

**CATHOLIC JUNIOR COLLEGE**  
**JC2 PRELIMINARY EXAMINATIONS**  
**Higher 1**

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**CHEMISTRY**

Paper 1 Multiple Choice

**8872/01**

**Wednesday 31 August 2016**  
**50 Minutes**

Additional Materials: Multiple Choice Answer Sheet  
Data Booklet

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**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

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

Write and/or shade your name, NRIC / FIN number and HT group on the Multiple Choice Answer Sheet in the spaces provided.

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 Multiple Choice Answer Sheet.

**Read the instructions on the Multiple Choice 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

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This document consists of **11** printed pages and **1** blank page.

**[Turn over**

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

- 1 Milk chocolate bars contain about 47% of sugar by mass. If these sugars are all sucrose,  $C_{12}H_{22}O_{11}$  ( $M_r = 342$ ), how many sugar molecules are there in a 250 g chocolate bar?
- A  $2.07 \times 10^{23}$  C  $4.40 \times 10^{23}$   
B  $3.87 \times 10^{23}$  D  $8.23 \times 10^{23}$
- 2 Which of the following samples of gas would occupy a volume of  $3 \text{ dm}^3$  at r.t.p.?
- A 5.6 g of  $O_2$  C 9.0 g of  $CO_2$   
B 8.0 g of  $SO_2$  D 10.0 g of Ar
- 3 In which of the following reactions does the greatest change in oxidation number of nitrogen occur?
- A  $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$   
B  $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$   
C  $2NO + O_2 \rightarrow 2NO_2$   
D  $4NH_3 + 6NO \rightarrow 5N_2 + 6H_2O$
- 4 In an experiment,  $1.00 \text{ mol dm}^{-3}$  sodium hydroxide solution was added to  $25.0 \text{ cm}^3$  of  $1.00 \text{ mol dm}^{-3}$  sulfuric acid until the acid was *completely* neutralised. What is the concentration of sodium sulfate (correct to 2 decimal places) in the resulting solution?
- A  $1.00 \text{ mol dm}^{-3}$  C  $0.33 \text{ mol dm}^{-3}$   
B  $0.50 \text{ mol dm}^{-3}$  D  $0.25 \text{ mol dm}^{-3}$
- 5 A proton,  $^1H^+$ , and a helium ion,  $^4He^{2+}$ , both move at the same speed perpendicular to a uniform electric field.
- Which statement correctly describes the deflections observed?
- A They are deflected in opposite directions.  $^1H^+$  is deflected to a greater extent.  
B They are deflected in opposite directions.  $^4He^{2+}$  is deflected to a greater extent.  
C They are deflected in the same direction.  $^1H^+$  is deflected to a greater extent.  
D They are deflected in the same direction.  $^4He^{2+}$  is deflected to a greater extent.

- 6 Use of the Data Booklet is relevant to this question.

**X** and **Y** are atoms of different elements.

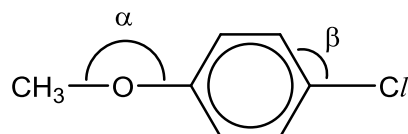
**X** has nine fewer protons than **Y**.

**X** has one more unpaired electron than **Y**.

What are the identities of **X** and **Y**?

	<b>X</b>	<b>Y</b>
<b>A</b>	beryllium	magnesium
<b>B</b>	carbon	phosphorus
<b>C</b>	oxygen	chlorine
<b>D</b>	neon	sodium

- 7 The following compound is a derivative of anisole found in natural and artificial fragrances.



What are the values of angle  $\alpha$  and angle  $\beta$ ?

	angle $\alpha$	angle $\beta$
<b>A</b>	180 °	120 °
<b>B</b>	120 °	107 °
<b>C</b>	107 °	109 °
<b>D</b>	105 °	120 °

- 8 Given the following enthalpy changes,



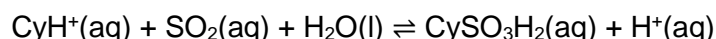
what is the standard enthalpy change of formation of gaseous phosphorous trichloride,  $\text{PCl}_3\text{(g)}$ ?

