



VICTORIA JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATIONS
Higher 1

CHEMISTRY

8872/01

Paper 1 Multiple Choice

24 September 2014

50 min

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.

Write your NRIC/FIN number, name and CT group on the Answer Sheet.

There are **thirty** questions. 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 choices 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.

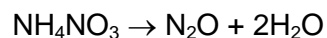
Any rough working should be done in this booklet.

This document consists of **10** printed pages.

Section A

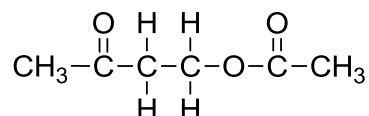
For each question there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct.

- 1 Ammonium nitrate, NH_4NO_3 , can decompose explosively when heated.



What are the changes in the oxidation numbers of the two nitrogen atoms in NH_4NO_3 when this reaction proceeds?

- A** -2, -4 **B** +2, +6 **C** +4, -4 **D** +4, -6
- 2 Compound **X** reacts with ethanoic acid in the presence of an H^+ catalyst to produce the compound below.



What is the molecular formula of compound **X**?

- A** $\text{C}_2\text{H}_6\text{O}_2$ **B** $\text{C}_2\text{H}_6\text{O}_3$ **C** $\text{C}_4\text{H}_8\text{O}$ **D** $\text{C}_4\text{H}_8\text{O}_2$
- 3 When potassium iodate(V), KIO_3 , reacts with iodine in hydrochloric acid solution, ICl_2^- is formed.

What is the ratio of IO_3^- to I_2 in the balanced chemical equation for the overall reaction?

- A** 1 : 1 **B** 1 : 2 **C** 1 : 4 **D** 2 : 1
- 4 Which of the following contains only one unpaired electron?

- A** Ga^- **B** Se^- **C** Te^+ **D** As^+

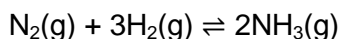
- 5 For which of the following pairs does the first species have a smaller bond angle?

- A** SnCl_2 , OCl_2
B H_2O , H_2S
C I_3^- , N_3^-
D NF_3 , NCI_3

- 6 Dicarbon monoxide, C_2O , is found in dust clouds in space. Analysis of it shows that the sequence of atoms in this molecule is $C - C - O$. All bonds are double bonds and there are no unpaired electrons.

How many lone pairs of electrons are present in a molecule of C_2O ?

- A 1 B 2 C 3 D 4
- 7 Which pair of elements has chemical bonds of the same type between their atoms under standard conditions?
- A sulfur and chlorine
B chlorine and argon
C magnesium and silicon
D aluminium and phosphorus
- 8 Which of the following compounds are arranged in decreasing order of their solubility in water?
- A $CH_3CH_2CO_2Na$, $CH_3CH_2CH_2NH_2$, $CH_3CH_2CH_2Cl$
B $CH_3CH_2CO_2Na$, $CH_3CH_2CH_2Cl$, $CH_3CH_2CH_2NH_2$
C $CH_3CH_2CH_2NH_2$, $CH_3CH_2CO_2Na$, $CH_3CH_2CH_2Cl$
D $CH_3CH_2CH_2Cl$, $CH_3CH_2CH_2NH_2$, $CH_3CH_2CO_2Na$
- 9 Nitrogen reacts with hydrogen to produce ammonia.



A mixture of 2.00 mol of nitrogen, 6.00 mol of hydrogen, and 2.40 mol of ammonia is allowed to reach equilibrium in a sealed vessel of volume 1 dm^3 under certain conditions. It was found that 2.32 mol of nitrogen were present in the equilibrium mixture.

What is the value of K_c under these conditions?

- A $\frac{(1.76)^2}{(2.32)(6.96)^3}$
B $\frac{(1.76)^2}{(2.32)(6.32)^3}$
C $\frac{(2.08)^2}{(2.32)(6.32)^3}$
D $\frac{(2.40)^2}{(2.32)(6.00)^3}$

- 10 Methanoic acid molecules, HCO_2H , and hydrogencarbonate ions, HCO_3^- , can both behave as acids.

Why does a solution of methanoic acid have a lower pH than a solution of sodium hydrogencarbonate of the same concentration?

