



**JURONG JUNIOR COLLEGE**  
**2016 JC 2 PRELIMINARY EXAMINATION**  
**Higher 2**

CANDIDATE  
NAME

CLASS

**16S**

EXAM INDEX  
NUMBER

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**CHEMISTRY**

**9647/01**

Paper 1 Multiple Choice

**16 September 2016**

**1 hour**

Candidates answer on separate paper.

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, highlighters, glue or correction fluid.

Write your name, class and exam index number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** or **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.

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

Which particle would, on losing an electron, have a configuration that corresponds to the ground state of an element in Group V?

- A**  $\text{Cl}^+$                       **B**  $\text{Si}^-$                       **C**  $\text{N}$                       **D**  $\text{C}^+$

- 2 In the following, the species in each pair contain the same number of electrons and the same number of neutrons.

Identify the pair of species that does **not** fit the above description.

- |          |                      |                 |
|----------|----------------------|-----------------|
| <b>A</b> | $\text{HF}$          | $\text{F}^-$    |
| <b>B</b> | $\text{H}_2\text{O}$ | $\text{OH}^-$   |
| <b>C</b> | $\text{NH}_3$        | $\text{NH}_4^+$ |
| <b>D</b> | $\text{CH}_4$        | $\text{CH}_3^+$ |

- 3 Four substances have the physical properties shown.

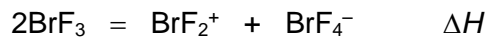
Which substance could be aluminium chloride?

	melting point / °C	electrical conductivity of solid	electrical conductivity of molten substance	electrical conductivity of aqueous solution
<b>A</b>	– 98	poor	poor	poor
<b>B</b>	190	poor	poor	good
<b>C</b>	660	good	good	insoluble
<b>D</b>	800	poor	good	good

- 4 In which of the following pairs does the second compound have a higher boiling point than the first?

- |          |                                   |                                   |
|----------|-----------------------------------|-----------------------------------|
| <b>A</b> | $\text{NaF}$                      | $\text{NaI}$                      |
| <b>B</b> | $\text{CaO}$                      | $\text{Na}_2\text{O}$             |
| <b>C</b> | $\text{CH}_3\text{OH}$            | $\text{CH}_3\text{OK}$            |
| <b>D</b> | $\text{CH}_3\text{CH}_2\text{OH}$ | $\text{CH}_3\text{CH}_2\text{SH}$ |

- 5 The interhalogen compound  $\text{BrF}_3$  is a volatile liquid which autoionises.



The electrical conductivity of  $\text{BrF}_3$  decreases with increasing temperature.

Which combination correctly represents the sign of  $\Delta H$  and the shape around bromine in  $\text{BrF}_4^-$ ?

	$\Delta H$	$\text{BrF}_4^-$
A	+	tetrahedral
B	–	tetrahedral
C	–	square planar
D	+	square planar

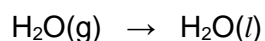
- 6 A quantity of ethanol was burned underneath a copper can containing 400 g of water at  $30^\circ\text{C}$ . The temperature of the water rose to  $85^\circ\text{C}$  after the complete combustion of 5 g of ethanol ( $M_r = 46$ ).

The efficiency of heat transfer to the water will not be 100% after taking into considerations the heat capacity of the copper can.

Given that the specific heat capacity of water is  $4.2 \text{ J g}^{-1} \text{ K}^{-1}$  and the enthalpy change of combustion of ethanol is  $-1367 \text{ kJ mol}^{-1}$ , what is the efficiency of heat transfer to the water?

- A 7.4%                      B 62%                      C 63%                      D 96%

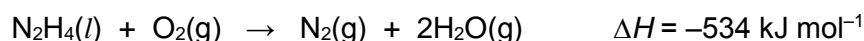
- 7 Clouds and rain form when air saturated with water vapour cools.



What are the correct signs of  $\Delta H$  and  $\Delta S$  for this reaction?