<b>A</b>	$x + y + z$	<b>C</b>	$-(x + y + z)$
<b>B</b>	$\frac{(x + y + z)}{2}$	<b>D</b>	cannot be determined

9 Which of the following will always be an exothermic process?

- A Bond breaking
- B Second ionisation energy
- C Standard enthalpy change of formation
- D Standard enthalpy change of combustion

10 Cyanidin (Cy) is a water-soluble plant pigment which can be found in blackberries. Blackberry juice is usually preserved by the addition of a small amount of  $\text{SO}_2(\text{g})$  and the following equilibrium is set up:

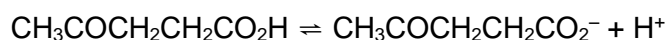


what are the units for  $K_c$ ?

- |                                      |                                 |
|--------------------------------------|---------------------------------|
| A $\text{mol dm}^{-3}$               | C $\text{mol}^{-1} \text{dm}^3$ |
| B $\text{mol dm}^{-3} \text{s}^{-1}$ | D no units                      |

11 “Levulinic acid was recognized by the US Department of Energy as one of the top bio-based platform chemicals of the future.” This is the bold statement found on the landing page of GF Biochemicals, a company owned by French professional footballer, Mathieu Flamini.

Levulinic acid, when dissolved in water, dissociates according to the following equation:



Which of the following statements regarding levulinic acid is correct?

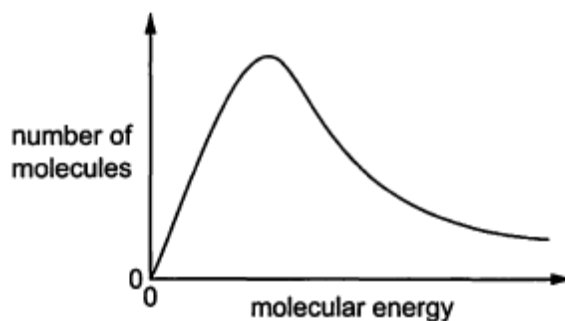
- A  $0.1 \text{ mol dm}^{-3}$  of levulinic acid will have a pH of 1.
- B Increasing the concentration of levulinic acid will increase the  $K_a$  value.
- C The Brønsted conjugate base of levulinic acid is the  $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CO}_2^-$  ion.
- D Adding NaOH will not change the amount of levulinic acid that will dissociate.

12 A solution was made by mixing  $0.0200 \text{ mol}$  of  $\text{HCl}(\text{aq})$  and  $0.0300 \text{ mol}$  of  $\text{NaOH}(\text{aq})$ . Water was added until the total volume of the solution was  $2 \text{ dm}^3$ .

What is the pH of the solution?

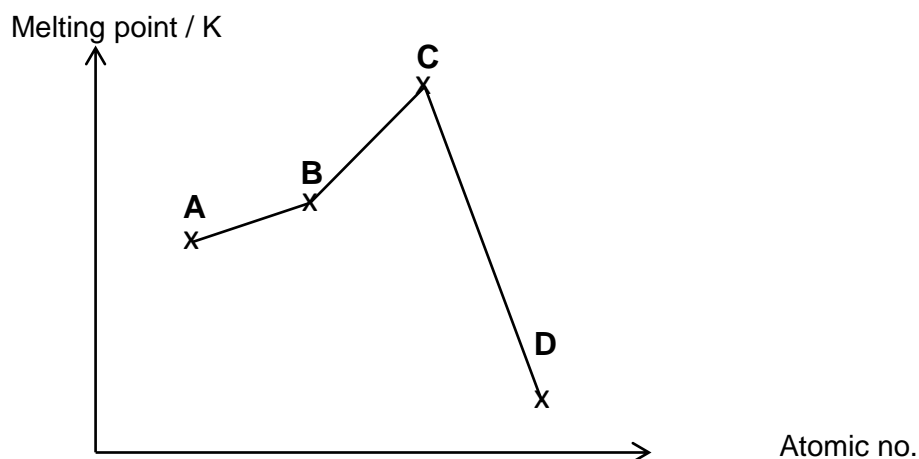
- |       |        |
|-------|--------|
| A 2.0 | C 11.7 |
| B 2.3 | D 12.0 |

- 13 The diagram represents the Boltzmann distribution of molecular energies at a given temperature.



