

CANDIDATE'S NAME: \_\_\_\_\_

CTG: \_\_\_\_\_

**YISHUN JUNIOR COLLEGE**  
2017 JC2 PRELIMINARY EXAMINATION

**CHEMISTRY**  
**HIGHER 1**

**8872/01**

Paper 1 Multiple Choice Questions

**FRIDAY 15 SEPTEMBER 2017**  
**0800hrs – 0850hrs**  
**(50 minutes)**

**Additional Materials:** Optical Mark Sheet (OMS)  
Data Booklet

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**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

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

Write your name, CTG, and NRIC / FIN number on the Optical Mark Sheet (OMS), and shade the corresponding boxes for your NRIC / FIN number.

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.

## Section A

For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct and shade your choice on the answer sheet provided.

- 1 Calcium nitrate,  $\text{Ca}(\text{NO}_3)_2$ , is added to fireworks to give a red colouration. When ignited, it reacts with carbon to produce calcium oxide,  $\text{CaO}$ , and three gases;  $\text{CO}_2$ ,  $\text{CO}$  and  $\text{Z}$ . The three gases are produced in a mole ratio of 2 : 1 : 1 respectively.

What is gas  $\text{Z}$ ?

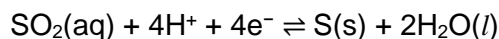
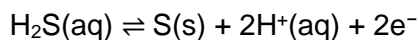
- A**  $\text{N}_2$                       **B**  $\text{N}_2\text{O}$                       **C**  $\text{NO}$                       **D**  $\text{NO}_2$

- 2 Naturally occurring silicon is a mixture of three isotopes,  $^{28}\text{Si}$ ,  $^{29}\text{Si}$  and  $^{30}\text{Si}$ . The relative atomic mass of silicon is 28.109.

What could be the relative abundance of each of the three isotopes?

- A** 91.1%  $^{28}\text{Si}$ ; 7.9%  $^{29}\text{Si}$ ; 1.0%  $^{30}\text{Si}$   
**B** 92.2%  $^{28}\text{Si}$ ; 4.7%  $^{29}\text{Si}$ ; 3.1%  $^{30}\text{Si}$   
**C** 95.0%  $^{28}\text{Si}$ ; 3.2%  $^{29}\text{Si}$ ; 1.8%  $^{30}\text{Si}$   
**D** 96.3%  $^{28}\text{Si}$ ; 0.3%  $^{29}\text{Si}$ ; 3.4%  $^{30}\text{Si}$

- 3 The reaction of hydrogen sulfide and sulfur dioxide gives sulfur as one of the products.



How many moles of hydrogen sulfide are needed to react with sulfur dioxide to produce 1 mole of sulfur?

- A** 2 mol                      **B**  $\frac{3}{2}$  mol                      **C** 1 mol                      **D**  $\frac{2}{3}$  mol

- 4 *Use of Data Booklet is relevant to this question.*

In research on the atomic nucleus, scientists have been comparing the stability of isotopes with the same neutron : proton ratio.

Which isotope has the same neutron : proton ratio as  $^{10}\text{B}$ ?

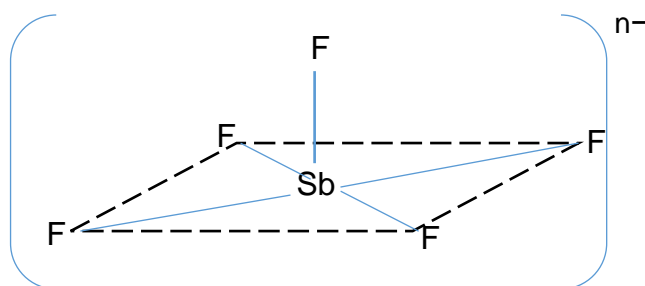
- A**  $^{40}\text{Ar}$                       **B**  $^{40}\text{K}$                       **C**  $^{32}\text{P}$                       **D**  $^{32}\text{S}$

- 5 Thionyl chloride,  $\text{SOCl}_2$ , can be used to convert alcohols into chloroalkanes.

Thionyl chloride can be represented as  $\text{O}=\text{S}(\text{Cl})_2$

What value does Valence Shell Electron Pair Repulsion theory suggest for the bond angle in thionyl chloride?

- A 90° exactly  
 B 107° approximately  
 C 118° approximately  
 D 120° exactly
- 6 Antimony, Sb, is in Group 15 of the Periodic Table. It forms a series of salts which contain the  $\text{SbF}_5^{n-}$  anion, the structure of which is a square-based pyramid.



Deduce the value of n.

