CATHOLIC JUNIOR COLLEGE
JC2 PRELIMINARY EXAMINATIONS
Higher 1

CHEMISTRY
Paper 1 Multiple Choice

8872/01
WEDNESDAY 2 SEPTEMBER 2015
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.
Write and/or shade your name, NRIC / FIN number and HT group on the Multiple Choice Answer Sheet provided.

There are **thirty MCQ** 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 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 **9** printed pages and **1** blank page.

[Turn over]

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 element zinc has four stable isotopes.

isotope	Relative abundance / %
^{64}Zn	49.29
^{66}Zn	27.83
^{67}Zn	4.14
^{68}Zn	18.74

Use the relative abundance data to find the relative atomic mass of zinc to 2 decimal places.

A 65.40 **B** 65.42 **C** 65.43 **D** 65.45

2 A liquid organic acid that contains sulfur has the formula $C_xH_yS_zO$. The liquid was completely burnt in 50 cm^3 of oxygen gas in an enclosed vessel. At the end of the reaction, there was a 5 cm^3 reduction in the total volume of gas present.
The carbon dioxide produced occupied twice the volume of the sulfur dioxide produced.
When the mixture of gases was passed through aqueous sodium hydroxide, the volume was reduced by 30 cm^3. Given that all measurements of gases were at room temperature and pressure, what is the possible formula of the organic acid?

A C_2H_4SO **B** $C_2H_4S_2O$ **C** $C_4H_6S_2O$ **D** $C_4H_4S_2O$

3 What are the number of moles of Cr^{3+} and SO_4^{2-} contained in 0.5 dm^3 of 0.2 mol dm^{-3} hydrated chromium(III) sulfate, $Cr_2(SO_4)_3.12H_2O$?

	Cr^{3+}	SO_4^{2-}
A	0.1	0.15
B	0.2	0.3
C	0.3	0.2
D	0.4	0.6

4 Which ion is least deflected in an electric field?

A $^{32}S^{2-}$ **B** $^{39}K^{+}$ **C** $^{24}Mg^{2+}$ **D** $^{31}P^{3-}$

5 *Use of the Data Booklet is relevant to this question.*
Archaeologists used ^{14}C, a radioactive isotope, in carbon dating. Which particle has the same number of neutrons and the same number of electrons as an atom of ^{14}C?

A $^{14}N^{+}$ **B** $^{16}O^{2+}$ **C** $^{17}F^{+}$ **D** ^{28}Si

6 *Use of the Data Booklet is relevant to this question.*
Which of the following has an unpaired electron in a spherically-shaped orbital?

A Na^+ **B** A*l* **C** Sc **D** Cr

7 Disulfur dichloride has the formula S_2Cl_2. What is the likely bond angle at each sulfur atom in the molecule?

A 107^o **B** 109^o **C** 120^o **D** 180^o

8 Which of the following molecules is planar?

A C_3H_6 **B** C_7H_8 **C** Al_2Cl_6 **D** C_6H_5Cl

9 Which equation correctly defines the enthalpy change of formation of carbon monoxide?

A $C(s) + CO_2(g) \rightarrow 2CO(g)$

B $C(s) + O(g) \rightarrow CO(g)$

C $C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g)$

D $C(g) + \frac{1}{2}O_2(g) \rightarrow CO(g)$

10 The following table lists some $\Delta H_f^{\ominus}$ values.

Compound	$\Delta H_f^{\ominus}$ / kJ mol^{-1}
$NO_2(g)$	+33.2
$N_2O_5(g)$	+5.0

The enthalpy change for the dissociation of $N_2O_5(g)$ is given below.

$$N_2O_5(g) \rightarrow NO_2(g) + NO_3(g) \qquad \Delta H^{\ominus} = +92.5 \text{ kJ mol}^{-1}$$

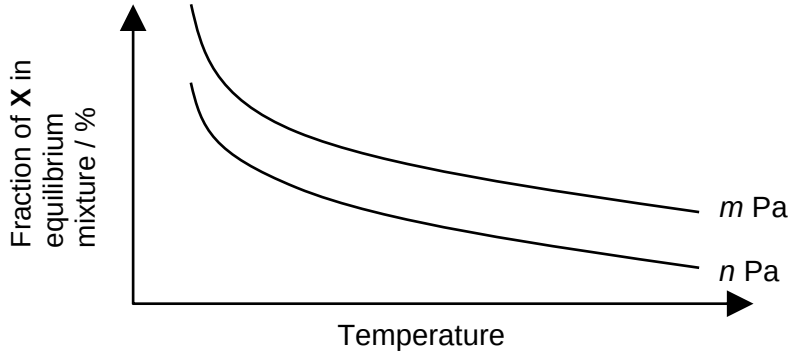
What is the standard enthalpy change of formation of $NO_3(g)$?