How does the shape of the graph change when the temperature decreases?

- A The peak is higher and further to the left.
  - B The peak is higher and further to the right.
  - C The peak is lower and further to the left.
  - D The peak is lower and further to the right.
- 14 Which statement is true of all enzymes?
- A They are denatured at temperatures above 70°C only.
  - B They increase the rate of random collisions of molecules.
  - C They reduce the amount of energy required to start a reaction.
  - D They are able to speed up a wide variety of reactions.
- 15 The graph shows the melting points of four consecutive elements in Period 3, Na to Ar, of the Periodic Table.



Which element, represented by **A**, **B**, **C** and **D**, is the best conductor of electricity among the four elements shown?

16 Element **U** is in Period 3 of the Periodic Table and has the following properties.

- Element **U** conducts electricity
- Oxide of **U** has the highest melting point compared to other oxides of Period 3 elements
- Chloride of **U** dissolves in water to give a slightly acid solution.

Which of the following is a possible identity of element **U**?

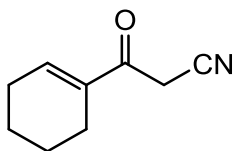
- A** Mg                      **B** Al                      **C** Si                      **D** P

17 Hydrocarbon **Z**,  $C_6H_{14}$ , is allowed to react with limited  $Br_2$  in the presence of UV light. It was found that the mono-brominated products formed has only two structural isomers.

Which of the following is a possible structure of **Z**?

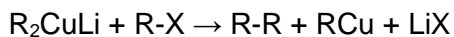
- A**  $(CH_3)_2CHCH(CH_3)_2$                       **C**  $(CH_3CH_2)_2CHCH_3$   
**B**  $(CH_3)_3CCH_2CH_3$                       **D**  $CH_3(CH_2)_4CH_3$

18 What is the total number of  $\pi$ (pi) bonds in the molecule below?



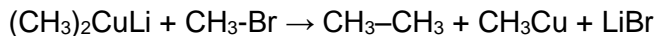
- A** 2                      **B** 3                      **C** 4                      **D** 5

19 The Corey-House synthesis is able to produce specific alkanes from halogenoalkanes, according to the general equation:



[R is the same alkyl group such as  $CH_3$ ,  $CH_3CH_2$ ,  $CH_3CH_2CH_2$  etc]

For example,



Which alkane **cannot** be produced from this reaction?

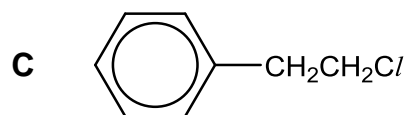
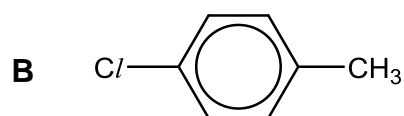
- A**  $CH_3(CH_2)_2CH_3$   
**B**  $CH_3(CH_2)_3CH_3$   
**C**  $CH_3(CH_2)_4CH_3$   
**D**  $CH_3(CH_2)_6CH_3$

**20** Which of the following is the most suitable reagent to distinguish between propanoic acid and propanol?

- A** Li
- B** KOH
- C**  $\text{SOCl}_2$
- D**  $\text{CaCO}_3$

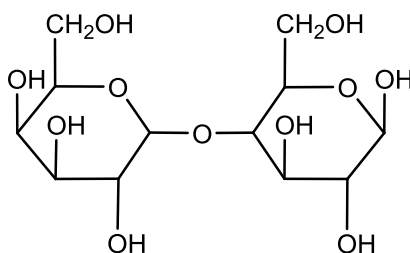
**21** Compound **W** gave no precipitate when heated under reflux with aqueous silver nitrate. Which of the following is likely to be **W**?