	$\Delta H$	$\Delta S$
A	–	–
B	+	+
C	–	+
D	+	–

- 8 Hydrazine,  $\text{N}_2\text{H}_4$ , is used as a rocket fuel because it reacts with oxygen as shown, producing 'environmentally friendly' gases.



Despite its use as a rocket fuel, hydrazine does not burn readily in oxygen.

Which statement explains why hydrazine does **not** burn readily?

- A The activation energy is too high.
- B Hydrazine is a liquid.
- C The N%N bond is very strong.
- D  $\Delta G$  of the reaction is negative.

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

During electrolysis under suitable conditions, 1.18 g of chromium is deposited on the cathode when 4370 C of electricity is passed into a chromium-containing electrolyte.

Which of the following could have been the electrolyte?

- A  $\text{CrCl}_2$
- B  $\text{CrCl}_3$
- C  $\text{K}_2\text{CrO}_3$
- D  $\text{K}_2\text{Cr}_2\text{O}_7$

- 10 A sample of hydrogen iodide gas is maintained at a constant temperature of 600 K. A dynamic equilibrium is established with hydrogen, iodine and hydrogen iodide all present.

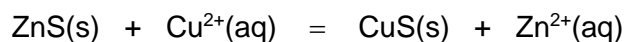
Which statement describes this situation?

- A The amount of hydrogen iodide present is constantly changing at equilibrium.
- B Half of the original amount of hydrogen iodide is present at equilibrium.
- C At equilibrium, hydrogen iodide is being formed at the same rate as it decomposes.
- D The amount of hydrogen iodide present at equilibrium is affected by the pressure.

- 11 Metal sulfides are generally insoluble and some relevant  $K_{sp}$  values are given in the table.

Salt	Colour	$K_{sp} / \text{mol}^2\text{dm}^{-6}$
CuS	black	$6.3 \times 10^{-36}$
ZnS	white	$1.6 \times 10^{-24}$

When aqueous copper sulfate is added to white solid of ZnS, black precipitate of CuS is observed according to the following reaction.



What is the equilibrium constant for the reaction above?

- A  $1.0 \times 10^{-59}$   
 B  $3.9 \times 10^{-12}$   
 C  $5.0 \times 10^5$   
 D  $2.5 \times 10^{11}$
- 12 A solution was made by mixing 0.040 mol of lactic acid and 0.030 mol of sodium hydroxide. Water was added until the volume of the solution was  $2 \text{ dm}^3$ .

What is the pH of the solution?

[Lactic acid is a monobasic acid with  $K_a = 8.4 \times 10^{-4} \text{ mol dm}^{-3}$ ]

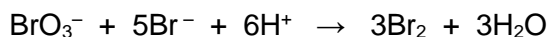
- A 2.6                      B 2.7                      C 3.0                      D 3.6
- 13 A piece of magnesium ribbon was added to  $25 \text{ cm}^3$  of dilute hydrochloric acid. The magnesium was completely dissolved and the total volume of hydrogen gas evolved was measured.

In a second experiment an identical piece of magnesium ribbon was used. This was added to another  $50 \text{ cm}^3$  of the same dilute 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 that of the first experiment?

	initial rate of reaction	total volume of hydrogen evolved
A	increase	increase
B	increase	no change
C	no change	increase
D	no change	no change

14 In acid solution  $\text{BrO}_3^-$  ions will slowly oxidise  $\text{Br}^-$  ions to  $\text{Br}_2$ .



The variation for the initial rate of reaction with the concentrations of the reactants was investigated in two experiments.

experiment	initial $[\text{BrO}_3^-]$ /mol dm <sup>-3</sup>	initial $[\text{Br}^-]$ /mol dm <sup>-3</sup>	initial $[\text{H}^+]$ /mol dm <sup>-3</sup>	initial rate /mol dm <sup>-3</sup> min <sup>-1</sup>
1	0.10	0.15	0.08	3.5
2	0.20	0.30	<b>y</b>	3.5

The rate equation for this reaction is

$$\text{Rate} = k[\text{BrO}_3^-][\text{Br}^-][\text{H}^+]^m$$

where  $k$  is the rate constant with units of mol<sup>-3</sup> dm<sup>9</sup> min<sup>-1</sup>.

