NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CHEMISTRY 8872/01

Paper 1 Multiple Choice **25 Sep 2017**

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, CT and NRIC / FIN on the Answer Sheet in the spaces provided.

There are **thirty** 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.

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*.

The compound S_2O_7 is hydrolysed by water to produce sulfuric acid and oxygen.

What volume of oxygen, measured at room temperature and pressure, is evolved when 0.352 g of S_2O_7 is hydrolysed?

A 12 cm^3 **B** 24 cm^3 **C** 48 cm^3 **D** 96 cm^3

2 Tanzanite is used as a gemstone for jewellery. It is a hydrated calcium aluminium silicate mineral with a chemical formula of $Ca_2Al_aSi_bO_{12}(OH).6½H_2O$. Tanzanite has M_r of 571.5.

Its chemical composition is 14.04% calcium, 14.17% aluminium, 14.75 % silicon, 54.59% oxygen and 2.45% hydrogen.

What are the values of a and b?

	a	b
A	1	1
B	2	3
C	3	3
D	6	1

3 Ammonium nitrate, NH_4NO_3, can decompose explosively when heated.

$$NH_4NO_3 \rightarrow N_2O + 2H_2O$$

What are the changes in the oxidation numbers of the two nitrogen atoms in NH_4NO_3?

A −2, −4 **B** +2, +6 **C** +4, −6 **D** +4, −4

4 Tritium is the isotope of hydrogen ^{3}H.

Which of the following is the same for a ^{4}He atom and a ^{3}H atom?

A the relative atomic mass

B the number of electrons

C the number of protons

D the number of neutrons

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

What could be the proton number of an element that has three unpaired electrons in each of its atoms?

A 5 **B** 13 **C** 15 **D** 21

6 Why does aluminium chloride, Al_2Cl_6, sublime at a relatively low temperature of 180 ^{o}C?

A The intermolecular forces between the Al_2Cl_6 molecules are weak.

B The co-ordinate bonds between aluminium and chlorine are weak.

C The covalent bonds between aluminium and chlorine are weak.

D The ionic bonds between aluminium and chlorine are weak.

7 Which of these statements cannot be explained by hydrogen bonding?

A At 0 ^{o}C, ice floats on water.

B At 20 ^{o}C, propanone and propanal are miscible.

C The relative molecular mass of ethanoic acid in benzene is 120.

D The boiling point of propan-2-ol and propanone are 82 ^{o}C and 56 ^{o}C respectively.

8 Silica, SiO_2 has many industrial uses, including the manufacture of glass, ceramic and cement.

In the structure of solid SiO_2

- each silicon atom is bonded to x oxygen atoms,
- each oxygen atom is bonded to y silicon atoms,
- each bond is a z bond.

What is the correct combination of x, y and z in these statements?

	x	y	z
A	2	1	covalent
B	2	1	ionic
C	4	2	covalent
D	4	2	ionic

9 Ethanol, commonly made from biomass such as sugarcane is increasingly being used as a green fuel due to its lower greenhouse gas emissions as compared to burning fossil fuels.

The appropriate enthalpy changes of formation are given in the table.

Compound	$\Delta H_f^{\ominus}$ / kJ mol^{-1}
Carbon dioxide	−393
Water	−286
Ethanol	−277

What is the enthalpy change of combustion of ethanol?

A $\Delta H_c^{\ominus} = -1921$ kJ mol^{-1}

B $\Delta H_c^{\ominus} = -1367$ kJ mol^{-1}

C $\Delta H_c^{\ominus} = -956$ kJ mol^{-1}

D $\Delta H_c^{\ominus} = -402$ kJ mol^{-1}

10 A student mixed 30.0 cm^3 of 0.350 mol dm^{-3} sodium hydroxide solution with 25.0 cm^3 of 0.350 mol dm^{-3} hydrochloric acid. The temperature rose by 2.5 °C. Assume that 4.20 J is required to raise the temperature of 1 cm^3 of the solution by 1 K.

Which is the enthalpy change of neutralisation?

A $\Delta H_n^{\ominus} = -330$ kJ mol^{-1}

B $\Delta H_n^{\ominus} = -66$ kJ mol^{-1}

C $\Delta H_n^{\ominus} = -55$ kJ mol^{-1}

D $\Delta H_n^{\ominus} = -30$ kJ mol^{-1}

11 $Na_2S_2O_3$ reacts with dilute HC*l* to give a pale yellow precipitate. If 1 cm^3 of 0.1 mol dm^{-3} HC*l* is added to 10 cm^3 of 0.02 mol dm^{-3} $Na_2S_2O_3$, the precipitate forms slowly.

If the experiment is repeated with 1 cm^3 of 0.1 mol dm^{-3} HC*l* and 10 cm^3 of 0.05 mol dm^{-3} $Na_2S_2O_3$, the precipitate forms more quickly.