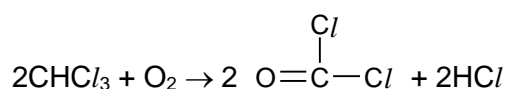
- A 1                      B 2                      C 3                      D 4
- 7 Pressurising butane in a cylinder causes it to liquify. It is then sold as 'liquidified petroleum gas', LPG. Under the same conditions, methane remains as a gas.
- Which best explains why butane is more easily liquified than methane?
- A Its molecule contains more electrons than that of methane.  
 B Its molecule contains more atoms than that of methane.  
 C Its molecular mass is higher than that of methane.  
 D Its molecule has a dipole moment, whereas methane does not.

8 Which row of the table is correct?

	least exothermic lattice energy	→	most exothermic lattice energy
<b>A</b>	sodium sulfide	lithium sulfide	lithium oxide
<b>B</b>	lithium sulfide	lithium oxide	sodium sulfide
<b>C</b>	lithium oxide	sodium sulfide	lithium sulfide
<b>D</b>	lithium oxide	lithium sulfide	sodium sulfide

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

Trichloromethane,  $\text{CHCl}_3$ , commonly known as chloroform, was used as an anaesthetic in surgery. One reason for it not being used today is that it naturally oxidises to phosgene,  $\text{COCl}_2$ , which is highly toxic.



What is the enthalpy change,  $\Delta H$ , for this reaction?

- A**  $-2342 \text{ kJ mol}^{-1}$                       **B**  $-346 \text{ kJ mol}^{-1}$   
**C**  $+75 \text{ kJ mol}^{-1}$                       **D**  $+1996 \text{ kJ mol}^{-1}$

10 The table shows the enthalpy change of neutralisation per mole of water formed,  $\Delta H$ , for various acids and bases.

acid	base	$\Delta H / \text{kJ mol}^{-1}$
hydrochloric acid	sodium hydroxide	-57.0
P	sodium hydroxide	-54.0
hydrochloric acid	Q	-52.0
nitric acid	R	-57.0

What are P, Q and R?

	P	Q	R
<b>A</b>	ethanoic acid	ammonia	potassium hydroxide
<b>B</b>	ethanoic acid	sodium hydroxide	ammonia
<b>C</b>	sulfuric acid	ammonia	potassium hydroxide
<b>D</b>	sulfuric acid	sodium hydroxide	ammonia

11 What is meant by the term *dynamic equilibrium*?

- A an equilibrium that is constantly changing its position
- B an equilibrium where the forward and reverse reactions are taking place at different rates
- C an equilibrium where the forward and reverse reactions are taking place at the same rate
- D an equilibrium which has not yet settled to a constant rate

12 Each of the following equilibria is subjected to two changes which are carried out separately.

I the pressure is reduced at constant temperature.

II the temperature is increased at constant pressure.

For which equilibrium will **both** of these changes result in an increase in the proportion of products?

- A  $\text{I}_2(\text{g}) + \text{H}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$   $\Delta H = +53 \text{ kJ mol}^{-1}$
- B  $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$   $\Delta H = +57 \text{ kJ mol}^{-1}$
- C  $3\text{H}_2(\text{g}) + \text{N}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$   $\Delta H = -92 \text{ kJ mol}^{-1}$
- D  $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightleftharpoons 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g})$   $\Delta H = -950 \text{ kJ mol}^{-1}$

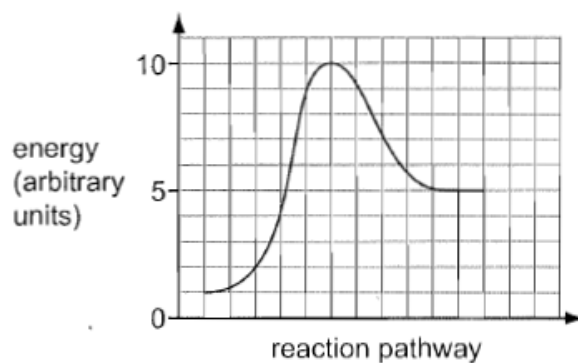
13 Values for the ionic product of water,  $K_w$ , at two different temperatures are given below.

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

What is correct for pure water at 30 °C?

- A  $[\text{H}^+] > [\text{OH}^-]$
- B  $\text{pH} = 1.44 \times 10^{-7}$
- C  $\text{pH} < 7$
- D  $\text{pH} > 7$

- 14 The diagram shows the reaction pathway diagram for an uncatalysed reaction.