A - 130.7 kJ mol^{-1} **C** + 64.3 kJ mol^{-1}

B - 64.3 kJ mol^{-1} **D** + 130.7 kJ mol^{-1}

11 The graph below shows how the fraction of a substance, **X**, represented by one of the following compounds in the equilibrium mixture shown below, varies with temperature at pressures of *m* Pa and *n* Pa.

$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$ $\quad \Delta H = +210$ kJ mol^{-1}



Identify **X** and the correct relative magnitudes of *m* and *n*.

	X	Pressure
A	CH_4	$m > n$
B	H_2	$m > n$
C	CO	$n > m$
D	H_2O	$n > m$

12 The Haber Process is the commercial method used to manufacture ammonia. Which of the following is true of this process?

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\quad \Delta H = -92$ kJ mol^{-1}

A A low temperature of 200 ^oC is used so that the forward exothermic reaction is favoured.

B Finely divided iron catalyst is used to increase the speed and to increase the yield of ammonia.

C A high temperature of 450 ^oC ensures a good speed of reaction and that the forward reaction is favoured.

D A pressure of about 200 atm is high enough to give a good yield of ammonia as the equilibrium shifts to the right.

13 A solution was made by mixing 0.0800 mol of HC*l*(aq) and 0.0500 mol of NaOH(aq). Water was added until the total volume of the solution was 1.5 dm^3.
What is the pH of the solution?

A 1.5 **B** 1.3 **C** 1.7 **D** 7.0

14 The kinetics of the reaction

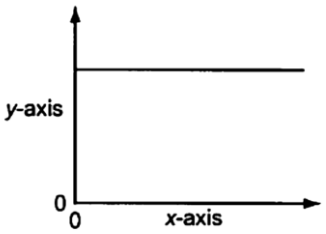
$$2NO(g) + Br_2(g) \rightarrow 2NOBr(g)$$

are second order with respect to [NO] and first order with respect to [Br_2]. What are the units of the rate constant?

A mol dm^{-3} s^{-1} **C** mol^{-2} dm^6 s^{-1}

B mol^{-1} dm^3 s^{-1} **D** mol^{-3} dm^9 s^{-1}

15 The reaction **A** → **B** was found to be a zero order reaction. What would be the x and y axes that would give rise to the following graph?



	y-axis	x-axis
A	rate	concentration
B	concentration	rate
C	concentration	time
D	time	concentration

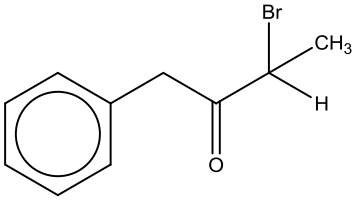
16 A particular reaction **B** → **C** + **D** is first order with respect to [**B**]. The numerical value of the rate constant is 5.78 x 10^{-3} s^{-1}. Approximately how many half-lives have passed after a period of 10 minutes?