What is the value of **y** in experiment 2?

- A** 0.02                      **B** 0.04                      **C** 0.16                      **D** 0.32

5

C

17

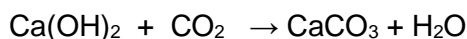
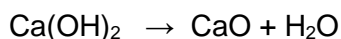
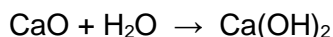
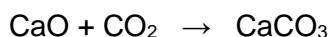
Lime mortar is made from quicklime, water and sand. Over a period of time, lime mortar changes into a much harder form. Both fresh and old lime mortar react with aqueous hydrochloric acid but only the old lime mortar effervesces during the reaction.

**A** Transition metals have higher electrical conductivity than aluminium.

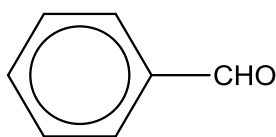
Which equation describes the change from fresh to old lime mortar?

**C** Transition metals have higher melting point than calcium.

**D** Transition metals ions are usually coloured.



- 21 Benzaldehyde is the simplest aromatic aldehyde and one of the most industrially useful.



Benzaldehyde

is true about the electrophilic reaction of benzaldehyde?

$AlCl_3(aq)$  can be used as a catalyst in its reaction with  $Cl_2$ .

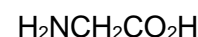
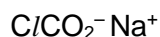
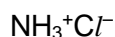
It reacts with concentrated  $HNO_3$  in the presence of concentrated  $H_2SO_4$  at  $30^\circ C$ .

A halogen carrier,  $FeCl_3$ , can be used as a catalyst in its reaction with  $Br_2$ .

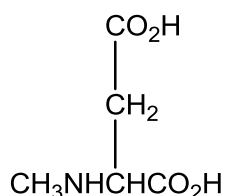
It is more reactive towards  $Br_2$  than alkene as it has delocalised electrons and is more electron-rich.

22

23



- 252 *N*-Methyl-D-aspartic acid is a neuroprotective agent which is used in the treatment of strokes, trauma and epilepsy. Its structure is shown below.



Which of the following statements is correct?

- A It exists as an anion at pH 7. exists as an anion at pH 7.
- B It reacts with phenol to form an ester.
- C It cannot form intramolecular hydrogen bonding.
- D One mole of *N*-Methyl-D-aspartic acid reacts with Na metal to give two moles of  $H_2$  gas.

- 3 Amides and esters both undergo hydrolysis, however esters are more reactive towards hydrolysis compared to amides.

When comparing  $CH_3COOCH_3$  and  $CH_3CONHCH_3$ , which factor best contributes to this difference in ease of hydrolysis?

- A** A lone pair of electrons on the nitrogen in  $\text{-NHCH}_3$ , is more readily delocalised into the  $\text{>C=O}$  group than is the corresponding pair on the oxygen,  $\text{-OCH}_3$
- B** The nitrogen atom in  $\text{CH}_3\text{CONHCH}_3$  is less electronegative than the  $\text{-OCH}_3$  group in  $\text{CH}_3\text{CO}_2\text{CH}_3$ .
- C** There is greater positive charge on the carbon atom in the  $\text{>C=O}$  group in  $\text{CH}_3\text{CONHCH}_3$ .
- D**  $\text{CH}_3\text{COOCH}_3$  has a lower energy content than  $\text{CH}_3\text{CONHCH}_3$ .

