

ANDERSON JUNIOR COLLEGE
2014 JC2 Preliminary Exam
Higher 1

CHEMISTRY

8872/01

Paper 1 Multiple Choice

22 September 2014

50 minutes

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

For Multiple Choice Answer Sheet:

1. Write your name, PDG and NRIC/FIN number, **including** the reference letter.
2. **Shade** the NRIC / FIN number.
3. Fill in the following details on your answer sheet.

Exam Title: 2014 JC2 Prelim

Exam Details: H1 Chemistry / Paper 1

Date: 22 September 2014

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 shade your choice in **soft pencil** on the separate Multiple Choice Answer Sheet.

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

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

1 Which of the following statements is true?

- A** There are 6.02×10^{23} electrons in 2 g of helium gas.
- B** There are 6.02×10^{23} chlorine molecules in 35.5 g of chlorine gas.
- C** There are 6.02×10^{23} hydrogen ions in 1 dm³ of 1 mol dm⁻³ sulfuric acid.
- D** There are 6.02×10^{23} oxygen atoms in 24.0 dm³ of carbon dioxide at r.t.p.

2 When 20 cm³ of a gaseous hydrocarbon was completely burnt in an excess of oxygen, 60 cm³ of carbon dioxide and 80 cm³ of water vapour were formed, all volumes being measured at the same temperature and pressure.

What is the formula of the hydrocarbon?

- A** C₃H₄
- B** C₃H₆
- C** C₃H₈
- D** C₆H₈

3 Which of the following species has two unpaired electrons in its ground state?

- A** ³⁴Se
- B** ³⁸Sr
- C** ⁵¹Sb
- D** ⁸⁵At

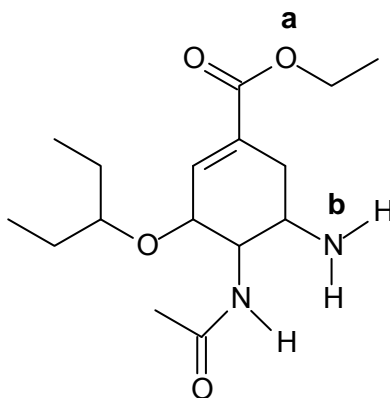
4 The successive ionisation energies, in kJ mol⁻¹, of an element **X** are given below.

870 1800 3000 3600 5800 7000 13200

What is **X**?

- A** ³³As
- B** ⁴⁰Zr
- C** ⁵²Te
- D** ⁵³I

- 5 Oseltamivir, commonly known as *Tamiflu*[®], is an antiviral drug that blocks the actions of influenza virus. The structure of Oseltamivir is shown below.

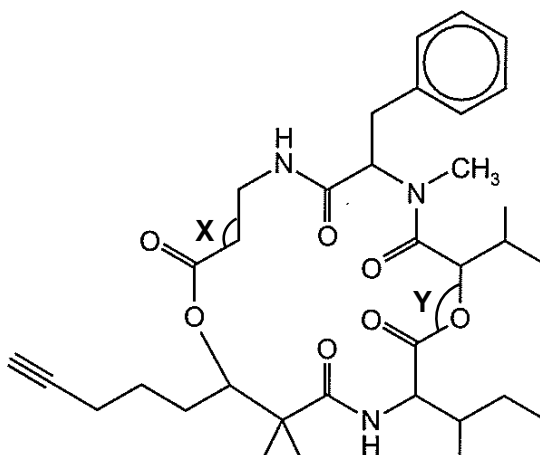


Which of the following shows the correct number of lone pair of electrons on the labelled atoms?

	a	b
A	1	1
B	2	0
C	2	1
D	4	2

- 6 Which of the following molecules is likely to have the highest boiling point?
- A** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
- B** $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_3$
- C** $\text{CH}_3\text{CH}_2\text{CHO}$
- D** $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