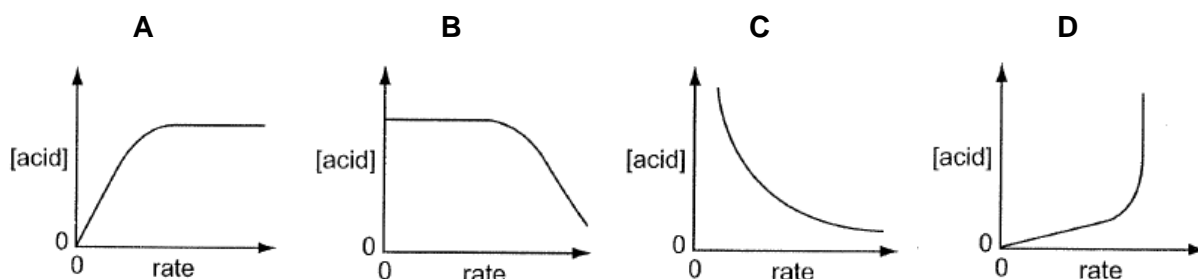
The reaction is then catalysed.

What are the changes in the rate constant and the reaction pathway diagram?

	rate constant	energy profile
A	decrease	
B	decrease	
C	increase	
D	increase	

- 15 In the reaction between aqueous sodium thiosulfate and dilute acid, the reaction is found to be first order with respect to acid at low concentrations of acid, but zero order with respect to acid when the acid concentration is high.

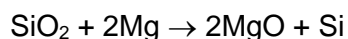
Which graph represents the experimental results?



- 16 The ionic radii of  $\text{Na}^+$ ,  $\text{Mg}^{2+}$  and  $\text{Al}^{3+}$  are 0.095 nm, 0.065 nm and 0.050 nm respectively. Which of the following statements correctly explains the decrease in radius from  $\text{Na}^+$  to  $\text{Al}^{3+}$ ?

- A** an increase in the nuclear charge and total number of electrons  
**B** an increase in the nuclear charge and constant total number of electrons  
**C** an increase in total number of electrons while nuclear charge remains constant  
**D** a decrease in nuclear charge while total number of electrons remains constant

- 17 In the preparation of silicon, silicon dioxide is heated with magnesium.



The product mixture contains MgO and Si only.

To separate the silicon from the product mixture, students proposed the following two possible methods.

1. Shake the mixture with aqueous hydrochloric acid and filter.
2. Heat the mixture gently and collect the evaporated silicon.

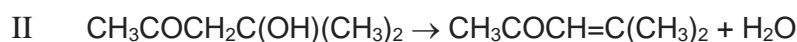
Which methods would work?

- A** 1 and 2      **B** 1 only      **C** 2 only      **D** neither 1 or 2

- 18 How many esters have the molecular formula  $\text{C}_4\text{H}_8\text{O}_2$ ?

- A** 2      **B** 3      **C** 4      **D** 5

- 19 The Russian composer Borodin was widely respected for his work as a chemist. In 1869, he discovered a reaction in which two ethanol molecules combine to form a new  $\beta$ -hydroxy carbonyl compound. A similar reaction is shown below.



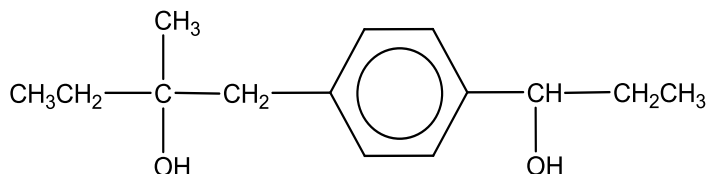
Which of the following best describes reactions I and II?

	I	II
A	addition	elimination
B	substitution	elimination
C	addition	reduction
D	condensation	elimination

- 20 Which statement about an ethene molecule is **not** correct?

- A It has all its atoms in the same plane.  
 B It has an empirical formula of  $\text{CH}_2$ .  
 C It has bond angles of  $109^\circ$ .  
 D It has five  $\sigma$  bonds and one  $\pi$  bond.

- 21 The compound shown below is a derivative of ibuprofen, which is a painkiller.



Which of the following reagents and conditions will react with only one alcohol group in the derivative of ibuprofen?

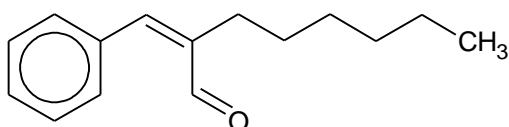
- A anhydrous  $\text{PCl}_5$   
 B concentrated  $\text{H}_2\text{SO}_4$ ,  $170^\circ\text{C}$   
 C  $\text{I}_2$  dissolved in  $\text{NaOH}$  (aq), warm  
 D  $\text{Cr}_2\text{O}_7^{2-}$ ,  $\text{H}_2\text{SO}_4$  (aq), heat



22 Which compound could **not** be a product of a single reaction of 2-bromobutane?

- A but-1-ene
- B butan-2-ol
- C butane
- D butyl-2-amine

23 Hexyl cinnamaldehyde is found in the essential oil of chamomile and is commonly used as a perfume.



If hexyl cinnamaldehyde is reacted with  $\text{NaBH}_4$ , what would be the  $M_r$  of the resultant product?

