



CHEMISTRY

8872/01

Paper 1 Multiple Choice

19th September 2016
50 minutes

Additional materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

1. Enter your NAME (as in NRIC). _____
2. Enter the SUBJECT TITLE. _____
3. Enter the TEST NAME. _____
4. Enter the CLASS. _____

Write your **name**
and **Civics Group**

Write and shade
your **CG number**
followed by
last 3 digits of NRIC

WRITE		SHADE APPROPRIATE BOXES									
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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.

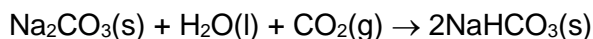
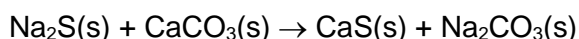
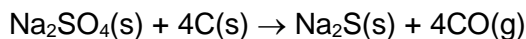
This document consists of **12** printed pages.

Section A

Part 1

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

- 1 Sodium hydrogen carbonate, NaHCO_3 , can be prepared from sodium sulfate by a three-step process.



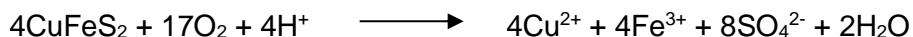
What is the mass of sodium hydrogen carbonate ($M_r = 84.0$), to the nearest kg, that could be formed from 100 kg of the sodium sulfate ($M_r = 142.1$), assuming a 90 % yield in each step?

- A** 43 **B** 86 **C** 106 **D** 118

- 2 When cobalt metal is reacted with a solution containing cobalt(III) ions, only cobalt(II) ions are formed. How many moles of Co and $\text{Co}^{3+}(\text{aq})$ would result in a mixture containing both cobalt(II) and cobalt(III) ions in the mole ratio of 3:1 after the reaction had taken place?

	Moles of Co	Moles of Co^{3+}
A	1	2
B	1	3
C	1	5
D	2	3

- 3 During the bacterial leaching of low grade copper ores, acidified water is sprayed onto the ore chalcopyrite, CuFeS_2 . Bacteria then convert the insoluble ore into a solution according to the equation shown below:

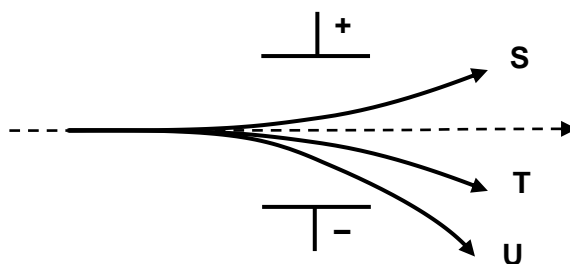


No change occurs in the oxidation state of copper.

What changes in oxidation state occur for the iron and the sulfur in this reaction?

	Change in oxidation state	
	Fe	S
A	+1	+8
B	+1	-8
C	-1	+6
D	-1	-6

- 4 The following are flight paths of charged particles when accelerated in an electric field.



Which of the following correctly identifies **S**, **T** and **U**?

	S	T	U
A	$^{15}\text{O}^+$	$^{14}\text{C}^+$	$^{14}\text{N}^+$
B	$^{15}\text{O}^-$	$^{14}\text{C}^+$	$^{28}\text{Si}^+$
C	$^{14}\text{N}^-$	$^{16}\text{O}^{2+}$	$^{28}\text{Si}^{2+}$
D	$^{14}\text{N}^-$	$^{14}\text{C}^+$	$^{28}\text{Si}^{4+}$

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

Which of the following pairs of species have the same number of unpaired p electrons?

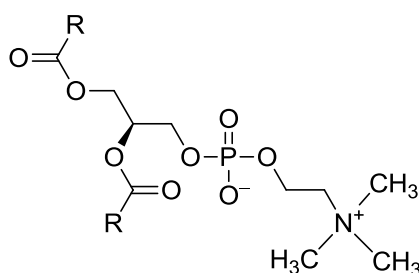
- A** O and Cl^-
B F^+ and Al^+
C Cl^+ and Al^-
D P and Ne^+
- 6 Which of the following processes is endothermic?

