

RAFFLES INSTITUTION
2017 YEAR 6 PRELIMINARY EXAMINATION

Higher 1



CHEMISTRY
8872/01

Paper 1 Multiple Choice

25 September 2017

50 minutes

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.

Write in soft pencil.

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

Write your name, index number and civics tutorial group in the spaces provided on the Answer Sheet.

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 shade 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 **13** printed pages.

Section A

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

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

How many atoms of carbon are present in 72 g of Buckminsterfullerene, C₆₀?

- | | | | |
|----------|-------------------------|----------|-------------------------|
| A | 6.02 x 10 ²² | B | 7.22 x 10 ²² |
| C | 1.20 x 10 ²³ | D | 3.61 x 10 ²⁴ |

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

Ethyl butyrate is an organic liquid with a pineapple-like odour.

The percentage by mass of ethyl butyrate is: C, 62.1%; H, 10.3%; O, 27.6%.

Which empirical formula could be that of ethyl butyrate?

- | | | | |
|----------|---------------------------------|----------|----------------------------------|
| A | CH ₂ O | B | CHO ₂ |
| C | C ₃ H ₆ O | D | C ₅ H ₁₀ O |

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

A 1.881 g sample of an unknown metallic carbonate is decomposed by heating to form the metallic oxide and 0.66 g of carbon dioxide according to the equation:



What is metal **M**?

- | | | | |
|----------|----|----------|----|
| A | Ca | B | Mn |
| C | Ni | D | Zn |

- 4 Which compound contains two different elements with identical oxidation states?

- | | | | | | | | |
|----------|------|----------|---------------------|----------|---------------------------------|----------|--------------------|
| A | HC/O | B | Mg(OH) ₂ | C | Na ₂ SO ₄ | D | NH ₄ Cl |
|----------|------|----------|---------------------|----------|---------------------------------|----------|--------------------|

5 Which of the following is **incorrect** for $^{32}\text{S}^{2-}$?

- A It is isoelectronic with argon.
- B Its p-orbitals are completely filled.
- C It is smaller than a sulfur atom.
- D It has an equal number of protons and neutrons.

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

The table below gives the successive ionisation energies for an element **X**.

What could be the formula of the chloride of **X**?

	1st	2nd	3rd	4th	5th	6th
ionisation energy / kJ mol^{-1}	1010	1910	2910	4960	6270	21270

- A XCl
- B XCl_2
- C XCl_3
- D XCl_4

7 Which of the following will **not** form a hydrogen bond with another of its own molecule?

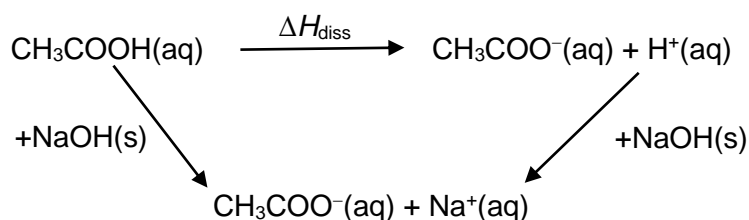
- A CH_3OH
- B CH_3CHO
- C CH_3NH_2
- D CH_3COOH

8 Which of the following statements is correct?

- A The Cl-P-Cl bond angle in PCl_3 is 120° .
- B Both CO_2 and SiO_2 have simple molecular structures.
- C The C-O bond has a larger dipole moment than the C-N bond.
- D The triple bond in nitrogen is three times as strong as an N-N single bond.

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

The energy cycle below can be used to calculate the enthalpy of dissociation of ethanoic acid, ΔH_{diss} .



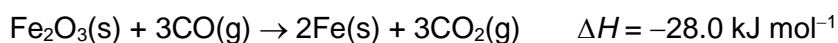
Two experiments were conducted to determine ΔH_{diss} .

In experiment 1, 1.0 g of sodium hydroxide pellets was added to 50 cm³ ethanoic acid (in excess) and the temperature rise was found to be 11.8 °C.

