CANDIDATE'S NAME: ______________________________ CTG: __________________

YISHUN JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATION 2015

CHEMISTRY **8872/01**
HIGHER 1 **27 August 2015**
Paper 1: Multiple-Choice Questions **1400 hrs – 1450 hrs**
50 minutes

Additional materials:

Optical Mark Sheet
Data Booklet

INSTRUCTIONS TO CANDIDATES

<u>Section A & B: Multiple Choice Questions</u>

Write in soft pencil.

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

Write your name and CTG on the Answer Sheet. Shade your NRIC number in the spaces provided in the Optical Mark Sheet.

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.

Section A

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

1 Naturally occurring neon is a mixture of three isotopes, ^{20}Ne, ^{21}Ne and ^{22}Ne. The relative atomic mass of neon is 20.18.

What could be the relative abundance for each of the three isotopes?

A 90.92% ^{20}Ne, 0.26% ^{21}Ne and 8.82% ^{22}Ne
B 91.1% ^{20}Ne, 7.9% ^{21}Ne and 1.0% ^{22}Ne
C 95.0% ^{20}Ne, 3.2% ^{21}Ne and 1.8% ^{22}Ne
D 96.3% ^{20}Ne, 0.3% ^{21}Ne and 3.4% ^{22}Ne

2 Carbon disulfide, CS_2, is a volatile flammable liquid used in the manufacture of cellophane.

Carbon disulfide vapour burns in oxygen according to the following equation.

$$CS_2(g) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$$

A sample of 10 cm^3 of carbon disulfide vapour was burned in 40 cm^3 of excess oxygen. After measuring the volume of gases after burning, the product gases were treated with an excess of aqueous sodium hydroxide and the volume of gases was measured again.

What were the measured volumes?

	Volume of gas after burning / cm^3	**Volume of gas after adding NaOH / cm^3**
A	30	0
B	30	20
C	40	10
D	40	20

3 A disproportionation reaction is a reaction in which an element in a species undergoes both oxidation and reduction simultaneously.

Which of the following is **not** a disproportionation reaction?

A $3ClO^- \rightarrow 2Cl^- + ClO_3^-$
B $2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$
C $H_2O + 2NO_2 \rightarrow HNO_2 + HNO_3$
D $H_2C_2O_4 \rightarrow H_2O + CO + CO_2$

4 The table below contains incomplete information about the three isoelectronic ions **X**, **Y** and **Z**. The atoms of **Y** and **Z** are isotopes.

ion	mass number	atomic number	number of neutrons	number of electrons	charge
X	55	25			***b***
Y	56	26			
Z	***a***		31		+3

What are the possible values of ***a*** and ***b***?

	a	***b***
A	56	+2
B	56	+3
C	57	+2
D	57	+3

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

The successive ionisation energies, in kJ mol^{-1}, of an element **E** are given below.

870 1800 3000 3600 5800 7000 13200

Which of the following could be **E**?

A Sn
B As
C Te
D I

6 The gecko, a small lizard, can climb up a smooth glass window, The gecko has millions of microscopic hairs on its toes and each hair has thousands of pads at its tip. The result is that the molecules in the pads are extremely close to the glass surface on which the gecko is climbing.

What is the attraction between the gecko's toe pad and the glass surface?

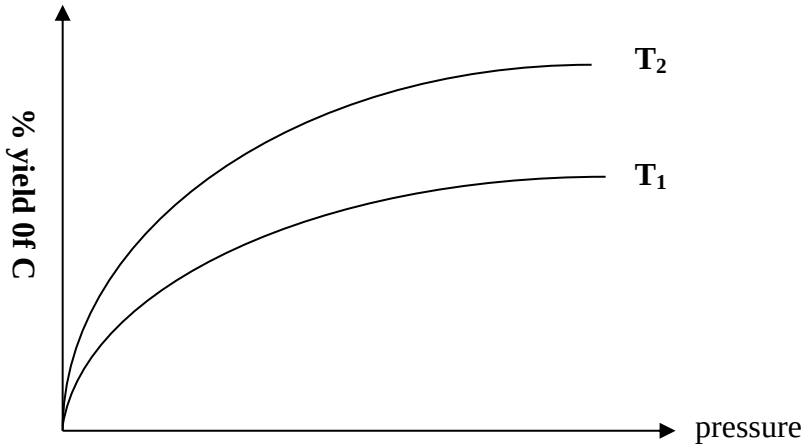
A co-ordinate bonds
B covalent bonds
C ionic bonds
D van der Waals' forces