- A** freezing of water
B condensation of steam
C auto-ionisation of water
D addition of sodium to water

7 Which reaction represents standard enthalpy change at 298 K?

- A $\text{P}_4(\text{l}) \rightarrow 4\text{P}(\text{g})$
- B $\text{H}_2(\text{g}) + \text{Br}_2(\text{g}) \rightarrow 2\text{HBr}(\text{g})$
- C $\text{HF}(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaF}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
- D $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$

8 Lecithin is used as an emulsifying and stabilising agent in the food, pharmaceutical and cosmetic industries.



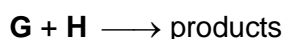
lecithin

where R = long hydrophobic carbon chains

Which of the following statements about lecithin is correct?

- A It can form hydrogen bonds between its own molecules.
 - B It has a low boiling point.
 - C All bond angles around each carbon atom are 109° .
 - D It can form van der Waals' forces with other non-polar molecules.
- 9 Which of the following correctly represents the units of the rate constant, k , for a zero order reaction?
- A s^{-1}
 - B $\text{mol}^{-1} \text{dm}^3 \text{s}^{-1}$
 - C $\text{mol dm}^{-3} \text{s}^{-1}$
 - D $\text{mol dm}^{-3} \text{s}$

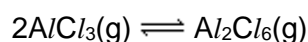
- 10 The following reaction is first order with respect to **G** and zero order with respect to **H**.



If the rate constant doubles for each 10 °C rise in temperature, which of the following sets of conditions will give the greatest initial rate of reaction?

	[G]/mol dm ⁻³	[H]/mol dm ⁻³	Temperature, T / °C
A	0.60	0.60	25
B	0.30	0.10	55
C	0.45	0.45	45
D	0.60	0.90	35

- 11 Consider the following equilibrium system:



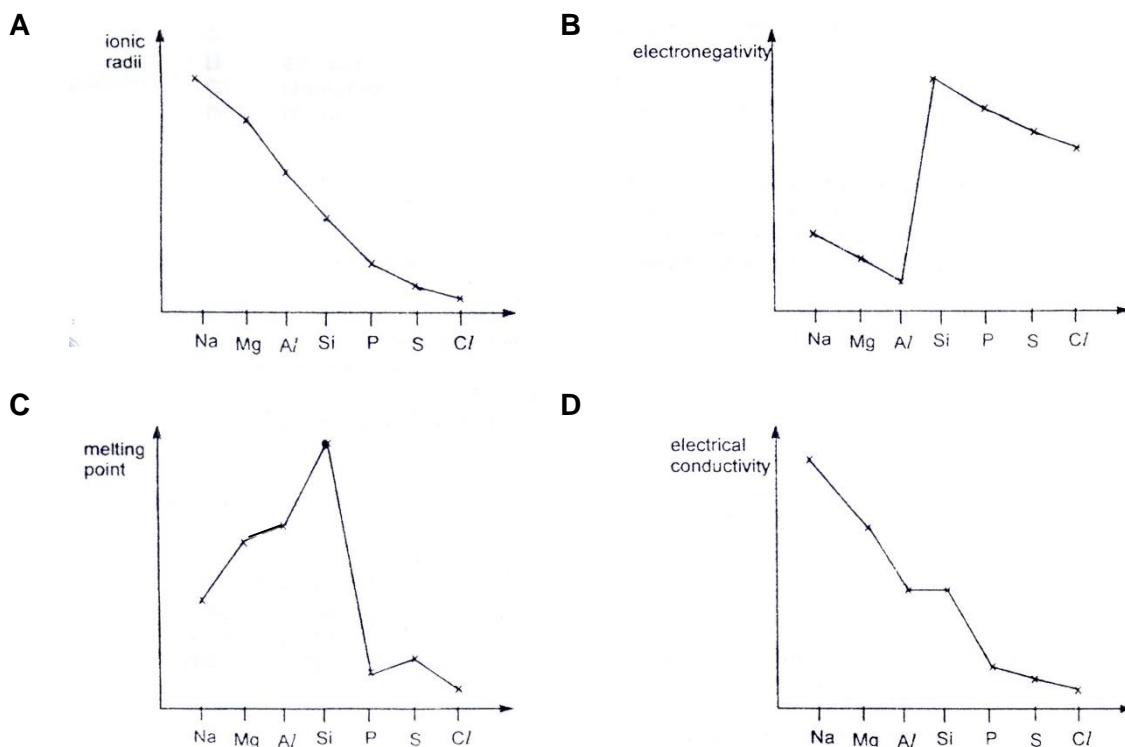
Which of the following statements will cause the position of the above equilibrium to shift to the left?