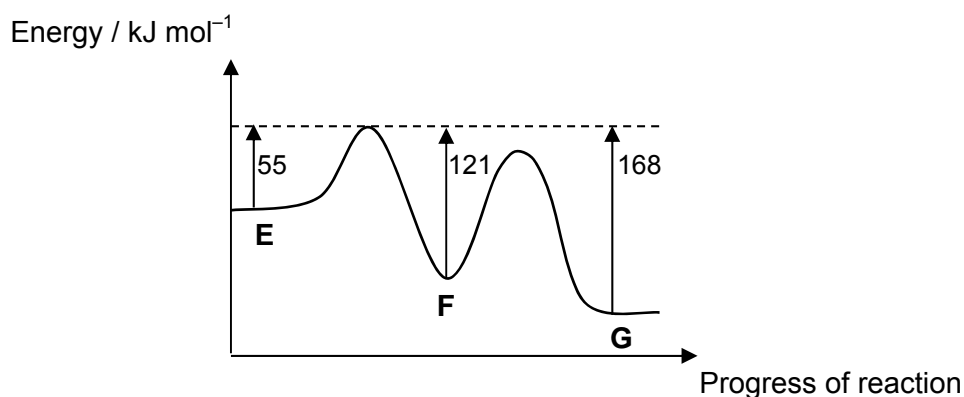
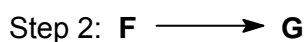
- 7 Yanucamide B can be extracted from a marine sponge.



What are the approximate values of the bond angles **X** and **Y** respectively in a molecule of Yanucamide B?

- A** 109°, 120° **B** 109°, 105° **C** 120°, 120° **D** 120°, 105°

- 8 The reaction pathway diagram for a two-step reaction is shown below.



Which statement about the reaction is correct?

- A** Step 2 is more exothermic than step 1.
B The enthalpy change of reaction for both the forward and backward reaction in step 1 is the same.
C The activation energy for the backward reaction in step 1 is 66 kJ mol⁻¹.
D The enthalpy change of reaction for the conversion of **E** to **G** is the sum of the enthalpy changes in step 1 and step 2.

- 9 The table shows the enthalpy change of neutralisation, ΔH , for the various acids and bases listed.

acid	base	$\Delta H / \text{kJ mol}^{-1}$
hydrobromic acid	sodium hydroxide	-57.0
P	sodium hydroxide	less exothermic than -57.0
hydrofluoric acid	potassium hydroxide	less exothermic than -57.0
Q	potassium hydroxide	-57.0

What are **P** and **Q**?

	P	Q
A	hydrochloric acid	nitric acid
B	ethanoic acid	hydrofluoric acid
C	hydrogen cyanide	carbonic acid
D	ethanoic acid	hydrobromic acid

- 10 For which compound is the lattice energy likely to have the **smallest** numerical value?
- A** caesium fluoride
B caesium iodide
C lithium chloride
D sodium iodide
- 11 In an experiment to measure the enthalpy change of neutralisation of hydrochloric acid, 20 cm³ of solution containing 0.04 mol of HCl is placed in a plastic cup of negligible heat capacity.

A 20 cm³ sample of aqueous sodium hydroxide containing 0.04 mol of NaOH, at the same initial temperature, is added and the temperature rises by 15 °C.

If the heat capacity per unit volume of the final solution is 4.2 J K⁻¹ cm⁻³, what is the numerical value of the enthalpy change of neutralisation?

- A** $\frac{20 \times 4.2 \times (273 + 15)}{0.04}$
B $20 \times 4.2 \times 15 \times 0.08$
C $\frac{40 \times 4.2 \times 15}{0.04}$
D $\frac{40 \times 4.2 \times (273 + 15)}{0.04}$

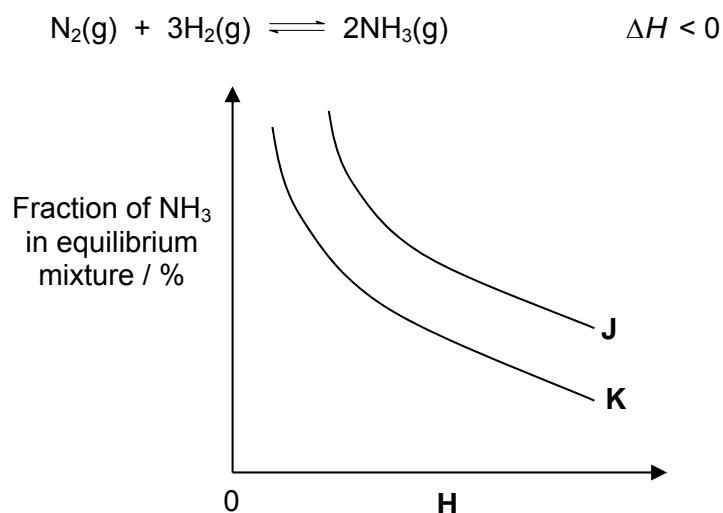
12 Each of the following equilibria is subjected to two changes separately.

