

Candidate's Name: \_\_\_\_\_

Class

Reg Number

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MERIDIAN JUNIOR COLLEGE  
**JC 2 Preliminary Examination**  
Higher 1

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## Chemistry

**8872/01**

**23 September 2016**

### Paper 1 Multiple Choice

**50 minutes**

Additional Materials: OMR Sheet and *Data Booklet*

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#### READ THESE INSTRUCTIONS FIRST

This booklet contains Section **A** of your paper.

Write your name, class and register number in the spaces provided at the top of this page.

There are **thirty** questions in this section. Answer **all** questions. For each question, there are four possible answers labelled **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the OMR answer sheet.

**Read very carefully the instructions on the use of OMR answer sheet.**

You are advised to fill in the OMR Answer Sheet as you go along; no additional time will be given for the transfer of answers once the examination has ended.

#### Use of OMR Answer Sheet

Ensure you have written your name, class register number and class on the OMR Answer Sheet.

Use a **2B** pencil to shade your answers on the **OMR sheet**, erase any mistakes cleanly. Multiple shaded answers to a question will not be accepted.

For shading of class register number on the **OMR sheet**, please follow the given examples:  
If your register number is **1**, then shade **01** in the index number column.  
If your register number is **21**, then shade **21** in the index number column.

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This document consists of **13** printed pages (including this cover page).

## Section A

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

- 1 *The use of Data Booklet is relevant to this question.*

Which of the following contains the most number of particles?

- A** Number of atoms in 9 dm<sup>3</sup> of O<sub>2</sub> gas at r.t.p.
- B** Number of ions in 600 cm<sup>3</sup> of 0.5 mol dm<sup>-3</sup> H<sub>2</sub>SO<sub>4</sub> solution
- C** Number of electrons in 3.01 x 10<sup>22</sup> Ca atoms
- D** Number of hydrogen atoms in 7 g of ammonia

- 2 20 cm<sup>3</sup> of a hydrocarbon, C<sub>x</sub>H<sub>y</sub>, was burnt in 130 cm<sup>3</sup> of excess oxygen. After the combustion, the mixture was cooled to r.t.p and was found to occupy a volume of 110 cm<sup>3</sup>. The remaining gases was passed through an excess of aqueous alkali and the volume of gas is reduced to 30 cm<sup>3</sup>.

What is the molecular formula of this hydrocarbon?

- A** C<sub>4</sub>H<sub>4</sub>                      **B** C<sub>4</sub>H<sub>6</sub>                      **C** C<sub>4</sub>H<sub>8</sub>                      **D** C<sub>4</sub>H<sub>10</sub>

- 3 The red colouration in fireworks is caused by the reaction between calcium nitrate and carbon. During a firework display, the reaction produces calcium oxide and three gases; CO<sub>2</sub>, CO and nitrogen oxide, **W**.

An analysis of these gases revealed that the mole ratio of these 3 gases is 1: 2: 1 respectively.

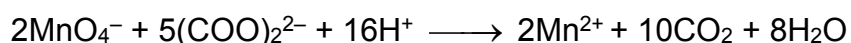
What is gas **W**?

- A** N<sub>2</sub>O<sub>4</sub>                      **B** N<sub>2</sub>O                      **C** NO                      **D** NO<sub>2</sub>

- 4 Sodium nitrate(V),  $\text{NaNO}_3$  decomposes on heating to form  $\text{NaNO}_x$  and oxygen.

8.50 g of  $\text{NaNO}_3$  was heated until a constant mass. The residue was dissolved in water to prepare  $1.00 \text{ dm}^3$  of solution.  $10.00 \text{ cm}^3$  of this solution was reacted against  $30.00 \text{ cm}^3$  of  $0.0200 \text{ mol dm}^{-3}$  of acidified potassium manganate(VII) solution.