7 Which type of structure does **not** correspond to its description of physical properties?

	type of structure	physical properties
A	giant molecular	high melting point, conducts electricity when in solution but not when in solid state
B	simple molecular	low melting point, does not conduct in any state
C	metallic	high melting point, conducts electricity when in solid state and molten
D	ionic	high melting point, conducts electricity when molten but not when in solid state

8 The variation of equilibrium yield of product **C** for the following gas-phase reaction with changes in temperature and pressure, is represented in the diagram below.

$$a\mathbf{A}\ (g) + b\ \mathbf{B}\ (g) \rightleftharpoons c\ \mathbf{C}\ (g) \qquad \Delta H = -92.4\ kJ\ mol^{-1}$$



Which of the following options correctly relates the temperatures (T_1 and T_2) and the number of moles of gases (a,b and c).

A	$T_2 < T_1$	$c < a + b$
B	$T_2 < T_1$	$c > a + b$
C	$T_2 > T_1$	$c < a + b$
D	$T_2 > T_1$	$c > a + b$

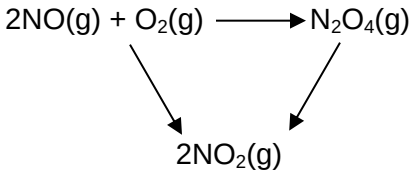
9 For a reversible reaction, what is the effect of a catalyst on the rate constant, k_1 for the forward reaction, the rate constant, k_1' for the reverse reaction, and the equilibrium constant, K_c?

	k_1	k_1'	K_c
A	increases	decreases	no effect
B	decreases	increases	no effect
C	increases	no effect	increases
D	increases	increases	no effect

10 Given the following data and energy cycle:

$N_2O_4(g) \rightarrow 2NO_2(g)$ $\quad \Delta H^{\theta} = +57.9$ kJ mol^{-1}

$NO(g) + \frac{1}{2} O_2(g) \rightarrow NO_2(g)$ $\quad \Delta H^{\theta} = -56.6$ kJ mol^{-1}



Determine the enthalpy change of the following reaction:

$2NO(g) + O_2(g) \rightarrow N_2O_4(g)$

A +114.5 kJ mol^{-1} **B** −114.5 kJ mol^{-1} **C** +171 kJ mol^{-1} **D** −171 kJ mol^{-1}

11 The lattice energies of magnesium fluoride and calcium chloride are − 2955 kJ mol^{-1} and − 2255 kJ mol^{-1}, respectively. Which of the following is likely to be the lattice energy of calcium fluoride?

A − 2030 kJ mol^{-1}
B − 2640 kJ mol^{-1}
C − 3160 kJ mol^{-1}
D − 4080 kJ mol^{-1}

12 The pH of human blood is constant at about 7.40.

Which ion or molecule present in the human body will remove contaminating H^+ (aq) ions from the blood to keep the pH constant?

A CO_3^{2-} **B** HCO_3^- **C** H_2CO_3 **D** PO_4^{3-}

13 The table shows some data regarding two indicators.

Indicator	Approximate pH range	Colour change	
		acid	alkali
bromocresol green	3.8 – 5.5	yellow	blue
phenol red	6.8 – 8.5	yellow	red

What conclusion can be drawn about a solution in which bromocresol green is blue and phenol red is yellow?

