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NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CHEMISTRY 8872/01

Paper 1 Multiple Choice **29 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 your name, class and tutor's name on the Answer Sheet in the spaces provided unless this has been done for you.

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 you 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.

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 question.*

Iron in the form of magnetite, Fe_3O_4, is extracted from ores in iron mines. The ore contains 69.9% by mass of iron.

What percentage of the ore contains Fe_3O_4, if it is the only iron-containing component present?

A 3.4%

B 69.9%

C 96.6%

D 100%

2 A 20 cm^3 sample of methanol is ignited with excess oxygen. The volume of the residual gas obtained was 80 cm^3. When the residual gas was shaken with aqueous sodium hydroxide, the volume decrease by 20 cm^3. What initial volume of oxygen present? (All volumes are measured at room temperature and pressure.)

A 60 cm^3 **B** 80 cm^3 **C** 90 cm^3 **D** 100 cm^3

3 The two most common isotopes of nickel are $^{58}_{28}Ni$ and $^{60}_{28}Ni$.

Which statement about the isotopes of nickel is correct?

A One of the isotopes has more protons than the other.

B Both isotopes have more electrons than neutrons.

C The electronic configuration of Ni^{2+} ion for both isotopes is the same.

D In the same magnetic field strength, $^{58}_{28}Ni$ will be deflected more than $^{60}_{28}Ni$.

4 The successive ionisation energies of two elements, **E** and **F**, are given below.

Ionisation energy / kJ mol^{-1}	1st	2nd	3rd	4th	5th	6th	7th	8th
E	1060	2330	4600	6225	37500	44000	-	-
F	1250	2300	3820	5160	6530	9360	11018	33604

What is the likely formula of the compound that is formed when **E** reacts with **F**?

A $\mathbf{EF_2}$ **B** $\mathbf{EF_4}$ **C** $\mathbf{E_2F_3}$ **D** $\mathbf{E_4F}$

5 Which of the following statements is correct?

A Dative bonding is present in the NH_4^+ ion.

B Molten $AlCl_3$ is able to conduct electricity because it is ionic.

C Ionic bonding in MgO (s) is between one Mg^{2+} ion and one O^{2-} ion.

D SiC has a giant molecular structure whereas SiO_2 has a simple molecular structure.

6 In which of the following pairs of species have the same bond angle?

A H_2O_2 and N_2F_2

B PH_3 and SF_3^+

C CH_4 and $SOCl_2$

D HCHO and BrF_3

7 H_2S can be oxidised in air to produce H_2O (g) and S (s).

The standard enthalpy change of formation of H_2S (g) is -20.5 kJ mol^{-1} and that of H_2O (g) is -243.0 kJ mol^{-1}.

What is the enthalpy change of the reaction per mole of H_2S (g)?

A -202.5 kJ mol^{-1}

B -222.5 kJ mol^{-1}

C -263.5 kJ mol^{-1}

D -445.0 kJ mol^{-1}

8 Which of the following equations best define the term *bond energy* of C–H bond?

A $CH_3CH_2CH_2CH_3$ (l) → 4C (s) + $5H_2$ (g)

B $CH_3CH_2CH_3$ (l) → 3C (s) + 8H (g)

C CH_3CH_3 (g) → 2C (g) + 6H (g)

D ¼CH_4 (g) → ¼C (g) + H (g)

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

An unknown amount of butane was burnt under a vessel containing 1 kg of water at 25 °C, it was found that the temperature of the water rose to 65 °C.

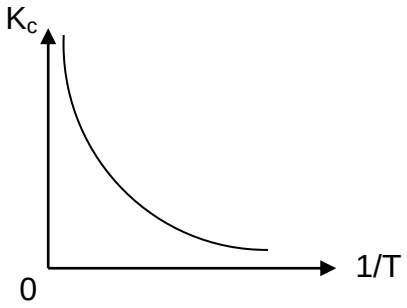
Given that 25% of the energy evolved from the combustion of butane was lost to the surroundings and the enthalpy change of combustion of butane is -2090 kJ mol^{-1}, what is the amount of butane burnt?

A 0.107 mol **B** 0.173 mol **C** 0.07 mol **D** 0.08 mol

10 The equilibrium constant K_c for the reaction

$$\mathbf{G}\ (g) + 2\mathbf{H}\ (g) \rightleftharpoons \mathbf{J}\ (g)$$

is found to vary with temperature T as shown in the diagram below.