- A**  $\text{CH}_3\text{CHCl}/\text{CH}_3$



- D**  $\text{CH}_2=\text{CHCH}_2\text{Cl}$

**22** Lactose is a disaccharide derived from galactose and glucose that is found in milk. The structure of lactose is as follows.

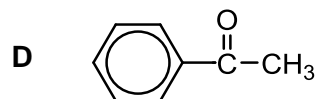
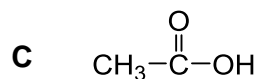
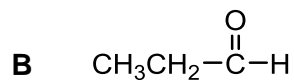
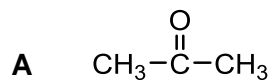


How many moles of hydrogen gas is evolved when one mole of lactose is reacted with excess sodium metal at room temperature?

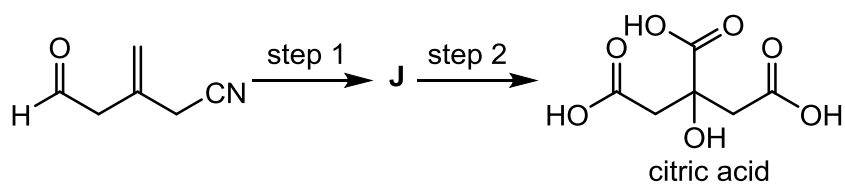
- A** 4                      **B** 5                      **C** 8                      **D** 11

- 23** When an organic compound **X** was treated with Fehling's solution, no precipitate was produced. When compound **X** was treated with acidified potassium manganate(VII), decolourisation of the purple solution was observed.

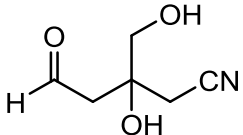
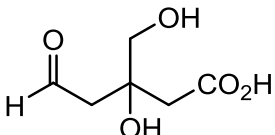
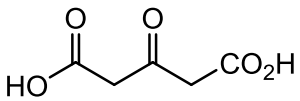
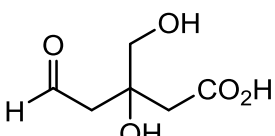
What is **X**?



- 24** Citric acid is a weak organic acid often found in citrus fruits. It can be synthesized in the following scheme.



What are the reagents for step 1, step 2 and the identity of organic intermediate **J**?

	step 1	<b>J</b>	step 2
<b>A</b>	cold $\text{MnO}_4^-/\text{OH}^-$		hot $\text{Cr}_2\text{O}_7^{2-}/\text{H}^+$
<b>B</b>	1) cold conc. $\text{H}_2\text{SO}_4$ 2) $\text{H}_2\text{O}$ , heat		hot $\text{MnO}_4^-/\text{H}^+$
<b>C</b>	hot $\text{MnO}_4^-/\text{H}^+$		hot $\text{MnO}_4^-/\text{OH}^-$
<b>D</b>	hot $\text{H}_2\text{SO}_4(\text{aq})$		hot $\text{Cr}_2\text{O}_7^{2-}$



**25** Rank the following compounds in terms of increasing  $pK_a$  values.

**I**  $\text{HCl}$

**II**  $\text{CH}_3\text{CO}_2\text{H}$

**III**  $\text{CH}_3\text{CH}_2\text{OH}$

**IV**  $\text{C}_6\text{H}_5\text{CO}_2\text{H}$

**A** **I, II, III, IV**

**C** **III, II, IV, I**

**B** **I, IV, II, III**

**D** **III, IV, II, I**

## 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

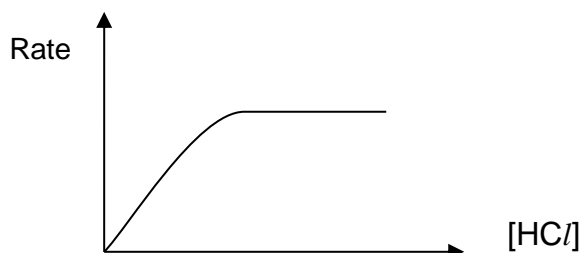
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>1, 2 and 3</b> are correct	<b>1 and 2</b> only are correct	<b>2 and 3</b> only are correct	<b>1</b> only is correct