A 3 **B** 5 **C** 7 **D** 10

17 Which of the following elements will form a chloride that will **not** undergo hydrolysis upon reaction with water?

A Na **B** Mg **C** Si **D** P

18 What are the functional groups present in the molecule shown below?



A phenyl, aldehyde and tertiary alkyl bromide

B phenyl, aldehyde and secondary alkyl bromide

C phenyl, ketone and tertiary alkyl bromide

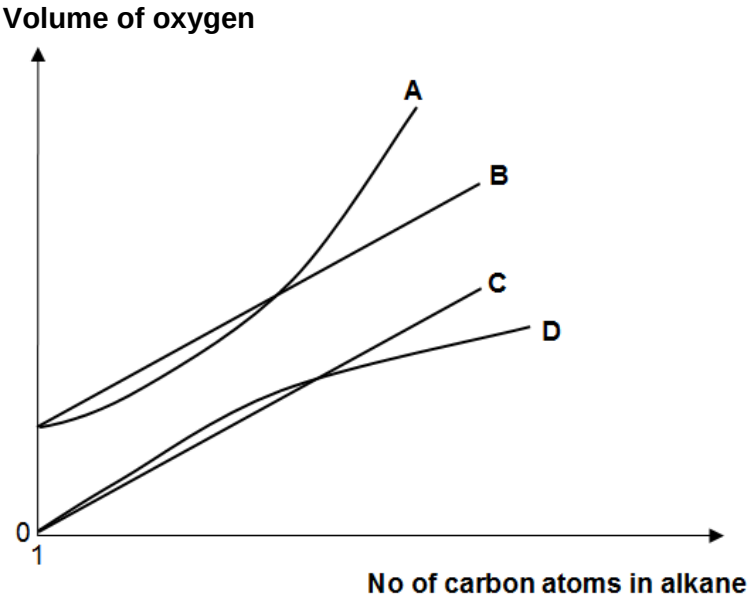
D phenyl, ketone and secondary alkyl bromide

19 How many structural and geometric isomers are there in a compound with a molecular formula C_5H_{10}, **excluding** all cyclic structures?

A 3 **B** 4 **C** 5 **D** 6

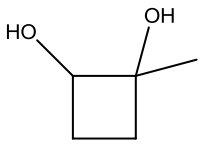
20 Alkanes undergo complete combustion in the presence of excess of oxygen to form only carbon dioxide and water at room temperature and pressure.

Which of the following graphs shows the relationship between the number of carbon atoms in an alkane and the volume of oxygen gas needed for complete combustion of one mole of the alkane?

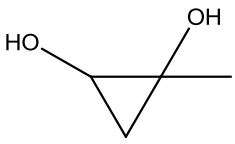


21 Hydrocarbon **X**, produces $HO_2CCH_2CH_2COCH_3$ upon heating with an excess of hot concentrated acidified $KMnO_4$(aq). Which of the following is the product of a mild oxidation of **X** with dilute cold alkaline $KMnO_4$(aq)?

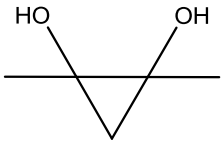
A



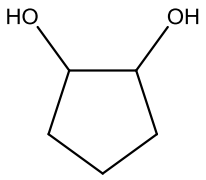
B



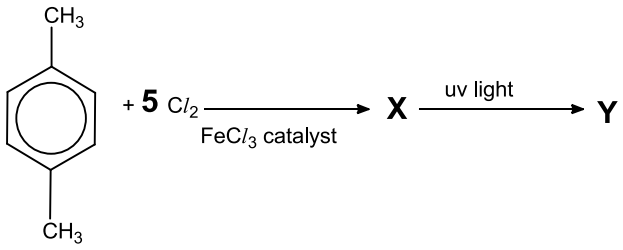
C



D

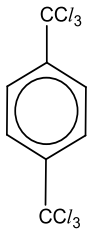


22 Arenes are able to undergo substitution reactions with chlorine under different conditions. One such reaction, with the exact stoichiometric ratio given, is as follows:

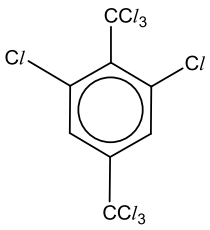


Which of the following is the most likely product, **Y,** from this synthesis?

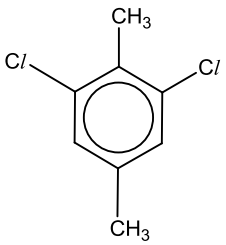
A



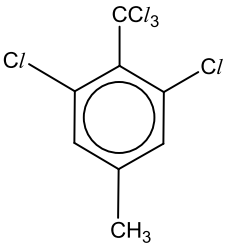
B



C



D

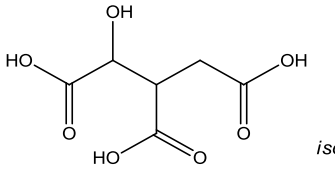


23 Chlorofluorocarbons, CFCs, are widely used but can cause damage to the ozone layer when the weakest bond in CFCs break to give free radicals that catalyse the breaking down of the ozone layer. A typical chlorofluorocarbon is $CH_2FCHCl F$.

Which is the weakest covalent bond in this CFC?

