JURONG JUNIOR COLLEGE

JC 2 PRELIMINARY EXAMINATION

Higher 1

CHEMISTRY 8872/01

Paper 1 Multiple Choice **18 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.

Write your name, class and shade your exam index number on the Answer Sheet in the spaces provided.

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.

A *Data Booklet* is provided. Do not write anything on the *Data 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. *Use of the Data Booklet is relevant to this qu*estion.

The label on the packaging of a garden fertiliser stated that there is 30.0 % by mass P_2O_5 present in the fertiliser.

What is the percentage by mass of phosphorus in this fertiliser?

A 6.55 **B** 13.1 **C** 26.2 **D** 30.0

2. What is the minimum volume of air required for complete combustion of 10 cm^3 of a hydrocarbon, C_3H_4?

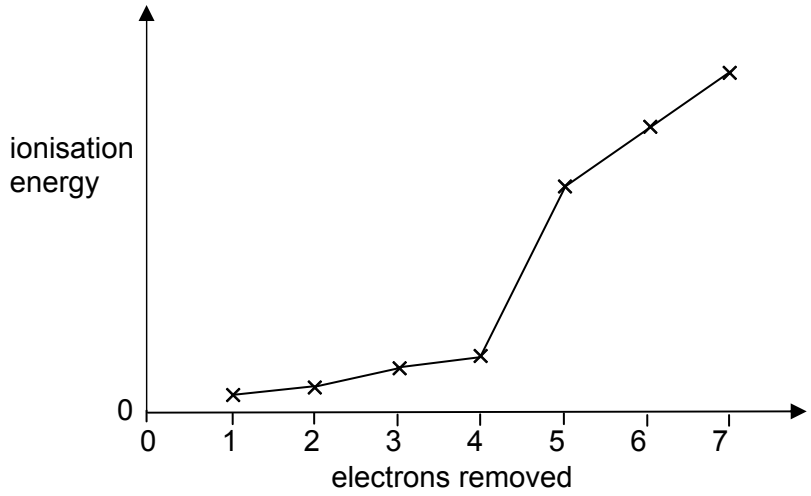
[Assume that air contains one-fifth oxygen by volume and that both gas volumes are measured at the same temperature and pressure.]

A 40 cm^3 **B** 50 cm^3 **C** 200 cm^3 **D** 250 cm^3

3. In which species are the numbers of electrons and neutrons equal?

A $^{9}_{4}Be$ **B** $^{19}_{9}F$ **C** $^{23}_{11}Na^{+}$ **D** $^{18}_{8}O^{2-}$

4. The first seven ionisation energies of an element **M** are shown in the sketch graph.



What could be the identity of element **M**?

A carbon
B aluminium
C magnesium
D silicon

5. How many 4s electrons are present in the ground state of chromium as an atom and as a 2+ ion?

	$_{24}Cr$	$_{24}Cr^{2+}$
A	0	0
B	1	1
C	1	0
D	2	0

6. Which of the following does **not** contain three atoms bonded at an angle between 109° and 110° in its structure?

A graphite

B propane

C ethanoic acid

D silicon(IV) oxide

7. Consider the following four compounds.

1 $(CH_3)_2CHCO_2H$
2 $CH_3CH_2CO_2CH_3$
3 $CH_3CH_2CH_2CO_2H$
4 $CH_3CHFCH_2CH_2OH$

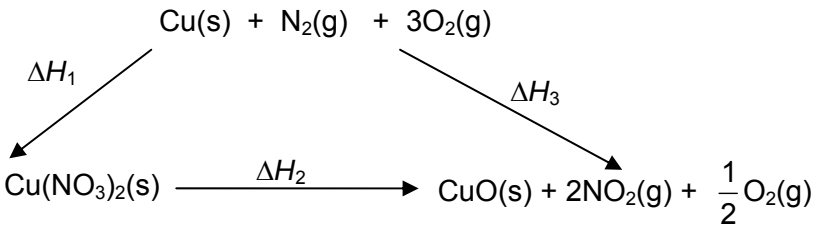
What is the order of **increasing** boiling points of the compounds?

A $2 \rightarrow 1 \rightarrow 4 \rightarrow 3$
B $2 \rightarrow 4 \rightarrow 1 \rightarrow 3$
C $1 \rightarrow 3 \rightarrow 2 \rightarrow 4$
D $4 \rightarrow 2 \rightarrow 3 \rightarrow 1$

8. Enthalpy changes that are difficult to measure directly can often be determined using Hess' Law to construct an energy cycle.