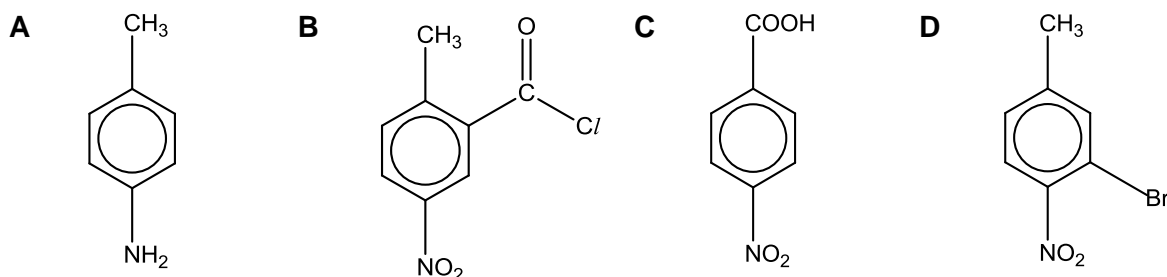
28

silver

- 5** Non covalent chlorides like  $\text{SiCl}_4$  and  $\text{PCl}_5$  undergo hydrolysis to give an acidic solution. Which of the following chlorides is **not** expected to undergo hydrolysis?

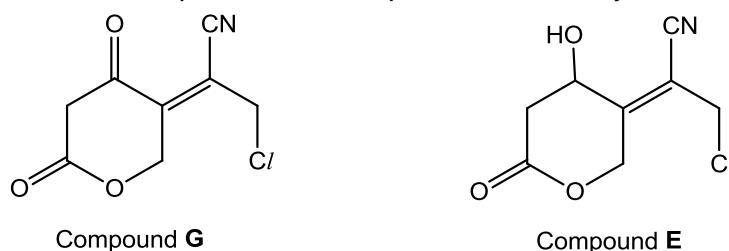
**A**  $\text{CCl}_4$                       **B**  $\text{GeCl}_4$                       **C**  $\text{AsCl}_3$                       **D**  $\text{SbCl}_3$

- 6** Which compound **cannot** be prepared directly from 4-nitromethylbenzene?

n  
7

- Which reagent will convert compound **G** to compound **E** efficiently.

ies



**A**  $\text{H}_2/\text{Ni}$                       **B**  $\text{H}_2\text{O}/\text{H}^+$                       **C**  $\text{NaBH}_4$                       **D**  $\text{LiAlH}_4$

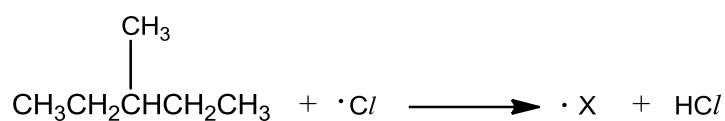
- 8** A sodium halide was reacted with phosphoric acid which evolves thick white fumes. The white fumes was then passed through  $\text{AgNO}_3(\text{aq})$  which gives a precipitate insoluble in concentrated  $\text{NH}_3$ .

What is the role of phosphoric acid in the reaction and the identity of the sodium halide?

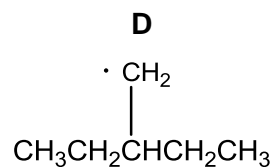
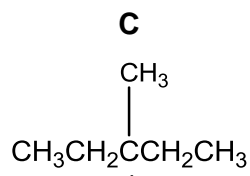
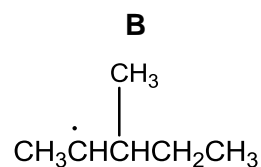
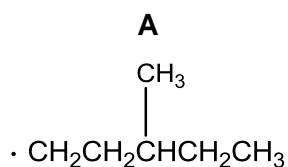
	Role of phosphoric acid	Identity of sodium halide
<b>A</b>	Acid	Sodium bromide
<b>B</b>	Acid	Sodium iodide
<b>C</b>	Oxidising agent	Sodium bromide
<b>D</b>	Oxidising agent	Sodium iodide



- 9 When heated with bromine, the hydrocarbon 3-methylpropane undergoes free radical substitution. In a propagation step, the free radical  $X\cdot$  is formed by the loss of one hydrogen atom.