Which statement about the reaction is correct?

A The yield will decrease at higher pressure.

B The reaction is exothermic in the forward reaction.

C Addition of a catalyst will cause the graph to be steeper at higher temperature.

D The equilibrium mixture contains a higher proportion of **J** at higher temperature.

11 Which set of solutions will give an acidic buffer solution when mixed?

A 50 cm^3 of 0.10 mol dm^{-3} CH_3CO_2H and 50 cm^3 of 0.10 mol dm^{-3} NaOH

B 50 cm^3 of 0.10 mol dm^{-3} H_2SO_4 and 100 cm^3 of 0.10 mol dm^{-3} NH_3

C 50 cm^3 of 0.10 mol dm^{-3} $CH_3CO_2^-$ and 50 cm^3 of 0.10 mol dm^{-3} CH_3CHO.

D 50 cm^3 of 0.10 mol dm^{-3} $(COOH)_2$ and 25 cm^3 of 0.10 mol dm^{-3} NaOH

12 Hydrogen peroxide reacts with acidified iodide ions to liberate iodine, according to the following reaction:

$$H_2O_2 + 2H^+ + 2I^- \rightarrow 2H_2O + I_2$$

The following experimental results were obtained.

Experiment	Initial $[H_2O_2]$ / mol dm^{-3}	Initial $[H^+]$ / mol dm^{-3}	Initial $[I^-]$ / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	0.005	0.100	0.050	3.75×10^{-5}
2	0.005	0.100	0.100	7.50×10^{-5}
3	0.010	0.005	0.100	1.50×10^{-4}

Given that the reaction is zero order with respect to H^+ ions, which statement is correct?

A The overall order of the reaction is 2.

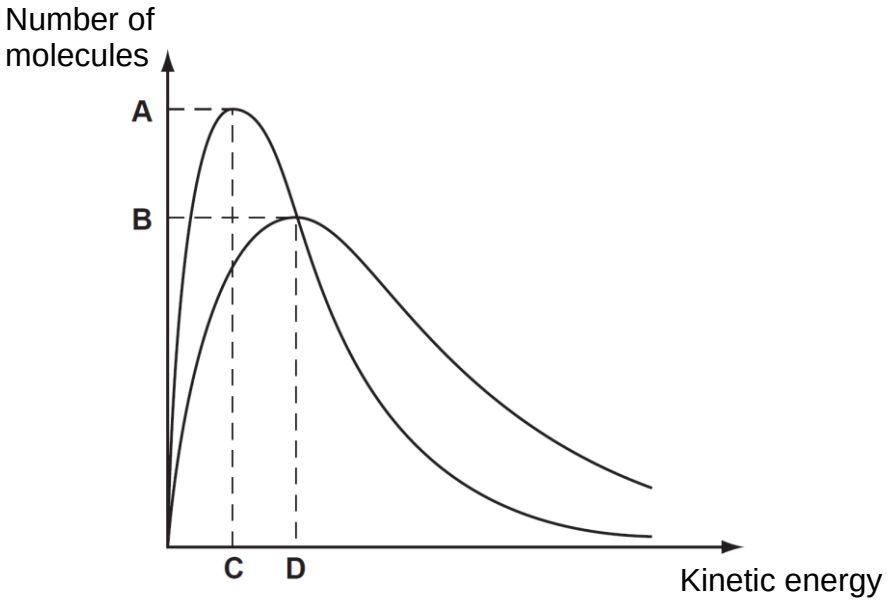
B The units for the rate constant are mol dm^{-3} s^{-1}.

C The rate constant for Experiment 2 will be double that of Experiment 1.

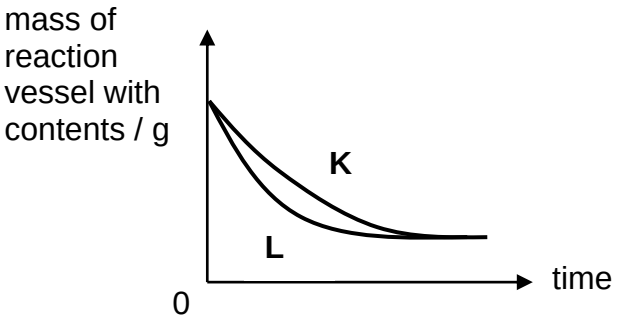
D The rate of reaction is dependent on the concentrations of H_2O_2, H^+ and I^-.