Given the following data and the energy cycle, what is the standard enthalpy change of formation of gaseous nitrogen dioxide?

ΔH_2 = +212 kJ mol^{-1}, $\Delta H_f^{\ominus}(Cu(NO_3)_2)$ = –302.9 kJ mol^{-1}, $\Delta H_f^{\ominus}(CuO)$ = –157.3 kJ mol^{-1}



A +33.2 kJ mol^{-1} **C** +178.8 kJ mol^{-1}

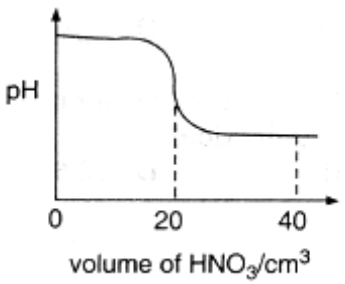
B +66.4 kJ mol^{-1} **D** +357.6 kJ mol^{-1}

9. How much water must be added to 2.0 dm^3 of a solution of pH 2.0 in order to increase its pH to 3.0?

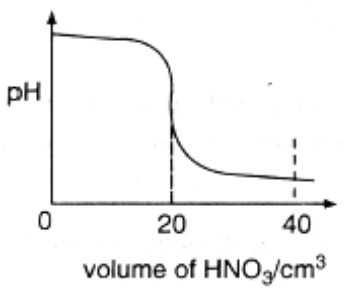
A 8.0 dm^3 **B** 10.0 dm^3 **C** 18.0 dm^3 **D** 20.0 dm^3

10. Which of the following graphs correctly represents the variation of pH against the volume of nitric acid added when 20.0 cm^3 of a 0.2 mol dm^{-3} sodium carbonate solution is titrated against 0.2 mol dm^{-3} nitric acid until nitric acid is in excess?

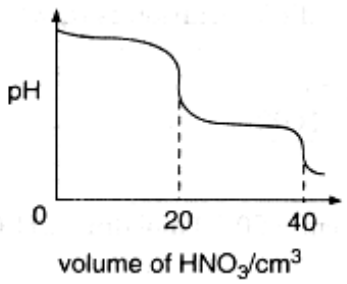
A



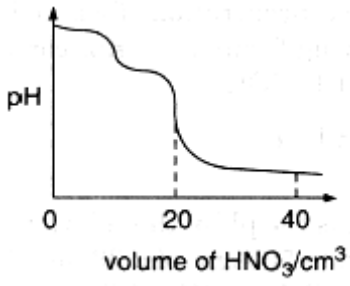
C



B



D

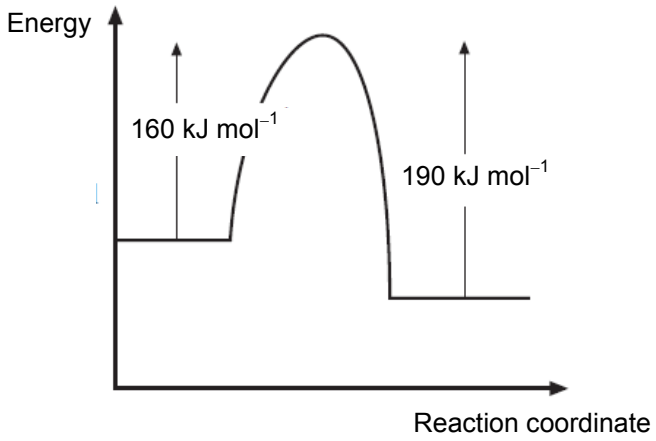


11. Bromoethanoic acid, $BrCH_2COOH$, has a pK_a of 2.9.

Which of the following substance has a lower pK_a than bromoethanoic acid?

A CH_3COOH **B** $ClCH_2COOH$ **C** CH_2BrCH_2OH **D** ICH_2COOH

12. The diagram below represents the reaction profile of an uncatalysed chemical reaction.



When a catalyst is used, the activation energy of the forward reaction is reduced to 35 kJ mol^{-1}.

What is the activation energy of the catalysed reverse reaction?