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

**26** Which molecules contain within their structures three atoms arranged in a straight line?

- 1**  $\text{NO}_2$
- 2**  $\text{CO}_2$
- 3**  $\text{XeF}_4$

**27** In monitoring the reaction between sodium thiosulfate and hydrochloric acid by the initial rate method, the following graph was obtained. The initial concentration of sodium thiosulfate was the same in all experiments.



What deductions can be made from the graph?

- 1** The order of reaction with respect to hydrochloric acid at low concentrations is 1.
- 2** The order of reaction with respect to hydrochloric acid at high concentrations is 0.
- 3** When [sodium thiosulfate] is high, the rate is independent of [sodium thiosulfate].

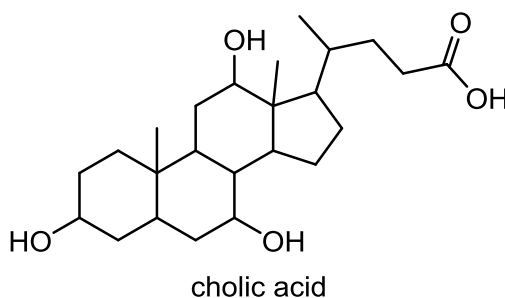
28 Which statements concerning the third period elements (sodium to argon) and their compounds are true?

- 1 Atomic radii decreases across the period.
- 2 Aluminium oxide is the only insoluble oxide.
- 3 The maximum oxidation state is shown by silicon.

29 Which one of the following structural formulae exists in both *cis* and *trans* forms?

- 1  $\text{CH}_3\text{CH}=\text{CHCl}$
- 2 cyclohexene
- 3  $\text{CHCl}=\text{C}(\text{CH}_2\text{CH}_3)_2$

30 Cholic acid is a primary bile acid that allows digestion of dietary fats and oils.



Which of the following statements regarding one mole of cholic acid is correct?

- 1 When reacted with excess  $\text{K}_2\text{CO}_3(\text{aq})$ , 0.5 mole of  $\text{CO}_2(\text{g})$  is produced.
- 2 When reacted with 4 moles of  $\text{SOCl}_2$ , 4 moles of  $\text{HCl}(\text{g})$  are produced.
- 3 When reacted with 2,4-dinitrophenylhydrazine, orange crystals are formed.

<b>1</b>	<b>A</b>	<b>6</b>	<b>C</b>	<b>11</b>	<b>C</b>	<b>16</b>	<b>A</b>	<b>21</b>	<b>B</b>	<b>26</b>	<b>C</b>
<b>2</b>	<b>B</b>	<b>7</b>	<b>D</b>	<b>12</b>	<b>C</b>	<b>17</b>	<b>A</b>	<b>22</b>	<b>A</b>	<b>27</b>	<b>B</b>
<b>3</b>	<b>A</b>	<b>8</b>	<b>A</b>	<b>13</b>	<b>A</b>	<b>18</b>	<b>C</b>	<b>23</b>	<b>D</b>	<b>28</b>	<b>D</b>
<b>4</b>	<b>C</b>	<b>9</b>	<b>D</b>	<b>14</b>	<b>C</b>	<b>19</b>	<b>B</b>	<b>24</b>	<b>A</b>	<b>29</b>	<b>D</b>
<b>5</b>	<b>C</b>	<b>10</b>	<b>D</b>	<b>15</b>	<b>B</b>	<b>20</b>	<b>D</b>	<b>25</b>	<b>B</b>	<b>30</b>	<b>B</b>