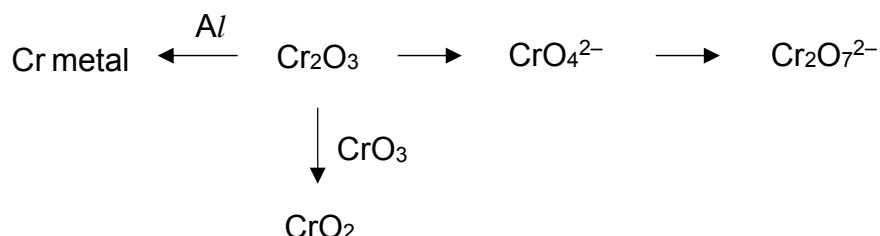
The excess potassium manganate(VII) solution required  $10.00 \text{ cm}^3$  of  $0.0500 \text{ mol dm}^{-3}$  ethanedioate solution for complete reaction as shown by the equation below:



What is the final oxidation state of nitrogen in  $\text{NaNO}_x$ ?

- A** +1                      **B** +2                      **C** +3                      **D** +5

- 5 Chromium(III) oxide,  $\text{Cr}_2\text{O}_3$ , can undergo different reactions to give other chromium-containing species as shown in the diagram below:



Which statement correctly describe these reactions?

- A** The formation of  $\text{Cr}_2\text{O}_7^{2-}$  from  $\text{CrO}_4^{2-}$  is a redox reaction.  
**B**  $\text{Cr}_2\text{O}_3$  reacts with  $\text{CrO}_3$  in a disproportionation reaction to give  $\text{CrO}_2$ .  
**C**  $\text{CrO}_3$ ,  $\text{CrO}_4^{2-}$ ,  $\text{Cr}_2\text{O}_7^{2-}$  contains chromium in its highest oxidation state.  
**D** Aluminium is acting as an oxidising agent.

- 6 Which species has two unpaired electrons?

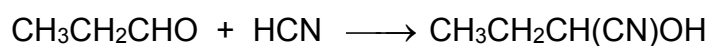
- A**  $\text{Cl}^+$                       **B**  $\text{Mg}$                       **C**  $\text{P}$                       **D**  $\text{S}^{2-}$

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

What do these ions,  $^{40}\text{Ca}^{2+}$  and  $^{31}\text{P}^{3-}$ , have in common?

- A Both ions are isoelectronic.
- B Both ions have more neutrons than protons.
- C Both ions contain the same number of neutrons.
- D Both ions have similar magnitudes of deflection in an electric field.

8 When one propanal molecule reacts with one hydrogen cyanide molecule by addition reaction, how many bonds are broken and formed?



	number of $\sigma$ bonds broken	number of $\pi$ bonds broken	number of $\sigma$ bonds formed
A	0	1	3
B	2	0	3
C	2	1	1
D	2	1	3

9 In which substance must covalent bonds break on boiling?

- A phosphorus (V) chloride
- B caesium chloride
- C silicon carbide
- D magnesium

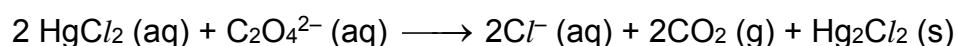
10 In which of the following pairs of compounds would the first compound have a lower melting point than the second compound?

- A  $\text{CH}_3(\text{CH}_2)_2\text{CH}_3$  and  $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_3$
- B  $\text{GaF}_3$ ,  $\text{GaCl}_3$
- C  $\text{SiO}_2$ ,  $\text{SiCl}_4$
- D  $\text{K}_2\text{O}$ ,  $\text{Na}_2\text{O}$

.11 Which pair of molecules is polar?

- A  $\text{C}_2\text{HCl}_3$  and  $\text{C}_2\text{Cl}_4$
- B COS and COSe
- C  $\text{PCl}_3$  and  $\text{BCl}_3$
- D  $\text{SO}_2$  and  $\text{XeF}_4$

12 The kinetics of the redox reaction between mercury (II) chloride,  $\text{HgCl}_2$  and oxalate ion,  $\text{C}_2\text{O}_4^{2-}$  was investigated and the following experimental results were obtained.



experiment	Initial $[\text{HgCl}_2]$ / $\text{mol dm}^{-3} \text{ s}$	Initial $[\text{C}_2\text{O}_4^{2-}]$ / $\text{mol dm}^{-3} \text{ s}$	Relative rate / $\text{mol dm}^{-3} \text{ s}^{-1}$
1	0.20	0.10	1
2	0.20	0.30	9
3	0.40	0.30	18

Which statement is correct?