- A The conjugate base of HCO_2H is stronger than that of HCO_3^- .
 B Each HCO_2H molecule has two hydrogen atoms and each HCO_3^- ion only has one.
 C HCO_2H molecules dissociate more fully than HCO_3^- ions.
 D The acid dissociation constant of HCO_2H is smaller than that of HCO_3^- .
- 11 Which of the following has an exothermic enthalpy change?
- A $\text{Ca(g)} \rightarrow \text{Ca}^{2+}(\text{g}) + 2\text{e}^-$
 B $\text{Ca(s)} + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{CaO(s)}$
 C $\text{CaO(s)} \rightarrow \text{Ca}^{2+}(\text{g}) + \text{O}^{2-}(\text{g})$
 D $\frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{O(g)}$
- 12 Based on the thermochemical data below, what is the ratio of the heat generated by hydrogen to that of carbon if 1 g of each substance is completely burned?

Standard enthalpy change of formation of water	= -285 kJ mol^{-1}
Standard enthalpy change of formation of carbon dioxide	= -394 kJ mol^{-1}

- A 0.4 B 0.7 C 3.4 D 4.3
- 13 0.1 mol of an unknown solid acid **A** was added to 200 cm^3 of excess NaOH(aq) . The initial and final temperature readings were taken and the temperature of the solution increased by 12.7°C .

Given that the specific heat capacity of solution is $4.18 \text{ J cm}^{-3} \text{ K}^{-1}$ and the enthalpy change of neutralisation between a strong acid and a strong base is -57 kJ mol^{-1} , which of the following provides an identity of the acid **A**?

- A **A** is a weak monobasic acid.
 B **A** is a strong monobasic acid.
 C **A** is a weak dibasic acid.
 D **A** is a strong dibasic acid.
- 14 A chemical plant illegally dumped some radioactive waste in a landfill. This waste composed of two radioactive isotopes **M** and **N** in the proportion 4:1. The decay of radioactive isotopes follows first-order kinetics. The half-life of **M** is 2 days whereas that of **N** is 4 days. By the time the authorities found out about this illegal dumping and analysed a sample of the waste, they found equal amounts of **M** and **N**.

How long was the waste in the landfill before the authorities arrived?

- A 2 days B 4 days C 8 days D 16 days

- 15 An experiment was carried out to investigate the initial rate of reaction between $\text{K}_2\text{S}_2\text{O}_8(\text{aq})$ and $\text{KI}(\text{aq})$. The initial concentrations of $\text{K}_2\text{S}_2\text{O}_8(\text{aq})$ and $\text{KI}(\text{aq})$ in the mixture together with the time taken for the mixture to darken for the various experimental runs were given below.

Initial $[\text{K}_2\text{S}_2\text{O}_8]$ / mol dm^{-3}	Initial $[\text{KI}]$ / mol dm^{-3}	Time taken to darken / s
0.10	0.20	35
0.05	0.20	70
0.10	0.067	105
0.02	Y	88

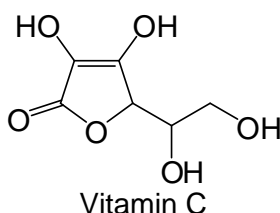
What is the value of Y in the table?

- A 0.10 B 0.20 C 0.40 D 0.80
- 16 Use of the Data Booklet is relevant to this question.
- Elements J and K react together to form compound L. Elements J and K are both in the third period of the Periodic Table. Element J has the smallest atomic radius in the third period. There are only two elements in the third period which have a lower melting point than element K.
- Which compound could be L?
- A Na_2S B MgS C MgCl_2 D PCl_3
- 17 The properties of the oxides of three elements in the third period of the Periodic Table, E, F and G, are given below.
- Oxide of E is amphoteric.
 Oxide of F reacts with aqueous sodium hydroxide at room temperature.
 Oxide of G dissolves in water to form a strong alkaline solution.
- Which of the following shows the order of increasing proton number of the elements?
- A G, E, F B E, F, G C G, F, E D F, G, E
- 18 How many isomeric aldehyde compounds with molecular formula $\text{C}_5\text{H}_{10}\text{O}$ are there?
- A 2 B 3 C 4 D 5
- 19 Compound S upon reaction with hot acidified potassium manganate(VII) yields CH_3COCH_3 , $\text{CH}_3\text{COCH}_2\text{CH}_2\text{CO}_2\text{H}$ and $\text{CH}_2(\text{CO}_2\text{H})_2$.