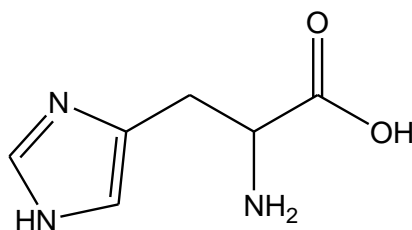


Which  $X\cdot$  formed is the most stable?



- 10** Histidine, an essential amino acid, is present in many proteins and enzymes and plays a vital role in the structure and oxygen-binding function of haemoglobin.

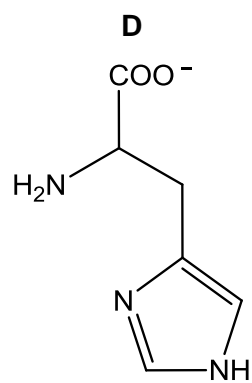
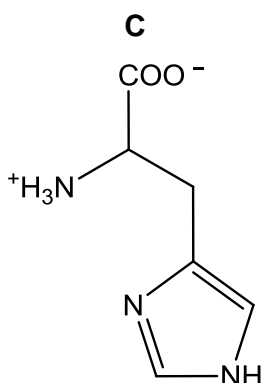
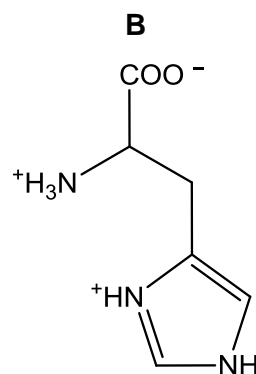
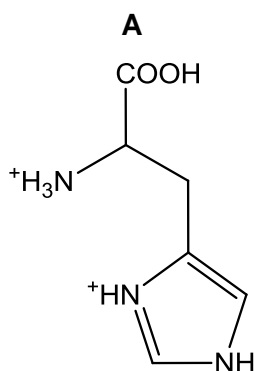
Similar to Q2  
Remove Q2



histidine

Histidine has pKa values of 1.8, 6.0 and 9.2.

What is the structure of the major species in a solution of histidine at pH 7?



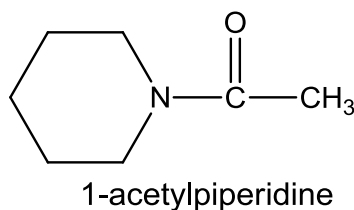
- 11** 1-bromopropane is converted to 2-bromopropane by a two-step process involving the intermediate **T**.



What could be the reagent for step 1 and for step 2 to get the highest yield of 2-bromopropane?

	step 1	step 2
<b>A</b>	Concentrated $\text{H}_2\text{SO}_4$ , heat	$\text{SOBr}_2$ , heat
<b>B</b>	$\text{NaOH(aq)}$ , heat	$\text{HBr(aq)}$
<b>C</b>	$\text{NaOH}$ in ethanol, heat	$\text{HBr(g)}$
<b>D</b>	$\text{NaCN}$ in ethanol, heat	$\text{PBr}_3$ , heat

**302** The structure of 1-acetylpiperidine is shown below.



Which pair of compounds would produce 1-acetylpiperidine when reacted together?

- A** +  $\text{CH}_3\text{COOH}$
- B** +  $\text{CH}_3\text{COCl}$
- C** +  $\text{CH}_3\text{OH}$
- D** +  $\text{CH}_3\text{OH}$

**13** A student added aqueous lead(II) nitrate into test tubes containing compounds **W**, **X**, **Y** and **Z** and obtained the following observations.