- A** increasing the temperature
 - B** pumping AlCl_3 gas into the vessel
 - C** decreasing the volume of the vessel
 - D** adding a solid catalyst into the vessel
- 12 Ethanol has a K_a of $3.16 \times 10^{-16} \text{ mol dm}^{-3}$ at room temperature. Sodium ethoxide can be produced by reacting ethanol with sodium metal, and the ethoxide ion has a K_b of 316 mol dm^{-3} . Solution **P** is 0.10 mol dm^{-3} sodium ethoxide.

Which of the following statements is **incorrect**?

- A** Ethanol is a weak acid.
- B** Ethoxide is a strong base.
- C** The pH of Solution **P** is 13.
- D** The type of reaction between ethanol and sodium is acid-base.

- 13 Which of the following graphs shows the correct trend in the physical property of the period 3 elements?



- 14 Which of the following elements has an oxide with a giant structure and a chloride which is readily hydrolysed?

- A sodium
B carbon
C silicon
D phosphorus

- 15 The chloride of an element **Q** of the third period is a liquid which has a boiling point of 76°C and fumes in air.

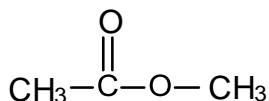
After mixing 0.010 mol of the chloride with water, the resulting solution required 100 cm^3 of 0.30 mol dm^{-3} silver nitrate for complete precipitation of the chloride ion.

To which Group of the Periodic Table does **Q** belong?

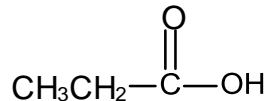
- A I B II C IV D V

- 16 Which of the following shows a general decrease for Period 3 oxides from MgO to P_4O_{10} ?
- A pH of the resulting solution when dissolve in water
 - B maximum oxidation states of the elements in the oxides
 - C electrical conductivity in solid state
 - D boiling point of the oxides

- 17 Compounds **X** and **Y** are isomers with the molecular formula $\text{C}_3\text{H}_6\text{O}_2$.



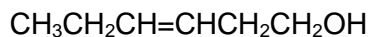
Compound **X**



Compound **Y**

Which reagent can be used to distinguish between **X** and **Y**?

- A sodium metal
 - B 2,4-dinitrophenylhydrazine
 - C aqueous alkaline iodine
 - D aqueous sodium hydroxide
- 18 The compound hex-3-en-1-ol has a strong 'leafy' smell of newly cut grass and is used in perfumery.



hex-3-en-1-ol

What are the organic products when hex-3-en-1-ol is treated with hot acidic $\text{K}_2\text{Cr}_2\text{O}_7$, followed by hydrogen gas in the presence of platinum?

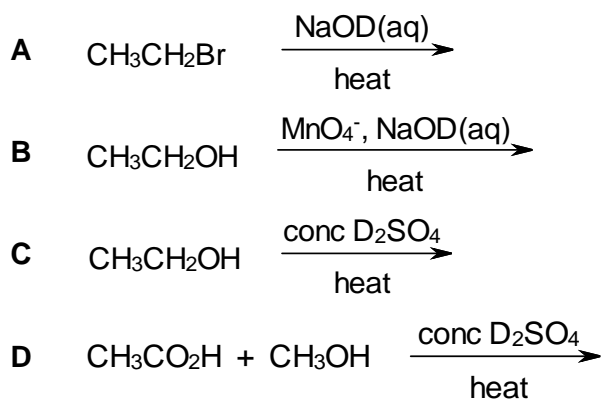
- A $\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}_2\text{OH}$
 - B $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$ and $\text{HO}_2\text{CCH}_2\text{CO}_2\text{H}$
 - C $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH}$
 - D $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
- 19 How many of the structural isomers of dibromopropane will react with aqueous sodium hydroxide to produce a carbonyl compound?