A C-H **B** C-F **C** C-C **D** C-C*l*

24 Isocitric acid, shown below, is an isomer of citric acid, which is commonly found in citrus fruits like the grapefruit.



isocitric acid

Which of the following reagents react completely with 1 mol of isocitric acid?

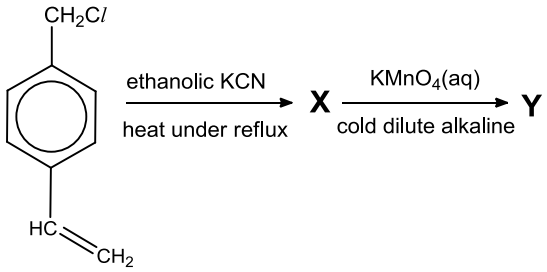
A 2 mol of CH_3CH_2OH

B 3 mol of Na_2CO_3

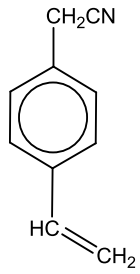
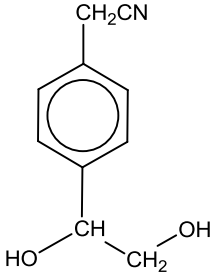
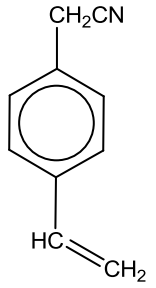
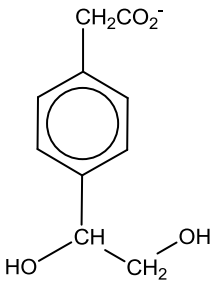
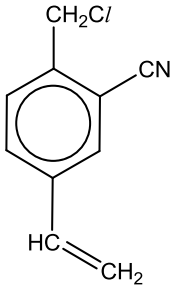
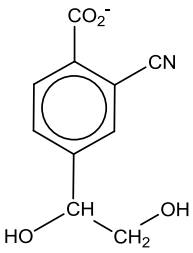
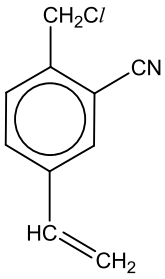
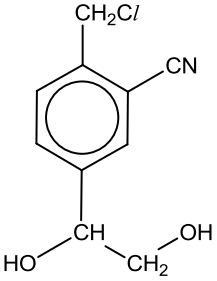
C 4 mol of Na

D 4 mol of NaOH

25 A synthesis reaction was carried out as follows:



Which organic products are formed from this synthesis?

	X	Y
A		
B		
C		
D		

Section B

For each of 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. 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 combinations of statements are used as a correct response.

26 In which pairs of compounds do the underlined elements exhibit different oxidation states?

1 $HC\underline{O}_2H$ and $H_2\underline{O}_2$

2 $LiA\mathit{l}\underline{H}_4$ and $N\underline{H}_4C\mathit{l}$

3 $\underline{P}C\mathit{l}_5$ and $H_3\underline{P}O_4$

27 In which of the following reactions do two conjugate acid-base pairs exist?

1 $C\mathit{l}_2 + H_2O \rightleftharpoons HOC\mathit{l} + HC\mathit{l}$

2 $C\mathit{l}O^- + H_2O \rightleftharpoons HC\mathit{l}O + OH^-$

3 $HSO_4^- + CN^- \rightleftharpoons SO_4^{2-} + HCN$

28 Which of the following pairs of compounds have the same structure and bonding?

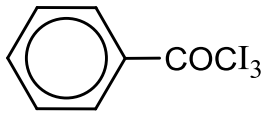
1 RbCl and AgBr

2 A$\mathit{l}C\mathit{l}_3$ and $MgC\mathit{l}_2$

3 SiO_2 and CO_2

29 Which compound will produce CHI_3 on warming with alkaline I_2(aq)?

1 $CH_3CO_2CHICOCH_2CH_3$

2 

3 $CH_3CH(OH)CH_2CH_3$

30 An aldehyde is treated with HCN in the presence of a little KCN. The organic product is then heated under reflux with dilute sulfuric acid.

Which of the following is **not** likely to be a product or by-product of the above reaction?

1 $CH_2{=}CHCO_2H$

2 $(CH_3)_2C(OH)CO_2H$

3 $CH_3CH(OH)CO_2H$

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