Compound	Observation
<b>W</b>	White precipitate formed immediately
<b>X</b>	White precipitate formed after 5 minutes
<b>Y</b>	White precipitate formed after 10 minutes
<b>Z</b>	No precipitate formed

What could be the identity of Compounds **W**, **X**, **Y** and **Z**?

	<b>W</b>	<b>X</b>	<b>Y</b>	<b>Z</b>
<b>A</b>	$\text{CH}_3\text{COCl}$	$\text{CH}_3\text{CH}_2\text{Cl}$	$\text{CH}_3\text{CH}_2\text{Br}$	$\text{C}_6\text{H}_5\text{Br}$
<b>B</b>	$\text{CH}_3\text{COCl}$	$\text{CH}_3\text{CH}_2\text{Br}$	$\text{CH}_3\text{CH}_2\text{Cl}$	$\text{C}_6\text{H}_5\text{Br}$

<b>C</b>	$\text{CH}_3\text{CH}_2\text{Br}$	$\text{CH}_3\text{COC}l$	$\text{C}_6\text{H}_5\text{Br}$	$\text{CH}_3\text{CH}_2\text{C}l$
<b>D</b>	$\text{CH}_3\text{CH}_2\text{Br}$	$\text{C}_6\text{H}_5\text{Br}$	$\text{CH}_3\text{COC}l$	$\text{CH}_3\text{CH}_2\text{C}l$

## 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.

**31** Consider the reaction below:



Which statements correctly describe the process?

- 1** The bond angle in  $\text{NO}_2^-$  ion is larger than that in  $\text{H}_2\text{O}$ .
- 2** This is a disproportionation reaction.
- 3**  $\text{H}^+(\text{aq})$  is oxidised by  $\text{NO}_2^-(\text{aq})$ .

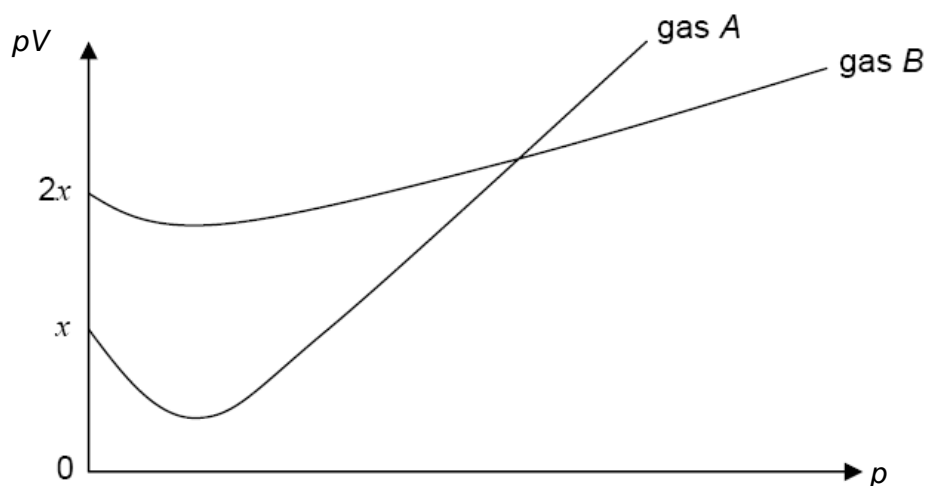
**32** The boiling points of six consecutive elements, lettered **T** to **Y**, are given in the table below. (Note: these letters are **not** the atomic symbols of the elements concerned.)

<b>Element</b>	<b>T</b>	<b>U</b>	<b>V</b>	<b>W</b>	<b>X</b>	<b>Y</b>
<b>Atomic Number</b>	$z$	$z + 1$	$z + 2$	$z + 3$	$z + 4$	$z + 5$
<b>Boiling Point / K</b>	73	93	83	23	1163	1373

Which of the following statements are true?

- 1** Only **X** and **Y** have giant structures.
- 2** The atomic radius of **W** is smaller than that of **X**.
- 3** First ionisation energy of **T** is higher than that of **U**.