- (i) the pressure is reduced at constant temperature;
- (ii) the temperature is increased at constant pressure.

For which equilibrium will both of these changes result in an increase in the proportion of the products?

- A** $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g}); \quad \Delta H = +53 \text{ kJ mol}^{-1}$
- B** $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightleftharpoons 4\text{NO}(\text{g}) + 6\text{H}_2\text{O}(\text{g}); \quad \Delta H = -950 \text{ kJ mol}^{-1}$
- C** $\text{CO}(\text{g}) + 2\text{H}_2(\text{g}) \rightleftharpoons \text{CH}_3\text{OH}(\text{g}); \quad \Delta H = -92 \text{ kJ mol}^{-1}$
- D** $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g}); \quad \Delta H = +57 \text{ kJ mol}^{-1}$

13 The graph below shows the fraction of ammonia in the equilibrium mixture obtainable if equilibrium was established under different temperature and pressure conditions during the Haber process.



What do **H**, **J** and **K** represent and what is the relative magnitude of **J** and **K**?

	H	J and K	relative magnitude
A	pressure	temperature	J > K
B	pressure	temperature	K > J
C	temperature	pressure	J > K
D	temperature	pressure	K > J

14 Which of the following represents an acid–base reaction?

- A** $\text{SO}_2 + 2\text{H}_2\text{S} \longrightarrow 2\text{H}_2\text{O} + 3\text{S}$
- B** $\text{HNO}_3 + 2\text{H}_2\text{SO}_4 \longrightarrow \text{NO}_2^+ + 2\text{HSO}_4^- + \text{H}_3\text{O}^+$
- C** $4\text{NH}_3 + 6\text{NO} \longrightarrow 5\text{N}_2 + 6\text{H}_2\text{O}$
- D** $\text{H}_2\text{O}_2 + 2\text{H}^+ + 2\text{I}^- \longrightarrow 2\text{H}_2\text{O} + \text{I}_2$

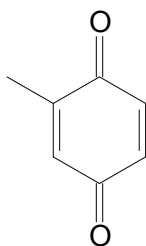
- 15 The table gives data for the reaction between **A** and **B** at constant temperature.

Experiment	[A] / mol dm ⁻³	[B] / mol dm ⁻³	Initial rate / mol dm ⁻³ s ⁻¹
1	0.3	0.2	4.0×10^{-4}
2	0.6	0.4	1.6×10^{-3}
3	0.6	0.8	6.4×10^{-3}

Which one of the following correctly represents the units of the rate constant k in the rate equation?

- A mol⁻¹ dm³ s⁻¹
 B mol dm⁻³ s⁻¹
 C mol s⁻¹
 D s⁻¹
- 16 Which of the following statements about the ionisation energies of elements across Period 3 is **incorrect**?
- A The first ionisation energies of elements generally increase with increasing proton number.
 B Sodium has the lowest first ionisation energy due to greater shielding by inner electrons.
 C The first ionisation energy of sulfur is lower than that of phosphorus due to repulsion between the paired 3p electrons.
 D The second ionisation energy of silicon is lower than that of aluminium as the electron is removed from a higher energy 3p orbital.
- 17 Which of the following statements about the electrical conductivity of elements across Period 3 is **incorrect**?
- A Sodium, magnesium and aluminium are good electrical conductors as their metallic lattices contain delocalised electrons.
 B Electrical conductivity increases from sodium to aluminium as the number of delocalised cations and electrons increases.
 C Silicon is a semiconductor as the electrons within the covalent bonds are held tightly and are not easily delocalised.
 D Phosphorous, sulfur, chlorine and argon are non-conductors as there are no mobile charge carriers in their simple molecular structures.
- 18 Which of the following compounds does **not** show *cis-trans* isomerism?
- A hex-3-ene
 B 3,4-dimethylhex-3-ene
 C 2-methylpent-2-ene
 D pent-2-ene

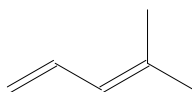
19 The unsaturated diketone shown is excreted by the bombardier beetle.