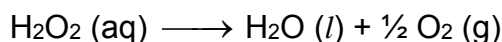
- A The rate constant depends on the concentration of  $\text{HgCl}_2$  and  $\text{C}_2\text{O}_4^{2-}$ .
- B The reaction is second order with respect to  $\text{HgCl}_2$ .
- C The rate of reaction is independent of  $\text{C}_2\text{O}_4^{2-}$ .
- D The units for the rate constant are  $\text{mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$

13 Archaeologists used  $^{14}\text{C}$ , a radioactive isotope, in carbon dating. An artifact is analysed and its  $^{14}\text{C}$  content is measured to be 20% of the typical initial amount of  $^{14}\text{C}$  in trees.

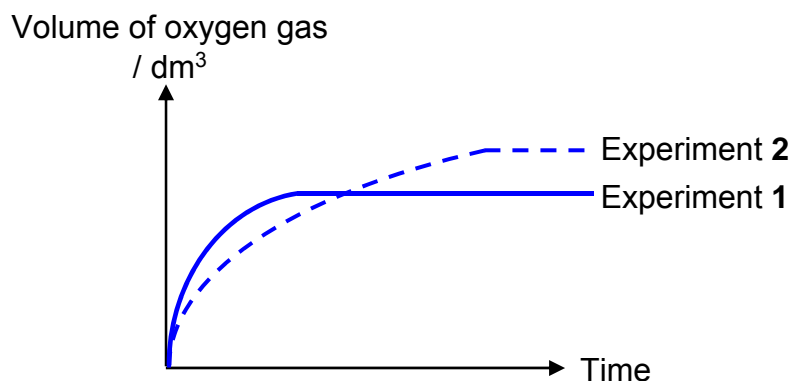
Given that the radioactive decay of  $^{14}\text{C}$  has a half-life of 5500 years, what is the approximate age of this artifact?

- A  $1.10 \times 10^4$  years
- B  $1.28 \times 10^4$  years
- C  $1.38 \times 10^4$  years
- D  $1.65 \times 10^4$  years

- 14 Experiments were carried out to investigate the rates of the decomposition of 100 cm<sup>3</sup> of 1.0 mol dm<sup>-3</sup> hydrogen peroxide, catalysed by manganese(IV) oxide.



The volume of oxygen gas collected using a gas syringe was monitored. The results are shown in the diagram below.



Which of the following alteration to the experimental conditions in Experiment 1 would produce the curve observed in Experiment 2?

- A Lowering the temperature
  - B Decreasing the amount of MnO<sub>2</sub> used
  - C Diluting the hydrogen peroxide solution with water
  - D Adding some 0.1 mol dm<sup>-3</sup> hydrogen peroxide
- 15 The standard enthalpy changes of combustion of carbon and hydrogen are -394 kJ mol<sup>-1</sup> and -286 kJ mol<sup>-1</sup> respectively.

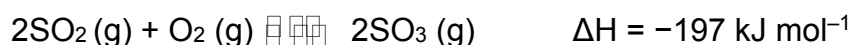
If the standard enthalpy change of combustion of propyne gas, C<sub>3</sub>H<sub>4</sub>, is -1938 kJ mol<sup>-1</sup>, calculate the standard enthalpy change of formation of propyne?

- |                             |                             |
|-----------------------------|-----------------------------|
| A +184 kJ mol <sup>-1</sup> | B -184 kJ mol <sup>-1</sup> |
| C +284 kJ mol <sup>-1</sup> | D -284 kJ mol <sup>-1</sup> |

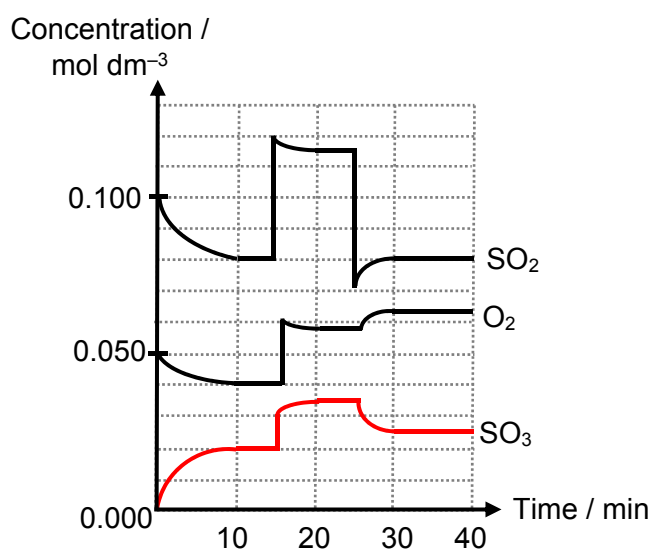
16 Which statements best defines the term *bond energy* for a diatomic molecule HCl?