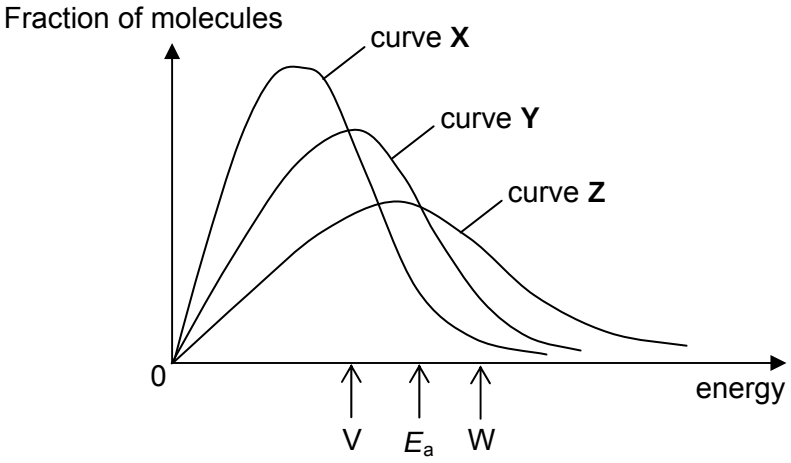
A 65 kJ mol^{-1}

B 35 kJ mol^{-1}

C 30 kJ mol^{-1}

D 190 kJ mol^{-1}

13. The curve **Y** and the value E_a represent the distribution of energies of the molecules and the activation energy for an uncatalysed gaseous reaction.



What is a possible outcome if the reaction is catalysed?

A The distribution of energies will be given by curve **X** and the activation energy by value V.

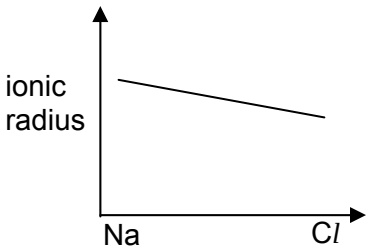
B The distribution of energies will be given by curve **Y** and the activation energy by value V.

C The distribution of energies will be given by curve **Y** and the activation energy by value W.

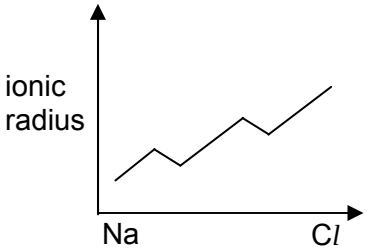
D The distribution of energies will be given by curve **Z** and the activation energy by value W.

14. Which diagram represents the change in ionic radius of the ions of the elements across the third period (Na to C*l*)?

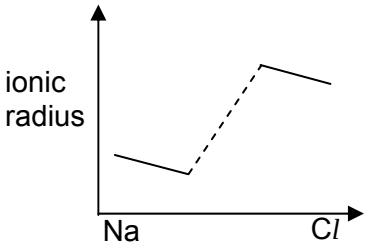
A



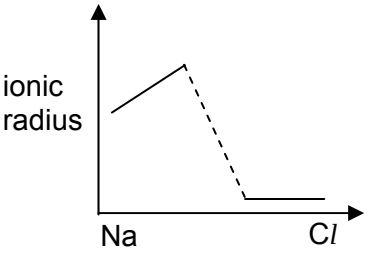
B



C



D



15. Consider the sequence of oxides Na_2O, SiO_2, P_4O_{10}.

Which factor decreases from Na_2O to SiO_2 and also from SiO_2 to P_4O_{10}?

A covalent character

B melting point

C pH when mixed with water

D solubility in aqueous alkali

16. An excess of cold water was added to 0.3 mol of a chloride of the third period of the Periodic Table at room temperature.

0.6 mol of HC*l* was formed.

Which chloride was treated?

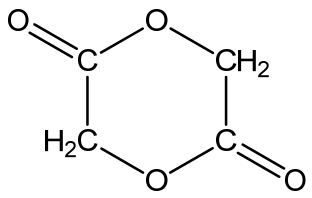
A PCl_5 **B** $SiCl_4$ **C** $AlCl_3$ **D** $MgCl_2$

17. *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 Period 3. Element **J** has the smallest atomic radius in Period 3. There are only two elements in Period 3 which have a lower melting point than element **K**.
Which compound could be **L**?

A Na_3P **B** SCl_2 **C** Na_2S **D** PCl_3

18. Compound **P** is used in textile and leather processing.



Compound **P**

Which statement about compound **P** is correct?

A It is a planar molecule.

B A molecule of compound **P** contains 4 lone pairs of electrons.

C It reacts with 2,4-dinitrophenylhydrazine solution to give an orange precipitate.

D It can be formed by reacting $HOCH_2COOH$ with a few drops of concentrated sulfuric acid on gentle heating.