- A 0 B 1 C 2 D 3

- 20 The compound of molecular formula $C_3H_4Br_2$ has structural isomers. How many of these structural isomers contain $C=C$ and how many do not contain $C=C$?

	structural isomers with $C=C$	structural isomers without $C=C$
A	4	0
B	4	2
C	5	0
D	5	2

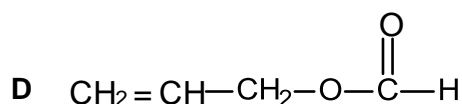
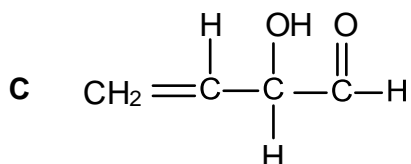
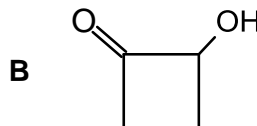
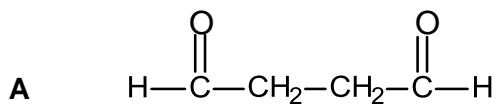
- 21 Which of the follow reaction produces an organic species that contains deuterium atom?



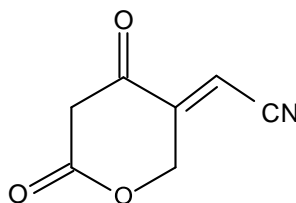
- 22 Compound **W**, $C_4H_6O_2$, undergoes the following reactions.

- It gives a red precipitate with Fehling's solution.
- It gives white fumes with PCl_5 .
- Upon reaction with hydrogen gas and nickel catalyst, $C_4H_{10}O_2$ is obtained.

What is compound **W**?

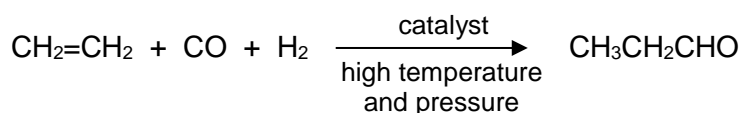


- 23 Which one of the following options correctly show the correct number of σ and π bonds in the following molecule?



	no. of σ bonds	no. of π bonds
A	11	3
B	11	5
C	16	3
D	16	5

- 24 The oxo reaction is an important industrial process in which an alkene combines directly with carbon monoxide and hydrogen under suitable conditions. The reaction with ethene is shown below.



Which of the following structural formulae correctly represents the product of the oxo reaction starting with but-2-ene?

- A** $\text{CH}_3\text{CH}_2\text{CH}(\text{CH}_3)\text{CHO}$
B $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO}$
C $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$
D $(\text{CH}_3)_2\text{CHCH}_2\text{CHO}$
- 25 2-methylpropanoic acid is used as an intermediate in the manufacture of pharmaceuticals and food additives. It may be synthesised in the laboratory from 1-bromopropane through a series of reactions.
- Which set of reagents, used in sequential order, would be the most suitable for this synthesis?
- A** ethanolic KOH, HBr, HCN with trace KCN, dilute HCl
B ethanolic KOH, HBr, ethanolic KCN, dilute H_2SO_4
C aqueous KOH, PCl_5 , ethanolic KCN, dilute HCl
D aqueous KOH, acidified KMnO_4

Part 2

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

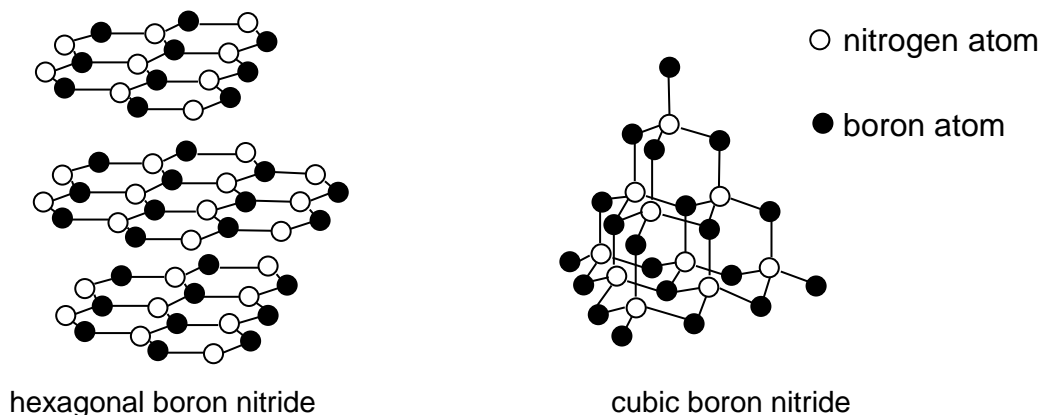
Decide whether each of the statements is or is not correct. (You may find it helpful to put a tick against the statements which you consider to be correct.)