A It is weakly acidic.
B It is neutral.
C It is weakly alkaline.
D It is strongly alkaline.

14 Using a colorimeter, the following reaction is studied by finding the time taken for the coloured reactant, **J**, to decolourise. The reaction is catalysed by **Y**.

$$\mathbf{J} + \mathbf{K} \xrightarrow{\mathbf{Y}} \mathbf{L} + \mathbf{M}$$

In this method, the rate of reaction is measured in terms of concentration of **J** per unit time taken for the colour of **J** to disappear

$$\text{i.e. rate of reaction} \propto \frac{\text{concentration of } \mathbf{J} \text{ added}}{\text{time taken for colour of } \mathbf{J} \text{ to disapper}}$$

The following results were obtained.

Experiment	Volume of **J** added / cm^3	Volume of **K** added / cm^3	Volume of **Y** added / cm^3	Volume of H_2O added / cm^3	Time taken for colour of **J** to disappear / s
1	5	5	5	10	40
2	5	20	10	15	10
3	10	20	10	10	20
4	10	20	5	15	40

Using the results from the table above, deduce the rate equation for the reaction.

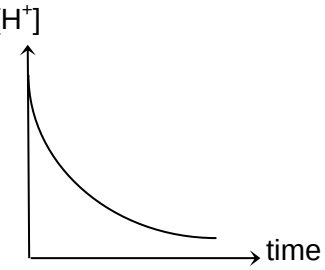
A Rate = k [**J**] [**Y**]
B Rate = k [**K**] [**Y**]
C Rate = k [**J**] [**K**]
D Rate = k [**J**] [**K**] [**Y**]

15 The reaction between acidified H_2O_2 and I^- has the following rate equation:

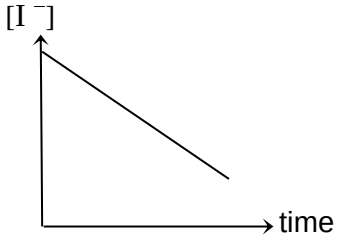
$$\text{Rate} = k\,[H_2O_2]\,[I^-]$$

Which graph would be obtained?