- A Energy absorbed when one molecule of HCl is broken into its gaseous atoms.
- B Energy absorbed when one mole of HCl is broken into its gaseous atoms.
- C Energy released when one mole of HCl is formed from its gaseous atoms.
- D Energy released when one mole of HCl is formed from its gaseous ions.

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



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



Which of the following statement does **not** agree with the above information?

- A At 10 min, the value of the equilibrium constant,  $K_c$ , is 1.56.
- B At 15 min, the temperature of the system was decreased.
- C At 15 min, the pressure of the system was increased by reducing the volume of the vessel.
- D At 25 min, some sulfur dioxide gas was removed from the system.

- 18 The table below shows some data on two common acid–base indicators.

Indicator	Approximate pH range of colour change	colour change	
		acid	alkali
Methyl orange	3.2 – 4.4	red	yellow
Bromothymol blue	6.0 – 7.6	yellow	blue

What conclusion can be drawn about a solution which appears yellow with both methyl orange and bromothymol blue?

- A** It is strongly acidic.                      **B** It is weakly acidic.  
**C** It is neutral.                                      **D** It is weakly alkaline.
- 19 What is the final pH of the resultant solution formed by mixing equal volumes of  $\text{Ba}(\text{OH})_2$  solutions, one with a concentration of  $0.05 \text{ mol dm}^{-3}$  and the other with  $0.01 \text{ mol dm}^{-3}$ ?
- A** 12.3                      **B** 12.5                      **C** 12.8                      **D** 13.1
- 20 The equilibrium constant,  $K_c$ , for this reaction represented by the equation below is significantly greater than 1.0.

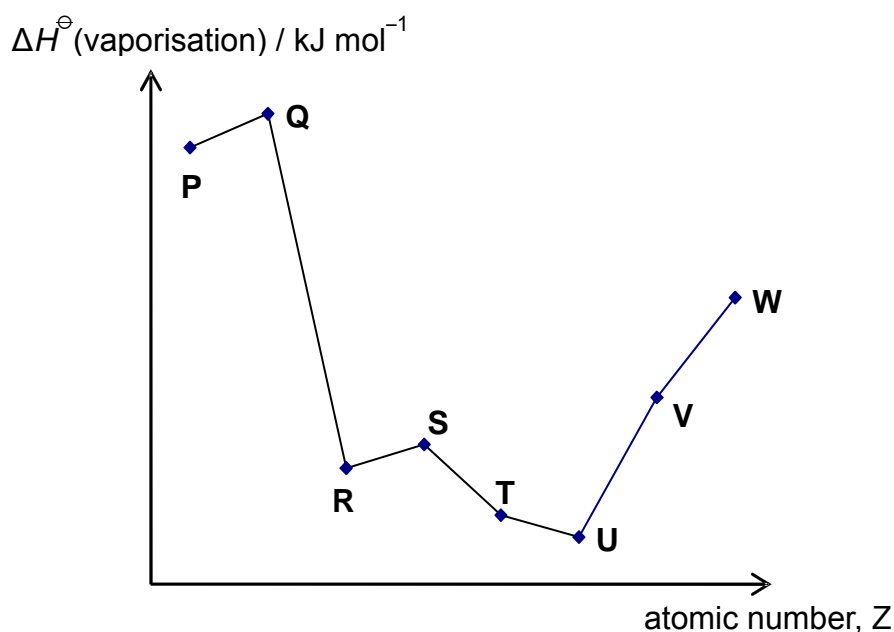


Which of the following states the correct relative strengths of the acid and base in the reaction?

