NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CHEMISTRY   8872/01

Paper 1 Multiple Choice   **26 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 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.

This document consists of **15** printed pages and 0 blank page.

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Section A

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

1   0.02 mol of $C_xH_yNO_2$ was burned in excess oxygen as shown by the equation below.

$$C_xH_yNO_2 + aO_2 \rightarrow xCO_2 + NO_2 + \frac{y}{2}H_2O$$
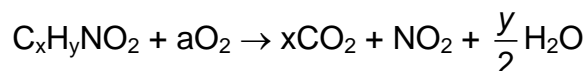
The gases that were produced were first passed through a U-tube containing phosphorus pentoxide and then bubbled through 0.25 mol of NaOH(aq).

The equations illustrating the reactions of the gases with NaOH(aq) are as shown below.

$CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$
$2NO_2 + 2NaOH \rightarrow NaNO_2 + NaNO_3 + H_2O$
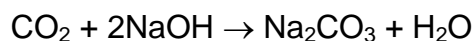
The phosphorus pentoxide U-tube increased in mass by 1.15 g and the excess NaOH(aq) required 40.00 cm^3 of 0.875 mol dm^{-3} H$_2$SO$_4$ for complete reaction.

What is the ratio of x:y?

A 2:3
B 4:3
C 4:7
D 8:7

2   An acidified solution of the salt KClO$_z$ will oxidise Ti^{3+}(aq) to Ti^{4+}(aq) quantitatively, the chlorine being reduced to Cl$^-$(aq).

When 0.170 g of the salt KClO$_z$ was reacted with 0.400 mol dm^{-3} Ti^{3+}(aq) in the presence of H$^+$(aq), 24.50 cm^3 of Ti^{3+}(aq) was needed for complete reaction.

What is the value of **z**?

A 1
B 2
C 3
D 4

3 Which of the following ions has one more electron in the third quantum shell than in the second quantum shell?

    A Ca^{2+}

    B Cl^-

    C Sc^+

    D S^{2-}

4 In which of the following pairs does species **I** have a smaller bond angle than species **II**?

	I	**II**
A	$AsCl_3$	ClO_2^-
B	CS_2	SO_4^{2-}
C	NO_2^-	NO_3^-
D	PH_4^+	SF_6

5 Which of the following statements about the properties associated with ionic and covalent bonds is correct?

    A   The only covalent compounds with high melting points are those in which hydrogen bonds occur.

    B   Any covalent compound that contains both oxygen and hydrogen in its molecule forms hydrogen bonds.

    C   Any ionic bonds and covalent bonds cannot both occur in the same compound.

    D   Ionic compounds differ from metals in that ionic compounds do not conduct electricity in the solid state.

6 The enthalpy change of combustion of butanone, $C_2H_5COCH_3$, is -2440 kJ mol^{-1}.

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

Substance	$\Delta H_f^{\ominus}$ / kJ mol^{-1}
$CO_2(g)$	-394
$H_2O(l)$	-286

What is the enthalpy change of formation of butanone?

A -1760

B -280

C $+280$

D $+1760$

7 *Use of the Data Booklet is relevant to this question.*
Octane can react with bromine to form bromooctane and hydrogen bromide.

$$2C_8H_{18} + 2Br_2 \rightarrow 2C_8H_{17}Br + 2HBr$$
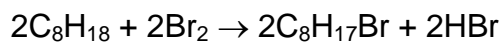
What is the enthalpy change of the reaction?

A -86 kJ mol^{-1}

B -43 kJ mol^{-1}

C $+58$ kJ mol^{-1}

D $+116$ kJ mol^{-1}

8 A radioactive element has two isotopes, **G** and **H**, with half-lives of 5 min and 15 min respectively. An experiment starts with 4 times as many atoms of **G** as of **H**.

Radioactive decay is a first-order reaction.

How long will it be before the number of atoms of **G** left equals the number of atoms of **H** left?

- **A** 5 min
- **B** 10 min
- **C** 15 min
- **D** 20 min

9 In the diagram, curve **X** was obtained by observing the decomposition of 100 cm^3 of 1.0 mol dm^{-3} hydrogen peroxide, catalysed by manganese(IV) oxide.