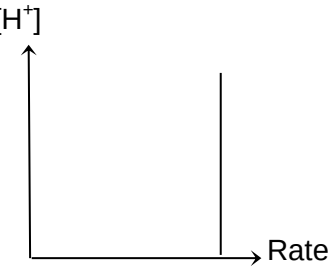
A



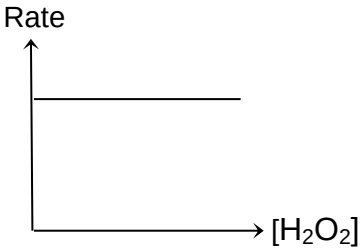
B



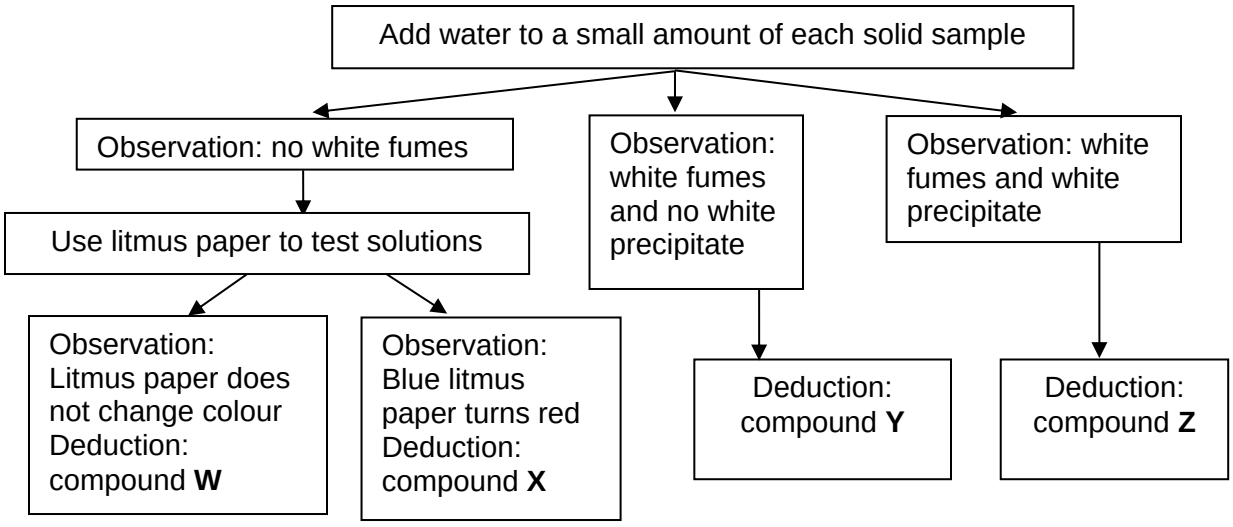
C



D



16 The labels of four bottles containing NaCl, MgCl_2, SiCl_4 and PCl_5 were detached from the bottles. Using the flowchart given below, identify compounds **W**, **X**, **Y** and **Z**.



	W	**X**	**Y**	**Z**
A	NaCl	MgCl_2	SiCl_4	PCl_5
B	MgCl_2	NaCl	SiCl_4	PCl_5
C	MgCl_2	NaCl	PCl_5	SiCl_4
D	NaCl	MgCl_2	PCl_5	SiCl_4

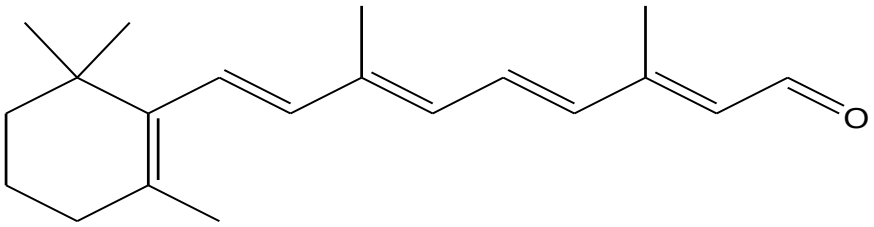
17 An element in Period 3 has the following properties:

- Its first ionisation energy is larger than both the elements before and after it.
- It conducts electricity.
- It does not react with cold water but can react with steam to give effervescence.

Which of the following statements about this element is **not** correct?

A It has a high melting and boiling point.
B Its oxidation state in compounds usually follows the group number it belongs to in the Periodic Table.
C The chloride of the element is mildly acidic when dissolved in water.
D The oxide of the element is acidic when dissolved in water.

18 β–Apo–15–carotenal is a chemical compound found in fruit extracts. How many geometrical isomers does it have?

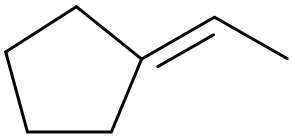


β –Apo –15–carotenal

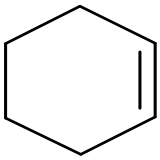
A 4
B 8
C 16
D 64

19 Which hydrocarbon can be distinguished from the other three compounds, on treatment with hot acidified potassium manganate(VII)?