- |          | Acids   |     | Bases                                |
|----------|---|-----|--------------------------------------|
| <b>A</b> | $\text{H}_2\text{PO}_4^- > \text{H}_2\text{CO}_3$ | and | $\text{HCO}_3^- > \text{HPO}_4^{2-}$ |
| <b>B</b> | $\text{H}_2\text{CO}_3 > \text{H}_2\text{PO}_4^-$ | and | $\text{HCO}_3^- > \text{HPO}_4^{2-}$ |
| <b>C</b> | $\text{H}_2\text{PO}_4^- > \text{H}_2\text{CO}_3$ | and | $\text{HPO}_4^{2-} > \text{HCO}_3^-$ |
| <b>D</b> | $\text{H}_2\text{CO}_3 > \text{H}_2\text{PO}_4^-$ | and | $\text{HPO}_4^{2-} > \text{HCO}_3^-$ |

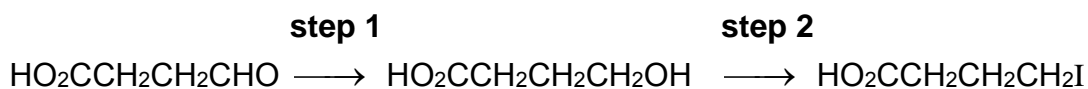


- 21 The graph below shows the variation in the standard enthalpy change of vaporisation,  $\Delta H^\ominus(\text{vaporisation})$ , for eight consecutive elements in the Periodic Table, all with atomic number,  $Z \leq 20$ .



Which element forms an oxide which is amphoteric?

- A Element P  
 B Element Q  
 C Element R  
 D Element V
- 22 4-oxobutanoic acid is used for metabolism in aerobic organisms. It can undergo the following two-step reaction.



What are the reagents and conditions required for **step 1** and **step 2**?

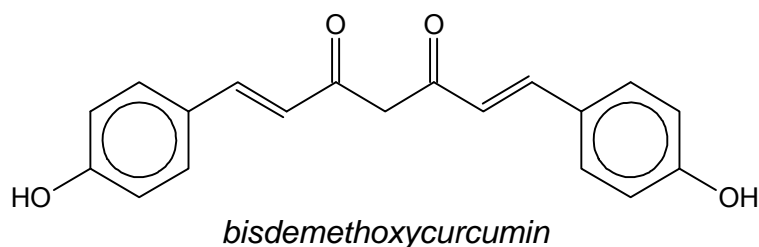
	step 1	step 2
A	LiAlH <sub>4</sub> in dry ether, r.t.p	I <sub>2</sub> with red phosphorus, heat
B	LiAlH <sub>4</sub> in dry ether, r.t.p	I <sub>2</sub> , <i>uv</i> light
C	NaBH <sub>4</sub> in ethanol, r.t.p	I <sub>2</sub> with red phosphorus, heat
D	NaBH <sub>4</sub> in ethanol, r.t.p	I <sub>2</sub> , <i>uv</i> light

- 23 Alcohol **Q** is treated with warm acidified potassium dichromate(VI) to form **R**. **R** does not form a yellow precipitate with aqueous alkaline iodine nor produce effervescence when sodium carbonate is added.

What is the identity of alcohol **Q**?

- A propan-1-ol
- B pentan-3-ol
- C 3-ethylpentan-3-ol
- D 3-methylbutan-2-ol

- 24 *Bisdemethoxycurcumin* is one of the active ingredients found in turmeric, a spice commonly used in Asian cuisine.



Which statement about *bisdemethoxycurcumin* is **incorrect**?

- A It turns hot acidified potassium dichromate(VI) from orange to green.
  - B It decolorises hot acidified potassium manganate (VII).
  - C It has 4 geometrical isomers.
  - D It forms orange crystals when warmed with 2,4-DNPH.
- 25 Propyl ethanoate is heated with an aqueous solution of potassium hydroxide.

What are the products of this reaction?

- A ethanol and propanoic acid
- B ethanol and potassium propanoate
- C propan-1-ol and ethanoic acid
- D propan-1-ol and potassium ethanoate

## Section B

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

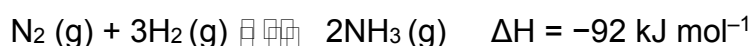
Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements which you consider to be correct).

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** During the Haber process, ammonia is synthesised from elemental nitrogen and hydrogen as shown in the equation below.