Which compound could be S?

- A $\text{CH}_3\text{CH}=\text{C}(\text{CH}_3)\text{CH}_2\text{CH}_2\text{C}(\text{CH}_3)=\text{CHCH}_2\text{CH}_2\text{OH}$
 B $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{CH}_2\text{C}(\text{CH}_3)=\text{CHCH}_2\text{CH}_2\text{OH}$
 C $(\text{CH}_3)_2\text{C}=\text{CHCH}_2\text{CH}_2\text{C}(\text{CH}_2\text{OH})=\text{CHCH}_2\text{CH}_3$
 D $(\text{CH}_3)_2\text{C}=\text{C}(\text{CH}_3)\text{CH}_2\text{C}(\text{CH}_3)=\text{CHCH}_2\text{CH}_2\text{OH}$

- 20 Which statement correctly describes the compound benzene as a consequence of the delocalised electrons present in its molecule?
- A Benzene is a good conductor of electricity.
 - B Substitution in benzene takes place at one particular carbon atom.
 - C Addition reactions of benzene take place more easily than substitution.
 - D The carbon–carbon bond lengths are between those of C–C bonds and C=C bonds.
- 21 Dichlorodifluoromethane, CCl_2F_2 , is widely used in aerosol propellants and as a refrigerant. Which statement helps to explain why dichlorodifluoromethane is chemically inert?
- A Fluorine atoms have high electronegativity.
 - B The carbon–fluorine bond energy is large.
 - C The carbon–fluorine bond has a high polarity.
 - D Van der Waals' forces between CCl_2F_2 molecules are weak.
- 22 The structure of Vitamin C is given below.



Which statement about Vitamin C is correct?

- A It exhibits geometric isomerism.
 - B It reacts with 5 mol of aqueous sodium hydroxide.
 - C It can react with 2,4–dinitrophenylhydrazine to form bright orange crystals.
 - D It can react with hot aqueous hydrochloric acid.
- 23 Group II ethanoates undergo thermal decomposition when heated, one example is magnesium ethanoate which produces propanone as shown in the equation below.

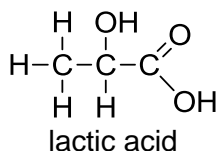


This reaction is carried out by heating an equimolar amount of magnesium propanoate, $(\text{CH}_3\text{CH}_2\text{CO}_2)_2\text{Mg}$, and magnesium methanoate, $(\text{HCO}_2)_2\text{Mg}$. A mixture of three carbonyl compounds is produced.

Which of the following carbonyl compounds is **not** formed?

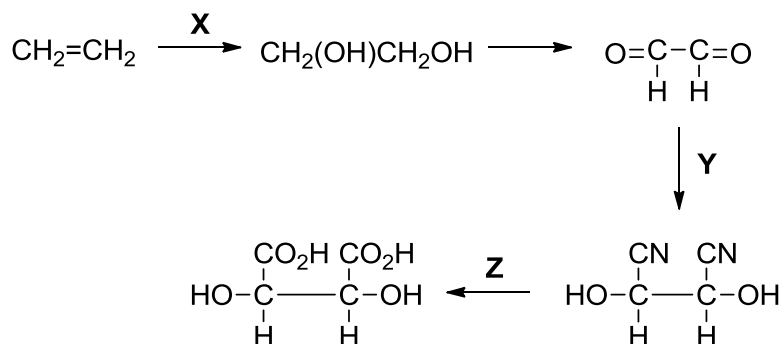
- A HCHO
- B $\text{CH}_3\text{CH}_2\text{COCH}_3$
- C $\text{CH}_3\text{CH}_2\text{CHO}$
- D $\text{CH}_3\text{CH}_2\text{COCH}_2\text{CH}_3$

- 24 Lactic acid occurs naturally, for example in sour milk.



What is a property of lactic acid?

- A** It decolourises aqueous bromine rapidly.
B It is insoluble in water.
C It reduces Fehling's reagent.
D A cyclic diester is formed when heated in the presence of a strong acid.
- 25 The following is a method of synthesising tartaric acid, a compound found in wine.