13 The diagram shows the Maxwell-Boltzmann energy distribution curves for molecules of a sample of a gas at two different temperatures.

Which letter on the axes represents the proportion of molecules with the most probable energy at the lower temperature?



14 Two experiments, **K** and **L**, were carried out to investigate the rates of the reaction between copper(II) carbonate and excess hydrochloric acid. The initial mass of the reaction vessel with contents was the same in both experiments. The results are shown in the diagram below.



Which of the following change in the conditions from Experiment **K** to Experiment **L** might explain the results shown?

A decreasing the concentration of hydrochloric acid

B decreasing the particle size of the copper(II) carbonate

C increasing the mass of copper(II) carbonate

D increasing the volume of the vessel

15 The cationic radius decreases from Na^+, Mg^{2+} to Al^{3+}. Which statement correctly explains this?

A Total number of electrons and nuclear charge increase.

B Total number of electrons and nuclear charge remain constant.

C Total number of electrons decreases and nuclear charge increases.

D Total number of electrons remains constant and nuclear charge increases.

16 Which of the following trend across the elements in Period 3 of the Periodic Table is always true?

A The ionisation energy of the elements decreases.

B The electrical conductivity of the elements decreases.

C The pH of their oxides in water decreases.

D The melting point of the elements decreases.

17 Two solutions were prepared by dissolving a chloride and an oxide of the elements in Period 3 of the Periodic Table in separate portions of water.

Both solutions prepared can be used to dissolve Al_2O_3 but only one can be used to dissolve SiO_2.

Which of the following could be the chloride and the oxide used?

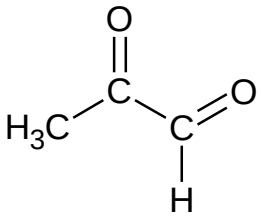
A $AlCl_3$ and Na_2O

B PCl_5 and P_4O_{10}

C $MgCl_2$ and MgO

D $NaCl$ and SO_3

18 2-Oxopropanal is one of a number of compounds responsible for the characteristic smell of burnt sugar.



2-Oxopropanal

How many σ and π bonds are there in a molecule of 2-Oxopropanal?

	σ	π
A	5	2
B	7	0
C	8	2
D	10	0

19 How many different isomers can be formed when 2-methylpentan-3-ol is heated with excess concentrated sulfuric acid at 180 ^{o}C?

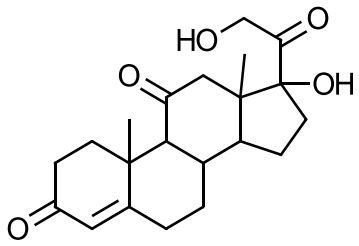
A 1

B 2

C 3

D 4

20 Cortisone is one of the main hormones that are released in response to stress.



cortisone

Which statement about this compound is **not** correct?

A It can exhibit geometric isomerism.

B It has a molecular formula of $C_{21}H_{28}O_5$.

C It will decolourise cold, dilute MnO_4^- ions.

D It can be esterified by ethanoic acid, in the presence of H^+ ions.

21 Which compound could be prepared by reacting bromoethane with potassium cyanide and then reducing the product?

A CH_3CH_3

B $CH_3CH_2CH_3$

C $CH_3CH_2NH_2$

D $CH_3CH_2CH_2NH_2$

22 Ozone depletion potential (ODP) is a measure of the effectiveness of chlorofluoroalkanes in destroying stratospheric ozone.

In which sequence are compounds listed in increasing order of their ODPs?

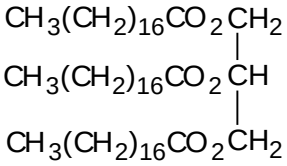
A $CH_3CClF_2 < CH_3CCl_2F < CCl_2FCClF_2$

B $CCl_2FCClF_2 < CH_3CClF_2 < CH_3CCl_2F$

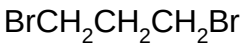
C $CH_3CClF_2 < CCl_2FCClF_2 < CH_3CCl_2F$

D $CH_3CCl_2F < CCl_2FCClF_2 < CH_3CClF_2$

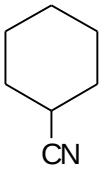
23 Experiments are carried out on three compounds **M**, **N**, and **P**.