In experiment 2, solid sodium hydroxide was reacted with aqueous nitric acid and the enthalpy change of neutralisation was found to be $-101.3 \text{ kJ mol}^{-1}$.

Using the energy cycle and the results of experiments 1 and 2, calculate a value for ΔH_{diss} .

- | | | | |
|----------|----------------------------|----------|----------------------------|
| A | -2.7 kJ mol^{-1} | B | -0.7 kJ mol^{-1} |
| C | $+0.7 \text{ kJ mol}^{-1}$ | D | $+2.7 \text{ kJ mol}^{-1}$ |
- 10 One of the processes in the production of iron from its ore involves the reduction of iron(III) oxide by carbon monoxide as shown below.



Additional data:

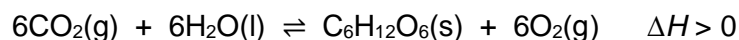
Enthalpy change of formation of iron(III) oxide = -824 kJ mol^{-1}

Enthalpy change of formation of carbon dioxide = -394 kJ mol^{-1}

Calculate a value for the enthalpy change of formation of carbon monoxide.

- | | | | |
|----------|----------------------------|----------|----------------------------|
| A | -330 kJ mol^{-1} | B | -110 kJ mol^{-1} |
| C | $+110 \text{ kJ mol}^{-1}$ | D | $+330 \text{ kJ mol}^{-1}$ |

- 11 For the following system at equilibrium, which change would increase the amount of $\text{C}_6\text{H}_{12}\text{O}_6(\text{s})$?



- A** Increasing the concentration of oxygen
- B** Decreasing the total pressure
- C** Heating the reaction mixture
- D** Removing CO_2
- 12 Which of the following pairs would give a buffer solution when equal volumes of the two solutions are mixed?
- A** $0.1 \text{ mol dm}^{-3} \text{ NaOH}$ and $0.1 \text{ mol dm}^{-3} \text{ CH}_3\text{COOH}$
- B** $0.2 \text{ mol dm}^{-3} \text{ Ba}(\text{OH})_2$ and $0.1 \text{ mol dm}^{-3} \text{ H}_2\text{C}_2\text{O}_4$
- C** $0.05 \text{ mol dm}^{-3} \text{ Ba}(\text{OH})_2$ and $0.2 \text{ mol dm}^{-3} \text{ CH}_3\text{COOH}$
- D** $0.2 \text{ mol dm}^{-3} \text{ NaOH}$ and $0.1 \text{ mol dm}^{-3} \text{ H}_2\text{C}_2\text{O}_4$
- 13 Some data on two acid-base indicators are shown in the table below.

Indicator	Approximate working range	Colour in	
		Acid	Alkali
methyl orange	3.2 – 4.4	red	yellow
bromothymol blue	6.0 – 7.6	yellow	blue

Which of the following conclusions can be drawn about a solution in which methyl orange is yellow and bromothymol blue is yellow?

- A** It is weakly basic.
- B** It is weakly acidic.
- C** It could be a solution of sodium chloride.
- D** It could be a solution of sodium ethanoate.

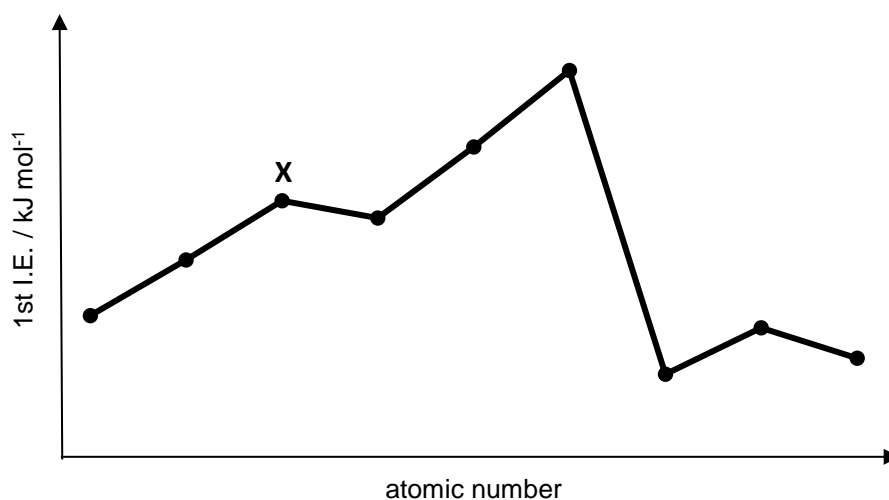
- 14 Values of the ionic product of water, K_w , at various temperatures are tabulated below.