- A 204                      B 218                      C 220                      D 226

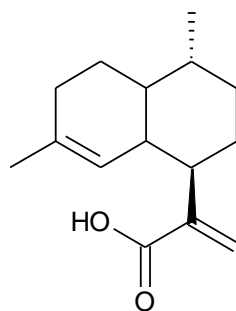
24 Compound X,  $\text{C}_4\text{H}_6\text{O}_2$ , which is responsible for giving butter its characteristic flavour, gives the following experimental observations.

- On reduction, X produces  $\text{C}_4\text{H}_{10}\text{O}_2$ .
- With hydrogen cyanide and aqueous sodium cyanide, X produces  $\text{C}_6\text{H}_8\text{N}_2\text{O}_2$ .
- On warming X with Fehling's solution, the solution remains blue.

What could be the structural formula of X?

- A  $\text{CH}_2=\text{CHCOCH}_2\text{OH}$
- B  $\text{CH}_3\text{COCH}=\text{CHOH}$
- C  $\text{CH}_3\text{COCOCH}_3$
- D  $\text{CH}_3\text{COCH}_2\text{CHO}$

- 25 Artemisinic acid is a useful intermediate for making the anti-malarial drug, artemisin.



artemisinic acid

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

- A It can exhibit geometric isomerism around a double bond.
- B It can be esterified by ethanol, in the presence of H<sup>+</sup> ions.
- C It has a molecular formula of C<sub>15</sub>H<sub>22</sub>O<sub>2</sub>.
- D It will decolourise cold, dilute MnO<sub>4</sub><sup>-</sup> ions.

## Section B

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

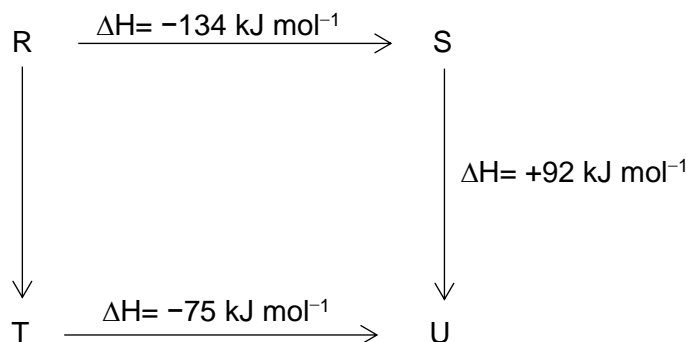
Decide whether each of the statements is or is not correct (you may find it helpful to pick a tick against the statements that you consider to be correct).

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

A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

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

**26** The diagram illustrates the energy changes for a set of reactions.



Which statements are correct?

- 1 The enthalpy change for the transformation  $R \rightarrow T$  is  $+33 \text{ kJ mol}^{-1}$
- 2 The enthalpy change for the transformation  $T \rightarrow S$  is endothermic.
- 3 S has a higher energy content than U.

**27** Which statements about order of reaction are correct?

- 1 Only first order reactions have constant half-lives.
- 2 Measurements of the initial rates of reaction can be used to determine the overall order of a reaction.
- 3 The units of a rate constant are independent of the order of the reaction.

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</b> only is correct

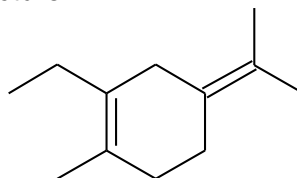
No other combination of statements is used as a correct response.

- 28** When 0.10 mol of chloride of a Period 3 element, A, is reacted with a limited amount of water, white fumes are observed. Upon dissolving the white fumes in water, the resultant solution is found to react with 0.30 mol of aqueous sodium hydroxide.

Which Groups of the Periodic Table can A belong to?

- 1** 15
- 2** 13
- 3** 14

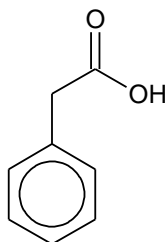
- 29** Compound N has the following structure.



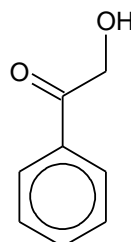
compound N

Which of the following statements are correct when compound N is treated with  $\text{KMnO}_4$  in the presence of hot dilute sulfuric acid?

- 1** The products contain at least one carbonyl functional group.
  - 2** The products contain at least one carboxylic acid functional group.
  - 3** There is only one organic product.
- 30** Which of the following reagents can be used to distinguish the following two compounds, P and Q?



P



Q

- 1** 2,4-DNPH, warm
- 2** hot acidified  $\text{K}_2\text{Cr}_2\text{O}_7$
- 3**  $\text{Na}_2\text{CO}_3$  (aq)

~ END OF PAPER ~