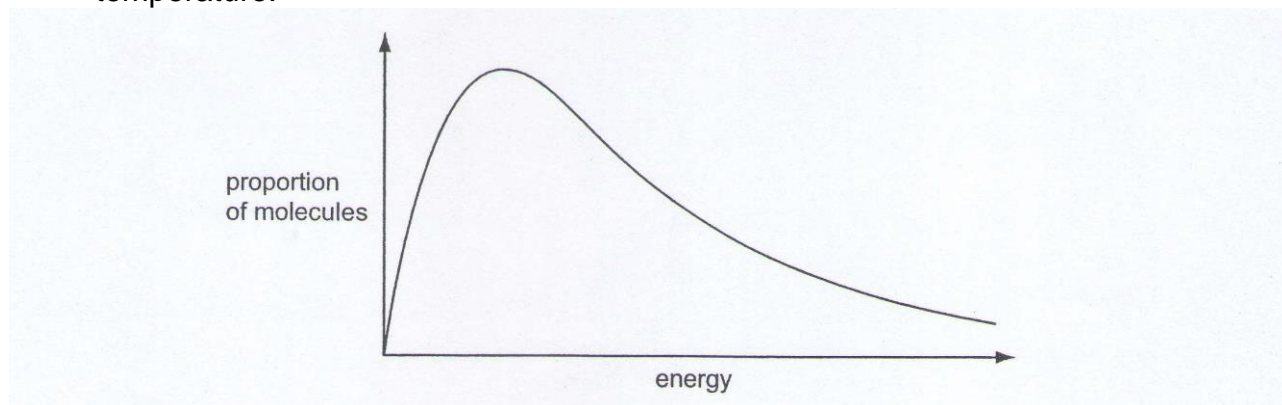
Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

The responses **A** to **D** should be selected on the basis of

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>1, 2 and 3</b> are correct	<b>1 and 2</b> only are correct	<b>2 and 3</b> only are correct	<b>1 only</b> is correct

No other combination of statements is used as a correct response.

- 26** The diagram represents the Boltzmann Distribution of molecular energies at a given temperature.



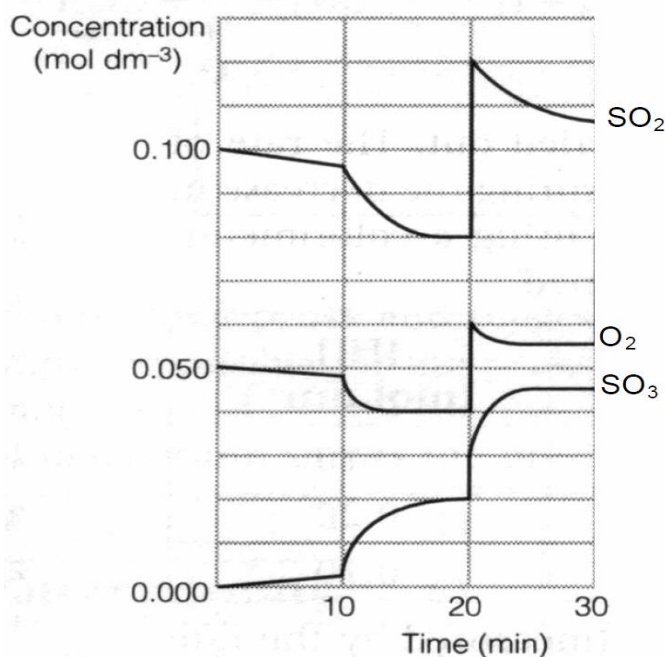
Which of the following statements are correct at a higher temperature?

- 1** The maximum of the curve is displaced to the right
- 2** The proportion of molecules with energies **above** any given value increases.
- 3** The proportion of molecules **with** any given value increases

- 27 During the Contact process, sulfur dioxide is converted to sulfur trioxide as shown by the equation below.



The following graph shows how the concentration of the three gases changed when a series of changes was made.



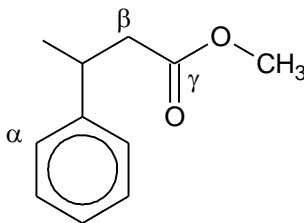
Which of the statements are correct?

- 1 At 20 minute, the numerical value of the equilibrium constant,  $K_c$ , is 1.56.
- 2 At 20 minute, the pressure of the system was increased by reducing the volume.
- 3 At 10 minute, heat was removed from the system.

- 28 Which of the reagents can be used to differentiate the pair of compounds given?

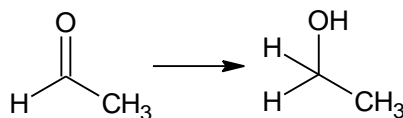
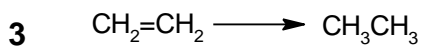
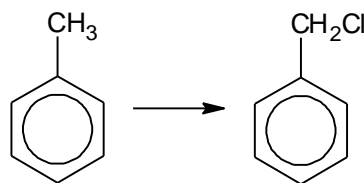
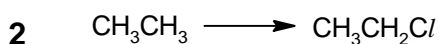
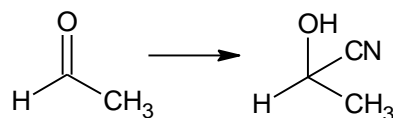
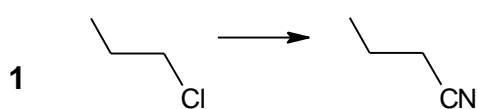
	Compound 1	Compound 2	Reagents
1	$\text{AlCl}_3$	$\text{SiCl}_4$	$\text{H}_2\text{O}$
2	$\text{SiCl}_4$	$\text{PCl}_5$	damp blue litmus paper
3	$\text{NaCl}$	$\text{MgO}$	dilute $\text{H}_2\text{SO}_4$

29 Which of the following statements on the given compound are true?



- 1 There are 14 hydrogen atoms
- 2 There are 7  $sp^2$  and 4  $sp^3$  hybridised carbons
- 3 The bond angles around carbons  $\alpha$ ,  $\beta$ , and  $\gamma$  are all  $120^\circ$

30 Which of the following pairs of reactions require the same reagents and conditions?



End of paper