Temperature / °C	K_w / mol ² dm ⁻⁶
10	2.88×10^{-15}
20	6.92×10^{-15}
30	14.5×10^{-15}
40	28.8×10^{-15}

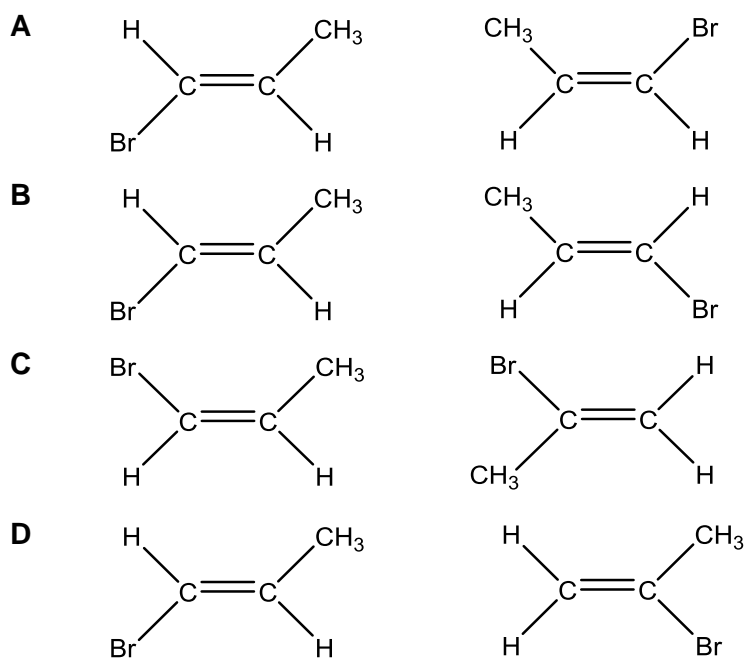
Which of the following statements is **not** correct?

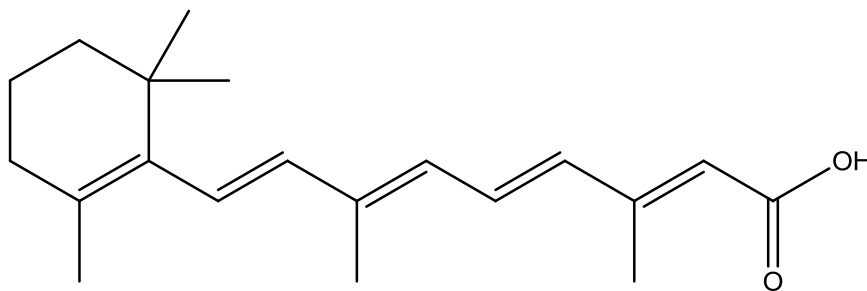
- A** When pure water is heated, the pH of the water decreases.
- B** Water is acidic at 40 °C.
- C** The dissociation of pure water is an endothermic process.
- D** When pure water is heated, the concentration of OH⁻(aq) increases.
- 15 Which of the following sets contains a basic, an acidic and an amphoteric oxide?
- A** Al₂O₃ SiO₂ P₄O₁₀
- B** SiO₂ SO₃ P₄O₁₀
- C** MgO P₄O₁₀ SO₃
- D** Na₂O Al₂O₃ SO₃
- 16 Which statement regarding the chlorides MgCl₂, SiCl₄ and PCl₃ is correct?
- A** All three chlorides hydrolyse completely in water to give acidic solutions.
- B** The oxidation states of chlorine in the three chlorides are -2, -4 and -3 respectively.
- C** All three chlorides are able to conduct electricity in the liquid state.
- D** SiCl₄ and PCl₃ are the only chlorides which exist as discrete molecules.