19. When one propanone molecule reacts with one hydrogen cyanide molecule by nucleophilic addition, how many bonds are broken and made?

	number of σ bonds broken	number of π bonds broken	number of new σ bonds made
A	0	1	2
B	1	1	2
C	1	1	1
D	1	0	2

20. The Russian composer Borodin was also a research chemist who discovered a reaction in which two ethanal molecules combine to form a compound commonly known as aldol (reaction **I**). Aldol forms another compound on heating (reaction **II**).

I $2CH_3CHO \rightarrow CH_3CH(OH)CH_2CHO$

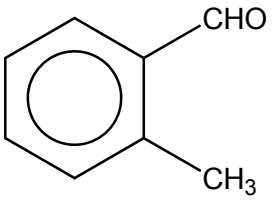
II $CH_3CH(OH)CH_2CHO \rightarrow CH_3CH{=}CHCHO + H_2O$

Which of the following describes reactions **I** and reaction **II**?

	I	**II**
A	addition	elimination
B	addition	reduction
C	elimination	reduction
D	substitution	elimination

21. Compound **Q** has the following structure.

8



Compound **Q**

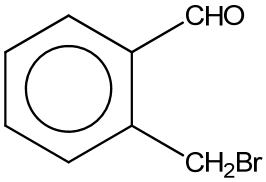
Which statement about compound **Q** is correct?

A Compound **Q** produces effervescence with sodium metal.

B Compound **Q** can be distinguished from ethanal by using Tollens' reagent.

C On heating compound **Q** under reflux with an acidified solution of manganate(VII) ions, the empirical formula of the product formed is $C_4H_3O_2$.

D On heating compound **Q** with Br_2 in the presence of a suitable catalyst in the dark,

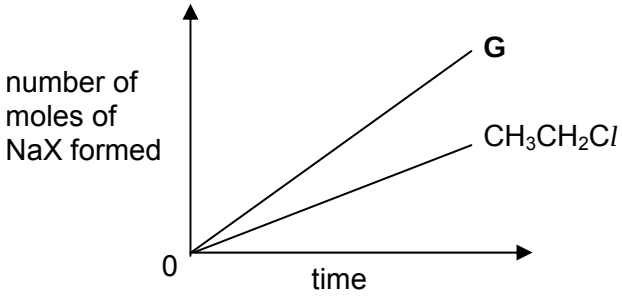


is obtained as the main product.

22. When halogenoalkanes, RX, are hydrolysed with NaOH, the corresponding sodium halide, NaX, is produced.

$$RX + NaOH \rightarrow ROH \text{ and } NaX$$

A student investigated the amount of NaX produced by separately hydrolysing equimolar quantities of CH_3CH_2Cl and another halogenoalkane, **G**. In a given time, the amount of sodium halide formed was greater with **G** than with CH_3CH_2Cl.



Which compound could be **G**?

A (bromomethyl)benzene

B 1,2-dichlorobenzene

C iodobenzene

D 1-chloro-2-fluoroethane

23. How many esters are there with the molecular formula $C_4H_8O_2$?

A 2 **B** 3 **C** 4 **D** 5

24. Ethyl phenylethanoate, $C_6H_5CH_2CO_2C_2H_5$, gives a characteristic flowery aroma to honey.

Which sequence of reagents, with heating in each case, leads to the preparation of $C_6H_5CH_2CO_2C_2H_5$?

A $C_6H_5CH_2CH_2OH \xrightarrow{MnO_4^-,\ H^+} \xrightarrow{C_2H_5OH,\ conc.\ H_2SO_4}$

B $C_6H_5CH_2Br \xrightarrow{NaOH(aq)} \xrightarrow{C_2H_5CO_2H,\ conc.\ H_2SO_4}$

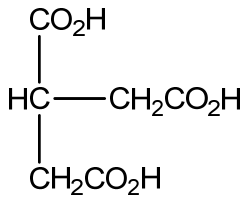
C $C_6H_5CHO \xrightarrow{HCN} \xrightarrow{H^+(aq)} \xrightarrow{C_2H_5OH,\ conc.\ H_2SO_4}$

D $C_6H_5CH_2Br \xrightarrow{NaCN(alcoholic)} \xrightarrow{H^+(aq)} \xrightarrow{C_2H_5OH,\ conc.\ H_2SO_4}$

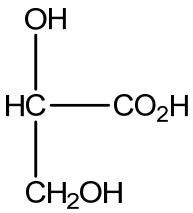
25. Ethanoic acid is prepared industrially by the direct carbonylation of methanol using a rhodium catalyst.

$$CH_3OH + CO \xrightarrow[\text{catalyst}]{\text{rhodium}} CH_3CO_2H$$

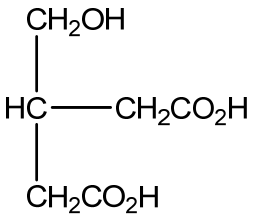
Which compound can be expected to produce the following product by this method?