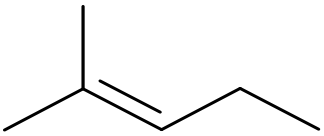
A



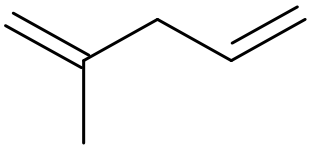
C



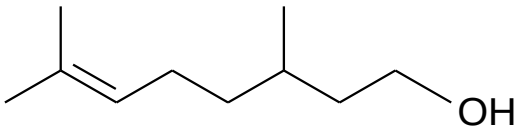
B



D

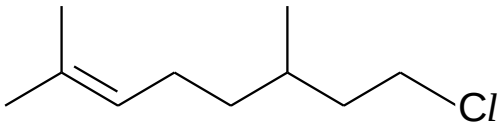
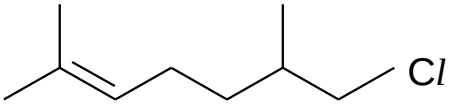
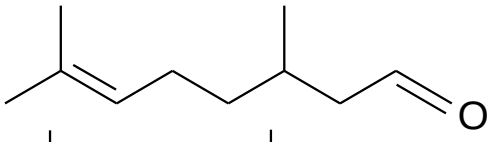
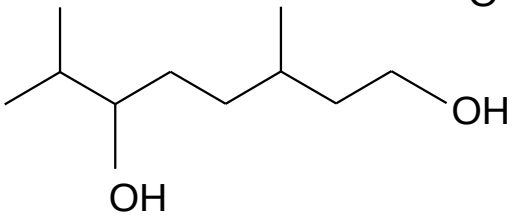


20 Citronellol is a colourless oily liquid with a rose-like smell. It is the active ingredient in over 30 essential oils and is a major component in perfumes, cosmetics and soap. It may be prepared synthetically from compound **S** using reagent **T**.



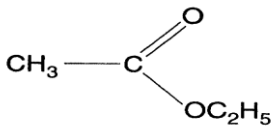
Citronellol

Which of the following could **S** and **T** most likely be?

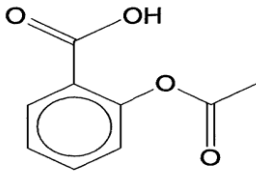
	S	**T**
A		Ethanolic KOH, reflux
B		Aqueous NaOH, heat
C		$NaBH_4$, dry ether
D		Conc H_2SO_4, 170 ^oC

21 Use the table of characteristic values for infra-red absorption in the Data Booklet to answer this question.

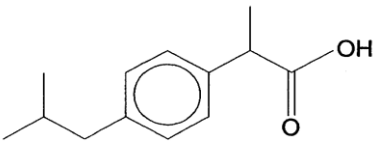
Infra-red absorptions can be used to identify functional groups in organic compounds. For example, ethyl ethanoate shows absorptions at 1000 – 1300 cm^{-1} and 1680 – 1750 cm^{-1}.



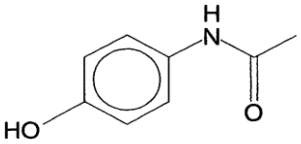
The structures of three compounds which are used as painkillers are shown below.



aspirin



ibuprofen



paracetamol

Which of the following statement is correct?

	Infra-red absorption range shown by aspirin but **not** ibuprofen or paracetamol	Infra-red absorption range shown by paracetamol but **not** ibuprofen or aspirin
A	1000 – 1300 cm^{-1}	2840 – 3095 cm^{-1}
B	2500 – 3300 cm^{-1}	2840 – 3095 cm^{-1}
C	1000 – 1300 cm^{-1}	3230 – 3550 cm^{-1}
D	2500 – 3300 cm^{-1}	3230 – 3550 cm^{-1}

22 Lactic acid was refined for the first time by the Swedish chemist Carl Wilhelm Scheele in 1780 from sour milk. In 1808, it was discovered that lactic acid (actually L-lactate) is produced in muscles during exertion. It can be synthesised using the following process.

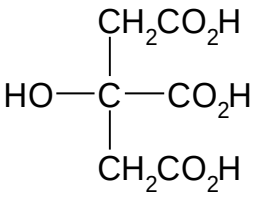
$$CH_3CH_2OH \xrightarrow{\text{step 1}} Q \xrightarrow{\text{step 2}} \text{intermediate} \xrightarrow{\text{dilute HC}l\text{, heat}} CH_3CH(OH)CO_2H$$

Lactic acid

What are the identities of the reagents for steps 1 and 2, and the organic intermediate Q?