- 17 The first ionisation energies of nine consecutive elements which have atomic numbers less than 20 are shown in the graph below. What is the valence electronic configuration of element X?



- A $ns^2 np^2$ B $ns^2 np^3$
 C $ns^2 np^4$ D $ns^2 np^5$
- 18 Which of the following pairs of compounds are cis-trans isomers?





A	5	B	6
C	10	D	12

A
OC(=O)c1ccc(cc1)C(=O)O

B
OC(=O)c1ccc(cc1)C(=O)O

C
[O-]C(=O)c1ccc(cc1)C(=O)O

D
[O-]C(=O)c1ccc(cc1)C(=O)[O-]

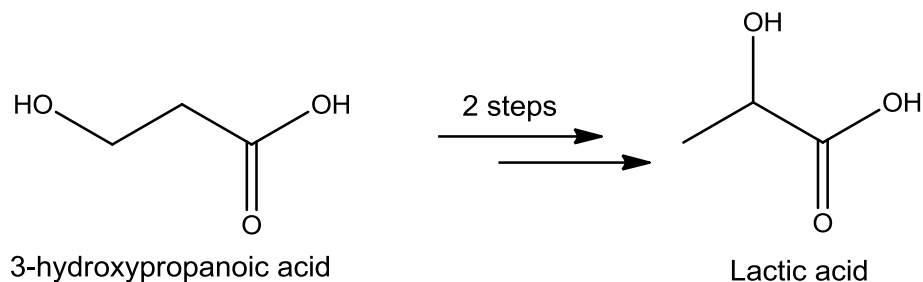
A Fluorine is much more electronegative than carbon.

B The F^- ion is the most stable halide ion.

C The C–F bond is the most polar carbon–halogen bond.

D The C–F bond is the strongest carbon–halogen bond.

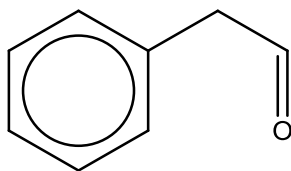
- 22** Lactic acid is often used as a chemical exfoliant for acne-prone skin. It can be produced from 3-hydroxypropanoic acid in two steps.



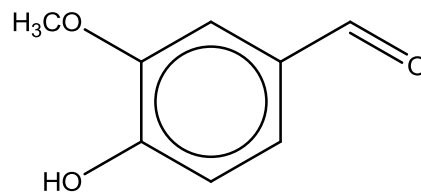
Which of the following is the correct set of reagents and conditions for the two steps?

	Step 1	Step 2
A	excess concentrated sulfuric acid, 170 °C	cold, concentrated sulfuric acid, followed by water, heat
B	cold, concentrated sulfuric acid	excess concentrated sulfuric acid, 170 °C, followed by water
C	hot, ethanolic NaOH	aqueous NaOH, heat
D	aqueous NaOH, heat	hot, ethanolic NaOH

- 23** Phenylacetaldehyde and vanillin are organic compounds found in chocolates and vanilla respectively.
[You may assume $\text{CH}_3\text{O}-$ and $-\text{OH}$ groups to be inert.]



phenylacetaldehyde



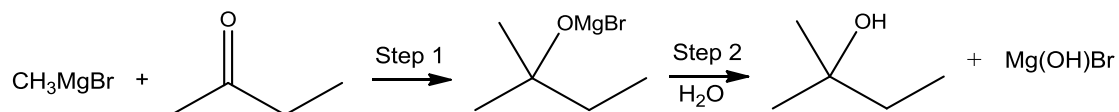
vanillin

Which of the following could distinguish phenylacetaldehyde from vanillin?