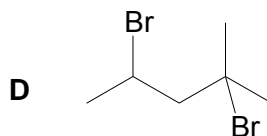
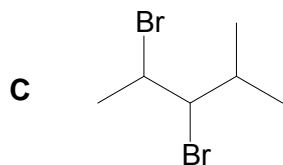
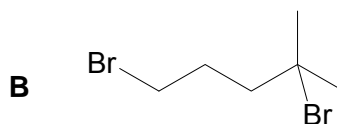
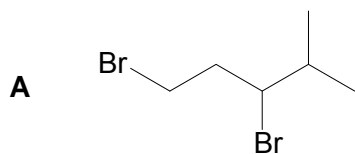
How many σ and π bonds are found in the product formed when the above diketone reacts with hydrogen cyanide?

	σ	π
A	13	4
B	15	4
C	18	6
D	21	6

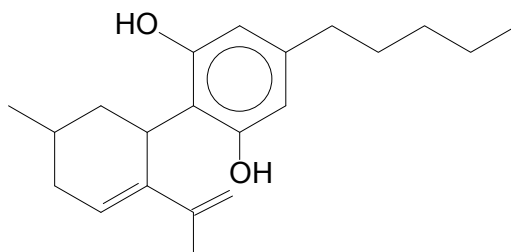
20 The following alkene is reacted with excess HBr.



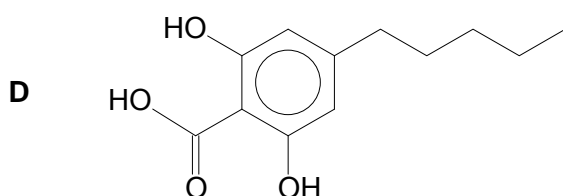
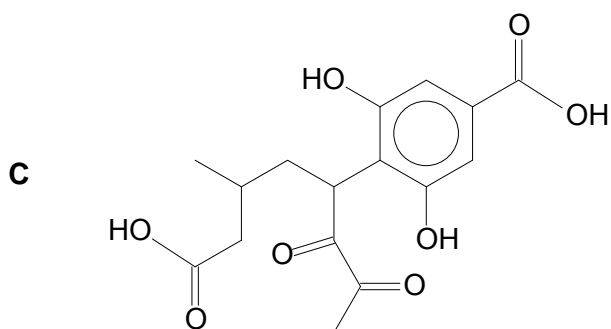
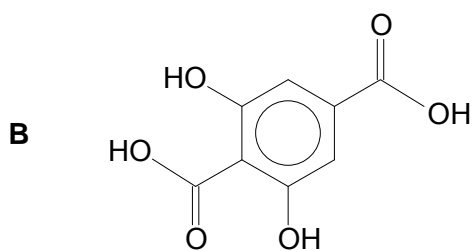
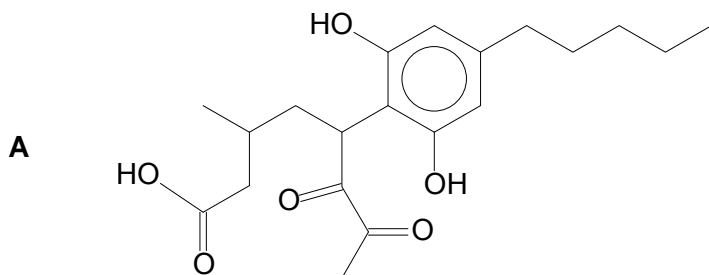
What is the most likely product formed?



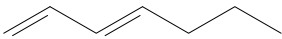
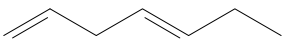
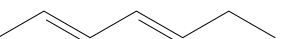
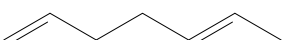
21 A psychoactive drug in cannabis has the structure shown.