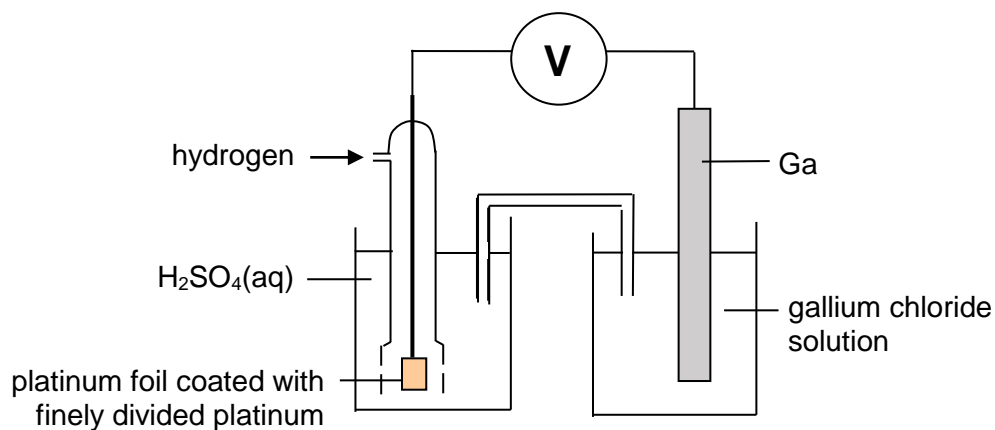
- 33 The value of  $pV$  is plotted against  $p$  for 2 gases, **A** and **B**, where  $p$  is the pressure and  $V$  is the volume of the gas.



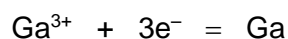
Which of the following could be the identities of the gases?

	gas A	gas B
1	0.5 mol of $\text{CH}_4$ at $25^\circ\text{C}$	0.5 mol of $\text{CH}_4$ at $50^\circ\text{C}$
2	0.5 mol of $\text{NH}_3$ at $25^\circ\text{C}$	1.0 mol of $\text{CH}_4$ at $25^\circ\text{C}$
3	0.5 mol of $\text{NH}_3$ at $25^\circ\text{C}$	0.5 mol of $\text{NH}_3$ at $323^\circ\text{C}$

- 34 The diagram shows apparatus that can be used to measure the  $E$  of a half-cell.



Which factors are essential for an accurate measurement of  $E$  for the following electrode system?



- 1 The  $\text{H}_2\text{SO}_4(\text{aq})$  should be at a concentration of  $0.5 \text{ mol dm}^{-3}$ .
- 2 The  $\text{Ga}^{3+}(\text{aq})$  and  $\text{Cl}^-(\text{aq})$  should **each** be at a concentration of  $1.0 \text{ mol dm}^{-3}$ .
- 3 The hydrogen should be dry.

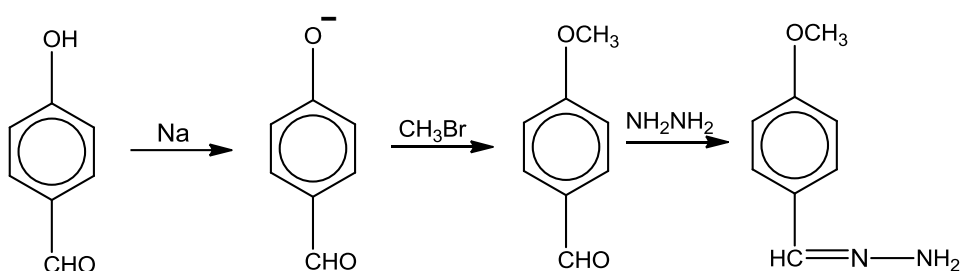
The responses **A** to **D** should be selected on the basis of

<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.

5

statements are.  
361 Consider the following reaction scheme.