M



N



P

A sample of 0.01 mol of each compound is heated under reflux with 100 cm^3 of 0.5 mol dm^{-3} NaOH (in excess) until hydrolysis is complete and any ammonia produced is expelled from solution. The left over NaOH is then titrated in each case and is found to require 40 cm^3, 60 cm^3 and 80 cm^3 of 0.5 mol dm^{-3} HC*l* for neutralisation.

Which sequence of compounds matches these results?

	Volume of HC*l* for neutralisation		
	40 cm^3	60 cm^3	80 cm^3
A	**M**	**N**	**P**
B	**M**	**P**	**N**
C	**N**	**M**	**P**
D	**P**	**N**	**M**

24 In the presence of dilute alkali, some carbonyl compounds undergo addition reactions to form a hydroxycarbonyl compound. For example, ethanal forms 3-hydroxybutanal.

$$2CH_3CHO \xrightarrow{OH^-} CH_3CH(OH)CH_2CHO$$

Which of the following gives the structure of the product formed when propanone undergoes the same reaction?

A $CH_3CH_2CH(OH)CH(CH_3)CHO$

B $CH_3C(OH)(CH_3)CH(CH_3)CHO$

C $CH_3CH_2CH(OH)CH_2COCH_3$

D $CH_3C(OH)(CH_3)CH_2COCH_3$

25 An organic compound is formed from the following three-step process.

$$CHOCH_2CH{=}CH_2 \xrightarrow{HCl} \mathbf{Q} \xrightarrow{\textbf{Step 2}} \mathbf{R} \xrightarrow{\textbf{Step 3}} CHOCH_2CH(CO_2^-Na^+)CH_3$$

What are the identities of the reagents for **Step 2** and **Step 3**, and the organic intermediate Q and R?

	Q	**Step 2**	**R**	**Step 3**
A	$CHOCH_2CH(Cl)CH_3$	HCN, NaOH	$CHOCH_2CH(CN)CH_3$	Na_2CO_3
B	$CHOCH_2CH(Cl)CH_3$	NaCN (alc)	$CHOCH_2CH(CN)CH_3$	NaOH (aq)
C	$CHOCH_2CH_2CH_2Cl$	NaCN (alc)	$CHOCH_2CH_2CH_2CN$	NaOH (aq)
D	$CHOCH_2CH_2CH_2Cl$	HCN, NaOH	$CHOCH_2CH_2CH_2CN$	Na_2CO_3

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 which 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 of the following is a disproportionation reaction?

1 Cu_2O (s) + H_2SO_4 (aq) → Cu (s) + $CuSO_4$ (aq) + H_2O (l)

2 $2NO_2$ (g) + H_2O (l) → HNO_3 (aq) + HNO_2 (aq)

3 $3Br_2$ (g) + 6NaOH (aq) → 5NaBr (aq) + $NaBrO_3$ (aq) + $3H_2O$ (l)

27 Which species in their ground states have 3 unpaired electrons?

1 P

2 Cr^{3+}

3 Fe^{3+}

28 Element **X** is in Period 3 of the Periodic Table.

X burns in air to form a solid white oxide, which reacts with acid to form a neutral solution. The hydroxide of **X** is also able to react with alkali.

Which elements can be **X**?

1 Aluminium

2 Magnesium

3 Sodium

29 A compound **Z** was boiled with aqueous sodium hydroxide and the resulting mixture was cooled and acidified with dilute sulfuric acid. The final products included a compound $C_3H_6O_2$ and an alcohol which gave a positive triiodomethane test.

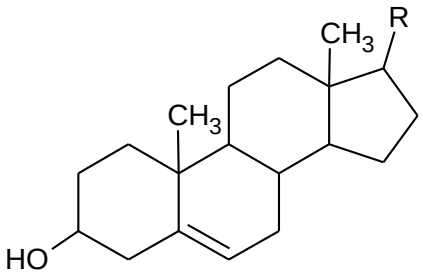
Which of the following formulae could represent **Z**?

1 $CH_3CH_2OCOCH_3$

2 $CH_3CH_2CO_2CH_2CH_3$

3 $C_6H_5CH(CH_3)OCOCH_2CH_3$

30 Cholesterol is the most common steroid alcohol. It has a molecular formula of $C_{27}H_{46}O$ and has the structure shown.



Cholesterol

Which reagent would react with this compound?

1 PCl_5

2 hot acidified $KMnO_4$

3 2,4-dinitrophenyhydrazine