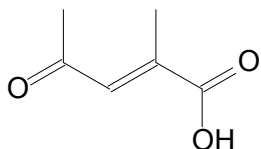
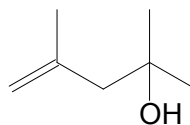
Which of the following is produced when cannabis is reacted with hot concentrated potassium manganate(VII) in the presence of dilute sulfuric acid? [You may assume that the -OH groups remain intact throughout the reaction.]



22 Which of the following will **not** be produced when 2,4-dibromoheptane reacts with hot ethanolic sodium hydroxide?

- A 
- B 
- C 
- D 

23 Which of the following reagents could be used to distinguish between compounds **M** and **N**?

**M****N**

- A aqueous Br_2
- B sodium metal
- C Tollens' reagent
- D alkaline aqueous iodine
- 24 Deuterium, D, is a heavy isotope of hydrogen. Which pair of reagents **cannot** be used to prepare CDH_2CDHBr ?
- A $\text{CDH=CHBr} + \text{HD}$
- B $\text{CDH}_2\text{CDHOH} + \text{DBr}$
- C $\text{CDH}_2\text{CDHOH} + \text{SOBr}_2$
- D $\text{CDH}_2\text{CDHOH} + \text{Br}_2$
- 25 Which reagent reacts with ethanal to give an organic molecule in which the reactive carbon atom does **not** remain trigonal planar?
- A 2,4-dinitrophenylhydrazine
- B acidified potassium dichromate(VI)
- C Fehling's solution
- D sodium borohydride

Section B

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

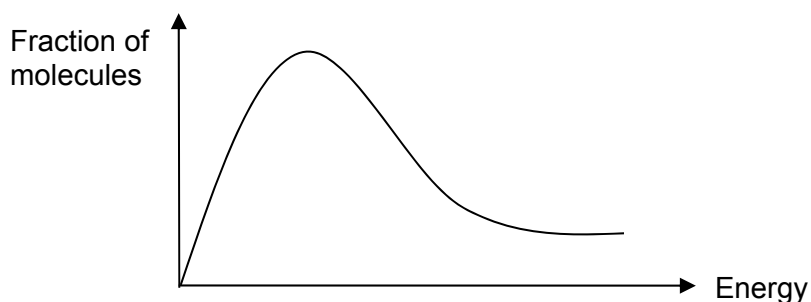
Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct.)

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

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** The diagram represents the Boltzmann distribution of molecular energies at a given temperature.



Which of the following statements are correct?

- 1 The total number of molecules is constant at all temperatures.
- 2 When temperature decreases, the maximum of the curve is displaced to the left.
- 3 When temperature increases, the fraction of molecules **with** any given energy also increases.

- 27** The activation energy of a reaction is usually

- 1 lowered by the presence of a catalyst.
- 2 high for a reaction that takes place slowly.
- 3 different for the forward and reverse reactions in an endothermic reaction.

- 28** Which of the following statements about the oxides of Period 3 elements are correct?

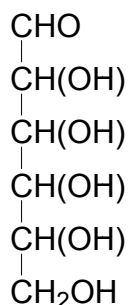
- 1 Al_2O_3 is insoluble in water.
- 2 P_4O_6 dissolves readily in water to give a strongly acidic solution, H_3PO_3 , of pH 2.
- 3 SiO_2 hydrolyses in water to give SiCl_4 and HCl .

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.

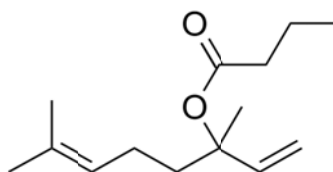
29 The open-chain structure of glucose can be represented as follows:



Which of the following statements about 1 mol of glucose are true?

- 1 It produces $\frac{5}{2}$ mol of hydrogen when reacted with excess sodium metal.
- 2 It reacts with 5 mol of PCl_5 to form white hydrogen chloride fumes.
- 3 It decolourises aqueous bromine.

30 Many esters have distinctive fruit-like odours and are often used in artificial flavourings. *Linalyl butyrate*, shown below, is often used as peach flavouring in cakes and pastries.



Which of the following statements about *linalyl butyrate* are correct?

- 1 Butanoic acid can be used in the synthesis of *linalyl butyrate*.
- 2 It produces two organic products when heated under reflux with acidified potassium manganate(VII).
- 3 When heated with dilute HCl and aqueous NaOH separately, it produces the same organic products.