- | | | | |
|----------|---|----------|------------------------------|
| A | hot, acidified potassium dichromate(VI) | B | alkaline copper(II) tartrate |
| C | hot, alkaline potassium manganate(VII) | D | diammine silver(I) ions |

- 24** Magnesium forms an important group of covalent compounds which are known as Grignard reagents. One example of a Grignard reagent is CH_3MgBr .

A typical example of the use of a Grignard reagent is the two-step reaction of CH_3MgBr with butan-2-one as shown below.



Which type of reaction occurs in Step 2?

- | | | | |
|----------|------------|----------|---------------------------|
| A | Acid-base | B | Nucleophilic addition |
| C | Hydrolysis | D | Nucleophilic substitution |
- 25** How many esters are possible with the molecular formula $\text{C}_5\text{H}_{10}\text{O}_2$, excluding stereoisomers?
- | | | | | | | | |
|----------|---|----------|---|----------|---|----------|----|
| A | 7 | B | 8 | C | 9 | D | 10 |
|----------|---|----------|---|----------|---|----------|----|

Section B

For each of the following questions, 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).

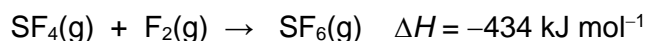
The responses **A** to **D** should be selected on the basis of

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 Use of the Data Booklet is relevant to this question.

Consider the following reaction.



Which of the following statements are correct?

- 1** $\text{F}_2(\text{g})$ acts as an oxidising agent.
- 2** The average value of the S–F bond energy is 296 kJ mol^{-1} .
- 3** SF_4 has a see-saw shape.

27 The conversion of graphite into diamond is an endothermic reaction ($\Delta H = +3.0 \text{ kJ mol}^{-1}$).

Which of the following statements are correct?

- 1** Diamond has a more exothermic enthalpy of combustion than graphite.
- 2** Graphite takes in more energy to form one mole of gaseous atoms than diamond.
- 3** The enthalpy change of formation of graphite is -3.0 kJ mol^{-1} .

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

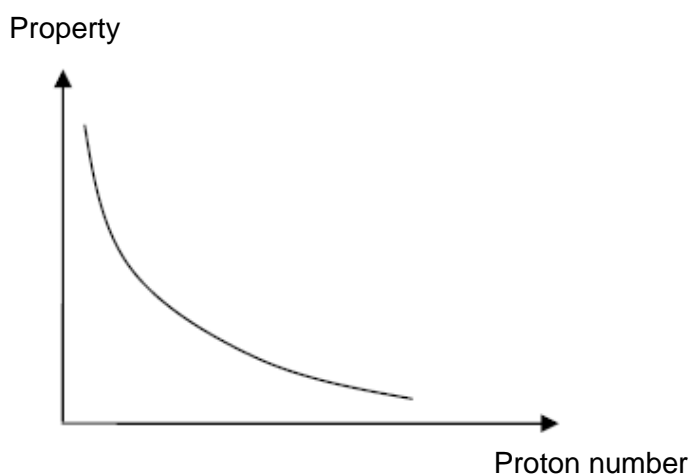
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

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

28 Which statements about a catalysed reversible reaction are correct?

- 1** The catalyst increases the rate constants for both the forward and reverse reactions.
- 2** The catalyst decreases the activation energies for both the forward and reverse reactions.
- 3** The catalyst alters the composition of the equilibrium mixture.

29 The graph shows how a property of some elements varies with proton number.



Which of the following can be the property that shows the above trend?

- 1** boiling point of the Group VII elements
- 2** melting point of Group I elements
- 3** atomic radius of the Period 2 elements

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

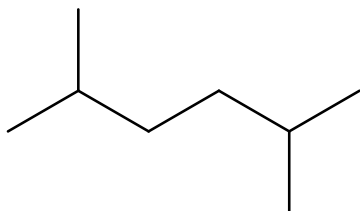
No other combination of statements is used as a correct response.

- 30** Which of the following alkanes react with bromine to form three types of mono-brominated products, excluding stereoisomers?

1



2



3