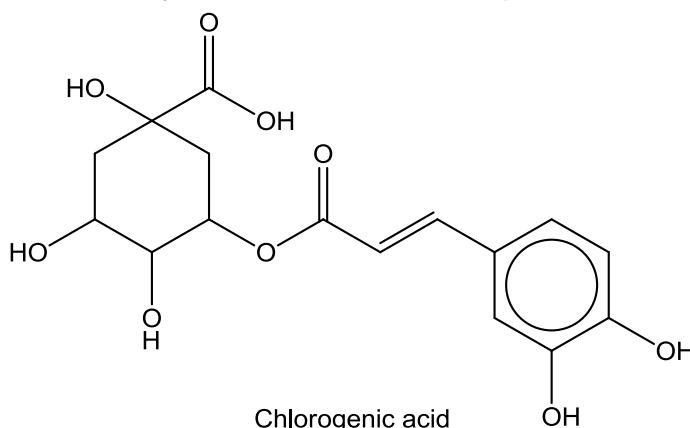


Which of the following type of reactions is involved in the reaction scheme.

S

- 1 Acid base reaction
- 2 **Condensation**
- 3 **Nucleophilic substitution**

32 Chlorogenic acid occurs naturally in coffee and an edible species of bamboo.



Which reaction will ajulmeic acid undergo?

- 1 It reacts with 4 mol of NaOH(aq) when heated with NaOH(aq).
- 2 It reacts with Br<sub>2</sub>(aq) to incorporate up to 5 atoms of bromine in each molecule.
- 3 It will turn a heated acidified solution of potassium dichromate (VI) from orange to green.

- 373** Chlorofluorocarbons (CFCs) have been widely used in aerosol sprays, refrigerators and in making foamed plastics, but are now known to destroy ozone in the upper atmosphere.

What will **not** destroy ozone, and therefore can be used as a replacement for CFCs?

- 1  $\text{CH}_2\text{FCH}_2\text{F}$
- 2  $\text{CH}_3\text{CH}_2\text{CH}_3$
- 3  $\text{CHBr}_3$

- 34** Which of the following is true about an  $\alpha$ -amino acid?

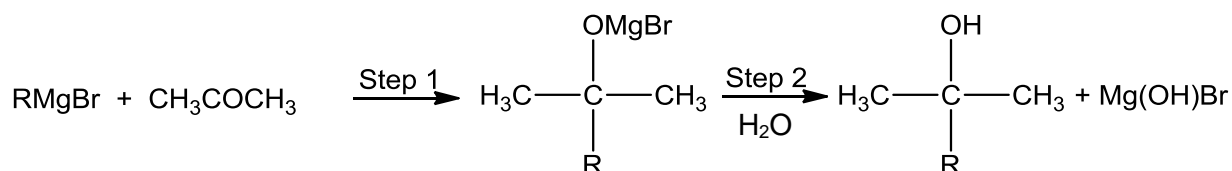
- 1 It is amphoteric.
- 2 It is soluble in water.
- 3 It always exists as a zwitterion at pH 7.

- 385** Which aspect of the protein structure will be affected by strong acids at room temperature?

- 1 Tertiary structure
- 2 Secondary Structure
- 3 Primary Structure

- 40** Most of the chemistry of magnesium relates to its ionic compounds. However, magnesium does form an important group of covalent compounds known as Grignard reagents.

A typical example of the use of a Grignard reagent is the two-step reaction of  $\text{C}_2\text{H}_5\text{MgBr}$  with propanone,  $\text{CH}_3\text{COCH}_3$ , to form 2-methylbutan-2-ol.



Which of the following compounds could be the product of a Grignard reagent reacting with an aldehyde?

- 1  $\text{CH}_3\text{CH(OH)CH}_3$
- 2  $\text{CH}_3\text{CH(CH}_3\text{)CH(OH)CH}_3$
- 3  $\text{CH}_3\text{CH}_2\text{C(OH)(CH}_3\text{)CH}_2\text{CH}_3$



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