	Step 1	Q	Step 2
A	MnO_4^- / H^+	CH_3CHO	NaCN / ethanol
B	$Cr_2O_7^{2-}$ / H^+	CH_3CHO	HCN / KCN
C	Br_2, CCl_4	CH_3CH_2Br	NaCN / ethanol
D	PBr_3	CH_3CH_2Br	HCN / KCN

23 Citric acid, which causes the sharp taste of lemon juice, has the following formula.



citric acid

Which of the following reagent reacts stoichiometrically with 1 mol of citric acid?

A 4 mol of NaOH
B 3 mol of PCl_5
C 1.5 mol of Na_2CO_3(aq)
D 1 mol of acidified $KMnO_4$

24 Which of the following is arranged in order of ***decreasing*** acid strength?

	decreasing acid strength →			
A	$ClCH_2CO_2H$	$BrCH_2CO_2H$	$BrCH_2CH_2CO_2H$	CH_3CH_2OH
B	CH_3CH_2OH	$BrCH_2CO_2H$	$BrCH_2CH_2CO_2H$	$ClCH_2CO_2H$
C	CH_3CH_2OH	$BrCH_2CH_2CO_2H$	$BrCH_2CO_2H$	$ClCH_2CO_2H$
D	$BrCH_2CO_2H$	$ClCH_2CO_2H$	$BrCH_2CH_2CO_2H$	CH_3CH_2OH

25 ^{18}O is an isotope of oxygen.
When propyl ethanoate is hydrolysed with dilute hydrochloric acid in the presence of $H_2{}^{18}O$, a mixture of two products is formed.

Which of the following pairs gives the correct structures of the two products?

A CH_3COOH and $CH_3CH_2CH_2{}^{18}OH$
B $CH_3CO^{18}OH$ and $CH_3CH_2CH_2OH$
C CH_3CH_2COOH and $CH_3CH_2{}^{18}OH$
D $CH_3CH_2CO^{18}OH$ and CH_3CH_2OH

Section B

For each 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:

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 Which particles have the electronic configuration $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$?

1 $_{24}Cr$

2 $_{25}Mn^{+}$

3 $_{26}Fe^{2+}$

27 Which statements about the ammonia molecule and ammonium ion are correct?

1 They are a conjugate acid / base pair.

2 They contain the same number of electrons.

3 They are both soluble in water.

28 Beryllium (Be) possesses similar characteristics as aluminium (A*l*). Which of the following statements are likely to be true?

1 $BeCl_2$ is an ionic compound.

2 $BeCl_2$ can be dimerised due to the availability of empty orbitals in Be to accept lone pairs of electrons.

3 BeO reacts with both acids and bases.

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.

29 A catalytic converter is part of the exhaust system of modern cars.

Which reactions occur in a catalytic converter?

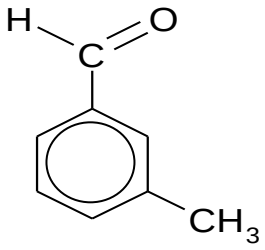
1 $2\ C_xH_y + (4x + y)NO \rightarrow 2x\ CO_2 + y\ H_2O + (2x + y/2)\ N_2$

2 $2\ CO + 2\ NO \rightarrow 2\ CO_2 + N_2$

3 $CO_2 + NO \rightarrow CO + NO_2$

30 Which of the following organic compounds can be oxidised by acidified potassium dichromate(VI) **and** reduced by lithium aluminium hydride?

1



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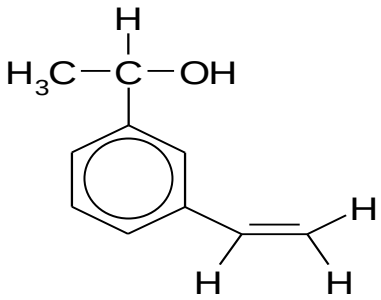

3