Which of the following statements is true?

- 1** To improve yield, the operating temperature of the system should be kept low.
  - 2** To improve yield, the operating pressure of the system should be kept high.
  - 3** When temperature is increased, the rate of the forward reaction increases but the rate of the reverse reaction decreases.
- 27** Which oxides of Period 3 elements gives an acidic solution when dissolved in water?
- 1**  $\text{P}_4\text{O}_{10}$
  - 2**  $\text{Al}_2\text{O}_3$
  - 3**  $\text{SiO}_2$

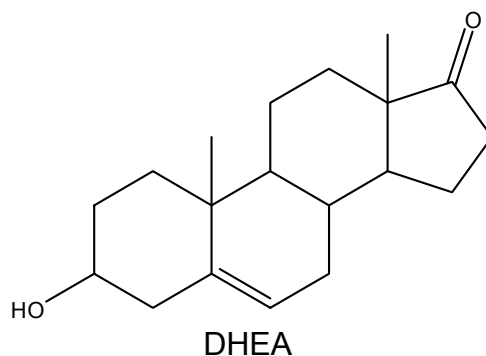
The responses **A** to **D** should be selected on the basis of

<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
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.

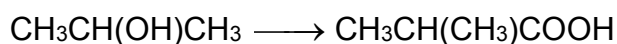
- 28** Athletes taking part in the Olympics could be disqualified and have their medal revoked for using banned performance-enhancing drugs.

DHEA, a steroid hormone, is illegally used as a performance-enhancing drug as it has minimal side effects.



Which reagents would react with DHEA?

- 1 Thionyl chloride,  $\text{SOCl}_2$
  - 2 Aqueous bromine
  - 3 Cold alkaline  $\text{KMnO}_4$
- 29** 2-methylpropanoic acid may be synthesised from propan-2-ol through a series of reactions.



Which sets of reagents would be suitable for this synthesis?

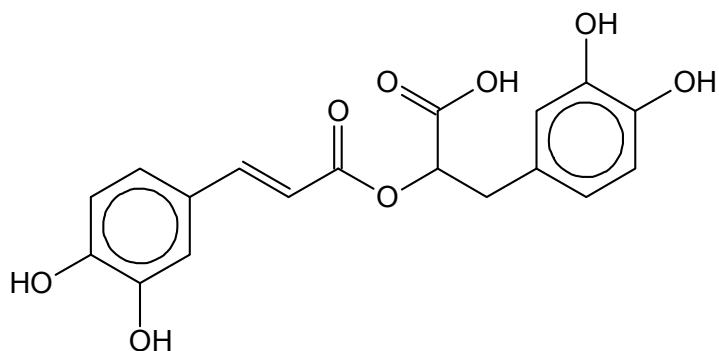
- 1  $\text{PBr}_3$ , ethanolic  $\text{KCN}$ , dilute  $\text{H}_2\text{SO}_4$
- 2 Acidified  $\text{KMnO}_4$ ,  $\text{HCN}$  with  $\text{NaCN}$  catalyst, dilute  $\text{H}_2\text{SO}_4$
- 3 Alkaline aqueous iodine, dilute  $\text{H}_2\text{SO}_4$ ,  $\text{HCN}$  with  $\text{NaCN}$  catalyst

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

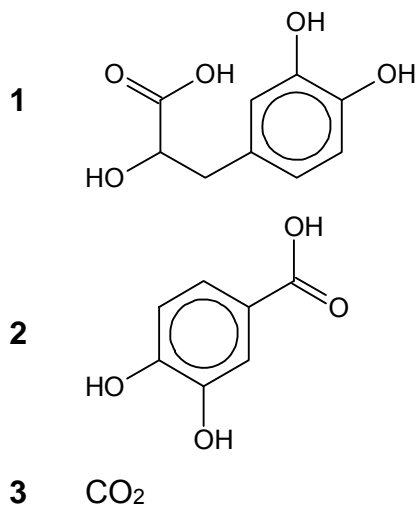
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

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

**30** *Rosmarinic acid* occurs in culinary herbs such as rosemary, sage and thyme.



Which products are obtained from the reaction of *rosmarinic acid* with excess, hot concentrated acidic  $\text{KMnO}_4$ ?



**END OF PAPER**