Which set of reagents and conditions can be used for the synthesis?

	X	Y	Z
A	H ₂ O(g), H ₃ PO ₄ (aq)	cold HCN, NaOH(aq)	hot K ₂ Cr ₂ O ₇ , H ₂ SO ₄ (aq)
B	cold KMnO ₄ , H ₂ SO ₄ (aq)	cold HCN, NaOH(aq)	HCl(aq), heat
C	H ₂ O(g), H ₃ PO ₄ (aq)	ethanolic KCN, heat	hot K ₂ Cr ₂ O ₇ , H ₂ SO ₄ (aq)
D	cold KMnO ₄ , NaOH(aq)	ethanolic KCN, heat	HCl(aq), heat

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

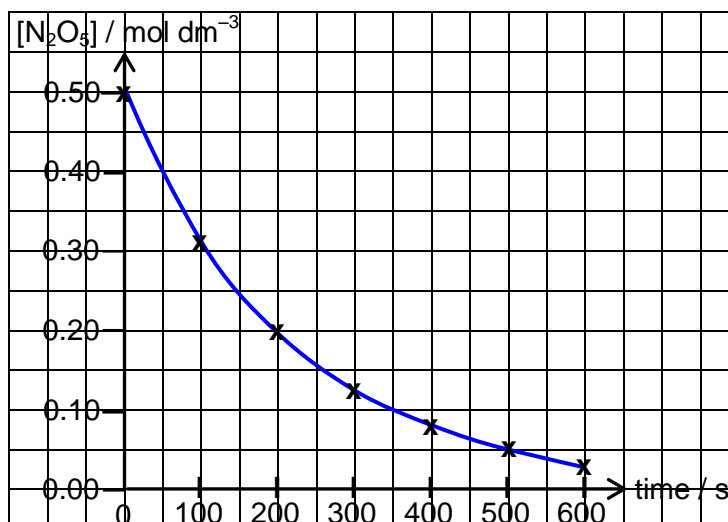
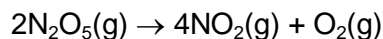
A	B	C	D
1, 2 and 3 are correct	1 and 2 only are correct	2 and 3 only are correct	1 only is correct

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

- 26** Which processes could be used to calculate the bond energy for the covalent bond X–Y by dividing its ΔH by n ?

- 1** $XY_n(g) \rightarrow X(g) + nY(g)$
- 2** $nXY(g) \rightarrow nX(g) + \frac{n}{2} Y_2(g)$
- 3** $2XY_n(g) \rightarrow 2XY_{n-1}(g) + Y_2(g)$

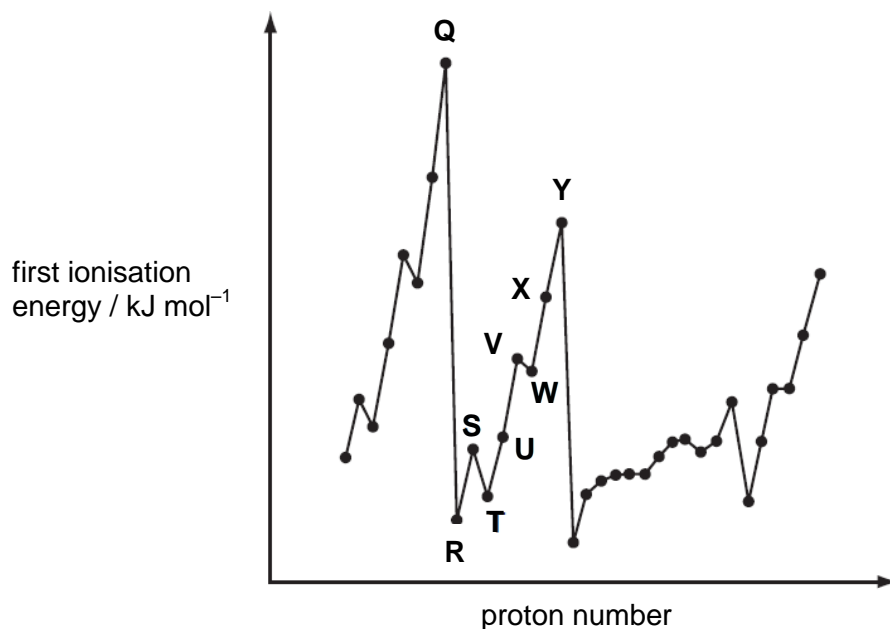
- 27** The rate kinetics of decomposition of N_2O_5 is investigated by plotting the concentration of N_2O_5 with respect to time.