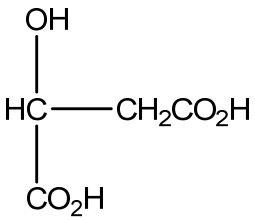
A



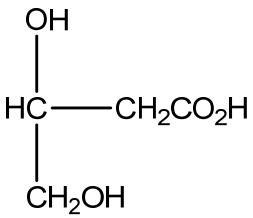
B



C



D



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

In the reaction shown, **T** represents a Group II element.

$$\mathbf{T}O_2 \rightarrow \mathbf{T}O + \frac{1}{2}O_2$$

Which statements about this reaction are correct?

1 It is a redox reaction.

2 The anion in $\mathbf{T}O_2$ contains 18 electrons.

3 Given that the percentage composition by mass of $\mathbf{T}O_2$ is **T**, 55.6; O, 44.4, the identity of **T** is calcium.

27. Which statements are true about the Haber process for the manufacture of ammonia?

1 In the presence of a catalyst, the equilibrium yield of ammonia increases and the rate of production of ammonia is faster.

2 At higher pressures, the equilibrium yield of ammonia increases and the rate of production of ammonia is faster.

3 At higher temperatures, the equilibrium yield of ammonia decreases but the rate of production of ammonia is faster.

28. Anhydrous aluminium chloride dissolves readily in water to form an aqueous solution.

Which observations are correct?

1 The O–H bonds are weaker in $[Al(H_2O)_6]^{3+}$ than in H_2O.

2 The H–O–H bond angle in an $[Al(H_2O)_6]^{3+}$ ion is larger than that in a H_2O molecule.

3 Universal indicator remains green in colour when added to this solution.

29. In water, the following equilibrium exists.

$$H_2O(l) = H^+(aq) + OH^-(aq) \qquad \Delta H^\ominus = +57 \text{ kJ mol}^{-1} \text{ at } 298 \text{ K}$$

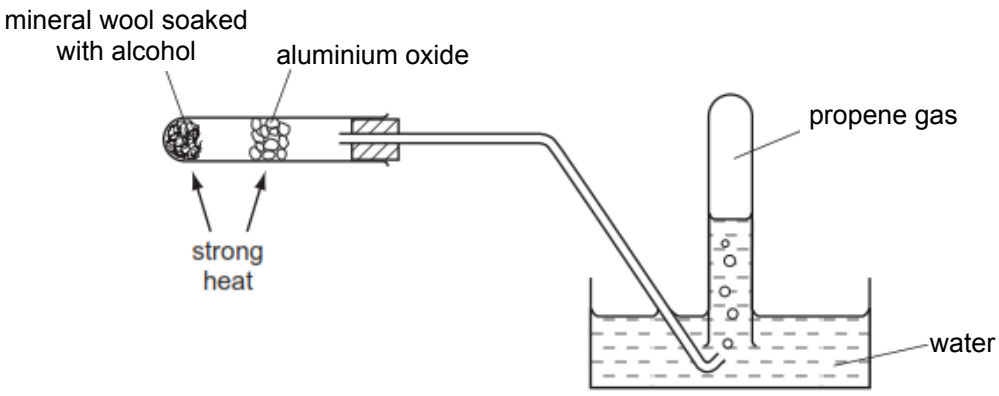
The ionic product of water is defined as $K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$ mol^2 dm^{-3} at 298 K.
What can be deduced from these data?

1 The equilibrium position lies further to the left at 273 K.

2 The K_w value decreases when sodium hydroxide is dissolved in water.

3 The pH of water at temperatures greater than 298 K is 7 because $[H^+] = [OH^-]$.

30. The diagram shows an experimental set–up for a reaction that collects propene gas as a product.



Which of the following about this reaction is correct?

1 The alcohol used in this reaction could be propan–1–ol.

2 If water in the trough is replaced by alkaline $KMnO_4$(aq), the product obtained is $C_3H_8O_2$.

3 Reduction has taken place.

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