Why is there a difference in observation when 0.05 mol dm^{-3} $Na_2S_2O_3$ is used?

A The reactant particles collide more frequently.

B The reaction proceeds by a different pathway.

C The activation energy of the reaction is lower.

D The collisions between reactant particles are more violent.

12 Which statement about dynamic equilibrium is always correct?

A Equal amounts of reactants and products are present.

B Concentrations of reactants and products remain constant.

C The rates of the forward and reverse reactions are equal to zero.

D The rate constant for the forward reaction equals the rate constant for the reverse reaction.

13 The following equilibrium is set up in a mixture of concentrated nitric acid and sulfuric acid.

$$HNO_3 + H_2SO_4 \rightleftharpoons H_2NO_3^+ + HSO_4^-$$

Which row correctly describes the behaviour of each substance in the reaction mixture?

	HNO_3	H_2SO_4	$H_2NO_3^+$	HSO_4^-
A	acid	acid	base	base
B	acid	base	acid	base
C	base	acid	acid	base
D	acid	base	base	acid

14 The table gives the concentrations and pH values of the aqueous solutions of two compounds, F and G. Either compound could be an acid or a base.

	F	G
concentration	2 mol dm^{-3}	2 mol dm^{-3}
pH	6	9

Student P concluded that G is a weak base.

Student Q concluded that the extent of dissociation is lower in F(aq) than in G(aq).

Which of the students are correct?

A both P and Q

B neither P nor Q

C P only

D Q only

15 The value of the ionic product, K_w, varies with temperature.

temperature / ^oC	K_w / $mol^2\ dm^{-6}$
25	1.0×10^{-14}
62	1.0×10^{-13}

What can be deduced from this information?

A Water is not a neutral liquid at 62 ^oC.

B The ionic dissociation of water is an endothermic process.

C Hydrogen bonding between water molecules increases as temperature rises.

D The ionic dissociation of water increases by a factor of 5 between 25 ^oC and 62 ^oC.

16 Elements X and Y are both in Period 3. Element X has the smallest atomic radius in Period 3. There are only two elements in Period 3 which have a lower melting point than element Y. Elements X and Y react together to form compound Z.

Which compound could be Z?

A $MgCl_2$ **B** SCl_2 **C** Na_2S **D** PCl_5

17 The electrical conductivities of two compounds, H and I, are shown in the table.

Electrical conductivity	H	I
conductivity of the compound in the liquid state	good	does not conduct
conductivity of the mixture obtained by adding the compound to water	good	good

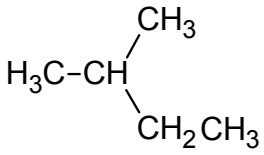
What could compounds H and I be?

	H	I
A	NaF	$SiCl_4$
B	NaF	Al_2O_3
C	Al_2O_3	$SiCl_4$
D	$SiCl_4$	Al_2O_3

18 Alcohols can be classified into primary, secondary and tertiary alcohols. How many structural isomers are there for each type with the formula $C_5H_{12}O$?

	primary	secondary	tertiary
A	3	3	2
B	4	2	2
C	4	3	1
D	5	2	1

19 When 2-methylbutane reacts with limited chlorine gas in the presence of uv light, monochlorinated compounds are formed.



2-methylbutane

Which of the following statements is **not** correct?

A H_2 molecule is a by-product of the reaction.

B Four different monochlorinated isomers may be formed.

C The reaction can take place if heat is used instead of uv light.

D The colour in the reaction vessel changes from yellow-green to white.

20 S and T are isomers of $C_4H_6Br_2$.

S **T**

Which of the following are three **different** possible products formed when S and T isomers react with HBr?

A	$(CH_3)_2CHCBr_3$	$(CH_3)_2CBrCHBr_2$	$CH_3CHBrCHBrCH_3$
B	$(CH_3)_2CBrCHBr_2$	$CHBr_2CBr(CH_3)_2$	$CH_3CHBrCBr_2CH_3$
C	$(CH_3)_2CBrCBr_3$	$(CH_3)_2CHCBr_3$	$CH_3CBr_2CHBrCH_3$
D	$(CH_3)_2CHCBr_3$	$(CH_3)_2CBrCHBr_2$	$CH_3CBr_2CHBrCH_3$

21 A catalytic converter is part of the exhaust system of many modern cars. Which reactions occur in a catalytic converter?

A $2CO + 2NO \rightarrow 2CO_2 + N_2$

B $2SO_2 + 2NO \rightarrow 2SO_3 + N_2$

C $C_6H_{14} \rightarrow C_2H_4 + C_4H_{10}$

D $CO_2 + NO \rightarrow CO + NO_2$

22 Sodium hydroxide reacts with chloropropane in a series of steps to produce propanal.

$$CH_3CH_2CH_2Cl \longrightarrow \longrightarrow CH_3CH_2CHO$$

Which of the following terms describe the first step of this reaction?