Which conclusions can be drawn from this result?

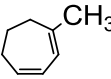
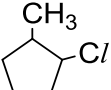
- 1** The reaction is first order with respect to N_2O_5 .
- 2** The initial rate of consumption of N_2O_5 is $2.0 \times 10^{-3} \text{ mol dm}^{-3} \text{ s}^{-1}$.
- 3** The initial rate of production of O_2 is $1.0 \times 10^{-3} \text{ mol dm}^{-3} \text{ s}^{-1}$.

- 28 The graph below shows the variation of the first ionisation energy with the number of protons for some elements.



Which statements are **incorrect**?

- 1 Elements **Q** and **Y** are in the same period in the Periodic Table.
 - 2 The small decrease between elements **S** and **T** is due to decreased shielding.
 - 3 The small decrease between elements **V** and **W** is due to repulsion between paired electrons.
- 29 Which processes will give a good yield of $\text{CH}_3\text{CO}(\text{CH}_2)_3\text{CO}_2\text{H}$?

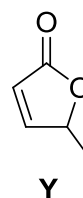
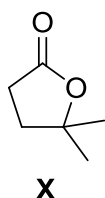
- 1 $\text{CH}_3\text{CH}(\text{OH})\text{CH}_2(\text{CH}_2)_2\text{CH}_2\text{Cl} \xrightarrow[\text{heat}]{\text{NaOH(alcohol)}} \xrightarrow{\text{hot KMnO}_4(\text{aq}), \text{H}_3\text{O}^+}$
- 2  $\xrightarrow{\text{hot KMnO}_4(\text{aq}), \text{H}_3\text{O}^+}$
- 3  $\xrightarrow[\text{heat}]{\text{KOH(ethanol)}} \xrightarrow{\text{hot KMnO}_4(\text{aq}), \text{H}_3\text{O}^+}$

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 Below are the structures of compounds **X** and **Y**.



Which sets of reagents and conditions can be used to distinguish between compounds **X** and **Y**?

- 1** aqueous bromine
- 2** acidified $\text{K}_2\text{Cr}_2\text{O}_7$, heat
- 3** alkaline aqueous iodine, heat

Level of difficulty	Percentage	No of questions
Easy	20	6
Moderate	60	18
Hard/Tedious	20	6

MCQ Questions for H1 Chemistry			
Qn No	Topic	Remarks	Answer
1	Stoichiometry (oxidation no.)	E	C
2	Stoichiometry (molecular formula)	E	D
3	Stoichiometry (balance eqns)	T	B
4	Atomic Structure (no. of unpaired e ⁻)	M	B
5	Bonding (bond angles)	T	D
6	Bonding (no. of lp e ⁻)	M	C
7	Bonding (type of chemical bonds)	E	A
8	Bonding (solubility in water)	M	A
9	Chemical Eqm (K_c calculation)	M	A
10	Ionic Eqm (strength of acids)	M	C
11	ΔH (definitions)	M	B
12	ΔH (calculations)	M	D
13	ΔH (calculations)	T	C
14	Kinetics ($t_{1/2}$)	M	C
15	Kinetics (initial rate method calculations)	M	C
16	Periodic Table (properties)	M	D
17	Periodic Table (reactions of oxides)	M	A
18	Organic (structural isomerism)	M	C
19	Organic (oxidation of alkenes)	M	B
20	Arenes (properties of benzene)	E	D
21	RX (CFCs)	E	B
22	Organic (C=C/ROH/ester reactions)	M	D
23	Organic (pattern recognition)	T	B
24	Organic (ROH/RCO ₂ H reactions)	M	D
25	Organic (C=C/ROH/RCO reactions)	M	B
26	ΔH (bond energy)	M	D
27	Kinetics (graphical method)	M	A
28	Periodic Table (1 st IE)	E	B
29	Organic (C=C/RX/ROH reactions)	T	C
30	Organic (distinguishing tests)	T	A

6 A, 8 B, 8 C, 8 D