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

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** Boron nitride, BN, exists in two possible forms, hexagonal boron nitride and cubic boron nitride. The structure of hexagonal boron nitride and cubic boron nitride are similar to graphite and diamond respectively.



Which of the following statements are correct?

- 1 There is dative bonding in cubic boron nitride.
- 2 The layers in hexagonal boron nitride are held together by van der Waals' forces.
- 3 The boron-nitrogen bond in cubic boron nitride is shorter than that in hexagonal boron nitride.

- 27** Consider the following equilibrium system:



Which of the following statements are correct?

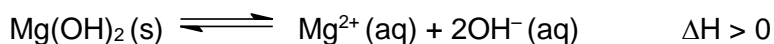
- 1 Adding CO causes the position of equilibrium to shift to the right.
- 2 The equilibrium constant, K_c , for this reaction has no units.
- 3 Adding FeO causes the position of equilibrium to shift to the left.

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.

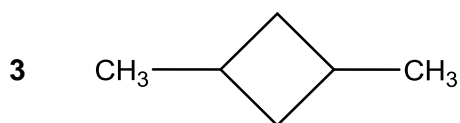
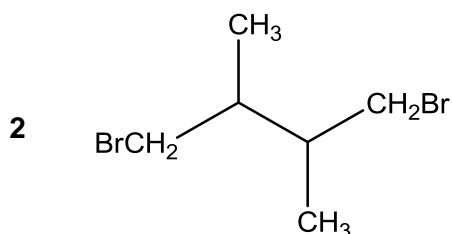
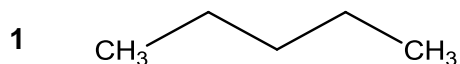
- 28** Solid magnesium hydroxide dissolves sparingly in water as shown:



Which of the following are true as temperature increases?

- 1** The pH of the solution will increase.
 - 2** The system will reach equilibrium in a shorter time.
 - 3** The magnitude of the equilibrium constant will increase.
- 29** A compound **Z**, upon mono-chlorination with chlorine in the presence of UV light, forms 3 possible structural isomers.

Which of the following compounds could be **Z**?

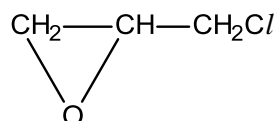


The responses **A** to **D** should be selected on the basis of

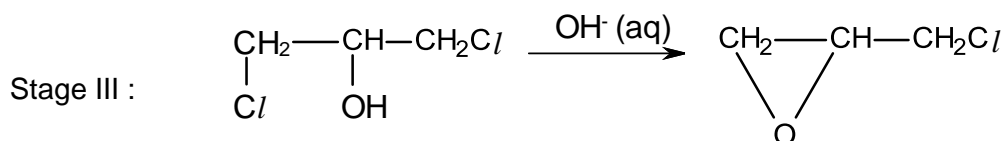
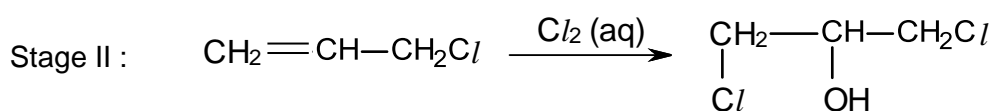
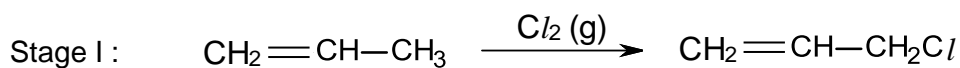
A	B	C	D
1,2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

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

- 30** Epoxy resins are polymers which are used in adhesives. One monomer used in their manufacture has the following structure:



This monomer is manufactured from propene in three stages:



Which statements are correct for the above synthesis?

- 1** Stage I involves free radical substitution.
- 2** Stage II involves electrophilic addition.
- 3** Stage III involves nucleophilic addition.