A addition

B elimaintion

C oxidation

D substitution

23 Which of the following reagents can be used to differentiate the two alcohols?

$CH_3CH_2CH_2CH(OH)CH_3$ $CH_3CH_2CH(OH)CH_2CH_3$

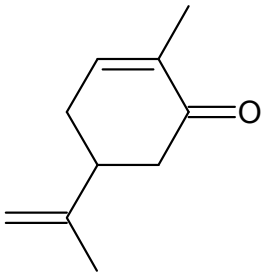
A Acidified $K_2Cr_2O_7$

B Acidified $KMnO_4$

C Tollens' reagent

D I_2 (aq), NaOH

24 Carvone is used to give the flavour of spearmint in chewing gums.



Carvone

Prolonged heating of carvone with hot concentrated acidified potassium manganate(VII) produces compound L.

What is the maximum number of molecules of 2,4-dinitrophenylhydrazine that will react with one molecule of L?

A 1 **B** 2 **C** 3 **D** 4

25 Butanedioic acid may be synthesised in two steps from 1,2-dibromoethane.

$$BrCH_2CH_2Br \xrightarrow{\text{step 1}} X \xrightarrow{\text{step 2}} HO_2CCH_2CH_2CO_2H$$

Which of the following reagents can be used for this synthesis?

	step 1	step 2
A	HCN and KCN	HC*l*
B	$HCO_2^-Na^+$	HC*l*
C	NaOH	$K_2Cr_2O_7$ and H_2SO_4
D	KCN in ethanol	H_2SO_4

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 Methanol is manufactured industrially by the catalytic reaction shown.

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g) \qquad \Delta H < 0$$

The operating conditions are:

- 250 ^{o}C
- a pressure between 50 atm and 100 atm
- a copper-based catalyst

Which factor influences the choice of these conditions?

1 The catalyst increases the equilibrium yield of methanol

2 At high pressures, the rate of formation of methanol increases.

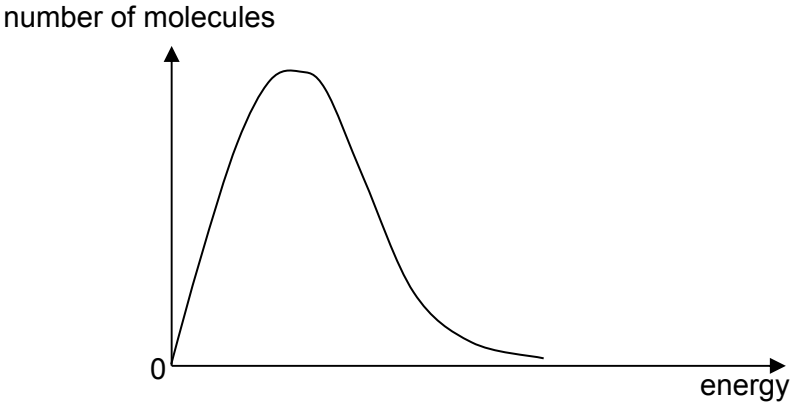
3 At lower temperatures, the equilibrium yield of methanol increases.

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.

27 The graph below shows the Boltzmann distribution of molecular energies.



Which of the following statements are correct?

1 Raising the temperature increases the spread of molecular energies.

2 The area under the curve is proportional to the number of molecules present.

3 Raising the temperature always increases the number of molecules with a given energy.

28 A little water is added to each of the following compounds and the mixture warmed. For which compounds will an acidic gas be evolved?

1 aluminium chloride

2 silicon chloride

3 phosphorus pentachloride

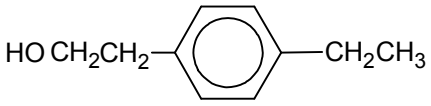
The responses **A** to **D** should be selected on the basis of

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 Which of the following structures will give benzene–1,4–dicarboxylic acid as the only organic product when heated with acidified $KMnO_4$ under reflux?

1



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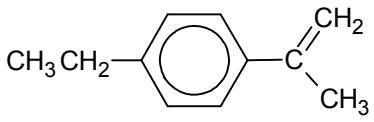

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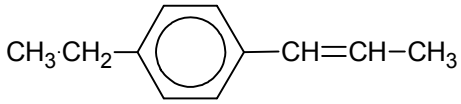

30 Bromoethane reacts with NaOH in different ways depending on the solvent used. Which of the following are correct?

	solvent	main organic product
1	water	ethane-1,2-diol
2	ethanol	ethene
3	water	ethanol

1		**11**		**21**	
2		**12**		**22**	
3		**13**		**23**	
4		**14**		**24**	
5		**15**		**25**	
6		**16**		**26**	
7		**17**		**27**	
8		**18**		**28**	
9		**19**		**29**	
10		**20**		**30**	