Which alteration to the original experimental conditions would produce curve **Y**?
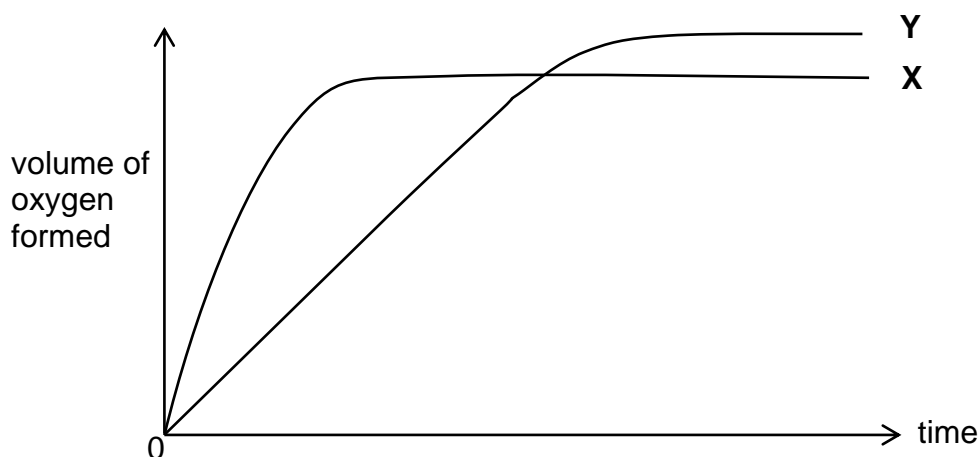
- **A** adding water
- **B** adding some 0.1 mol dm^{-3} hydrogen peroxide
- **C** using less manganese(IV) oxide
- **D** lowering the temperature

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10 For the reaction

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$
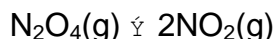
the numerical value of K_c is 0.273 at 500 K and is 0.339 at 600 K.

What deduction can be made from this information?

    A The yield of NO_2 will increase at higher pressure.

    B The yield of NO_2 is independent of temperature.

    C The forward reaction is endothermic.

    D The value of K_c depends on the amount of N_2O_4 initially present.

11 PCl_5 decomposes on heating according to the following equation.

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$
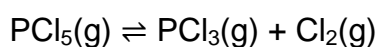
When 0.8 mol of PCl_5 were put into a 2 dm^3 container and heated, the equilibrium mixture contained 0.48 mol of chlorine.

What is the numerical value of the equilibrium constant, K_c, at the temperature of the experiment?
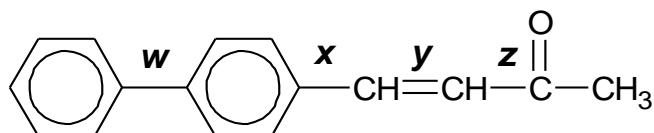
    A 0.144

    B 0.288

    C 0.360

    D 0.720

12 Which statement is correct about the following reaction?

$$C_6H_5O^- + HCl \rightarrow C_6H_5OH + Cl^-$$
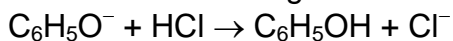
    A C_6H_5OH is a proton acceptor.

    B $C_6H_5O^-$ is a Bronsted base.

    C Cl^- is a Bronsted acid.

    D HCl is the conjugate base of Cl^-.

13 A 0.100 mol dm^{-3} aqueous solution of an acid HX has a pH of 4.0.
Which statement is correct?

A Adding an equal volume of water to the acid solution increases the pH to 8.0.

B HX is a weak acid.

C The hydrogen ion concentration is 0.100 mol dm^{-3}.

D 1 dm^3 of the acid solution requires 1.00×10^{-4} mol NaOH for neutralisation.

14 Which statement concerning only the elements in the third period, sodium to argon, is correct?

A The element that has exactly four atoms in its molecule is sulfur.

B The element with the highest electrical conductivity is aluminium.

C The element with the highest melting point is aluminium.

D The element with the largest anion is chlorine.

15 Which compound is **not** a product of the reaction between an oxide of a third period element and water?

A NaOH

B H_2SiO_3

C H_3PO_4

D H_2SO_4

16 Four carbon-carbon bonds are labelled in the diagram.

(structure: biphenyl with bond *w* joining the two rings; the second ring joined via bond *x* to $-CH=CH-C(=O)-CH_3$, where bond *y* is the $CH=CH$ bond and bond *z* is the $CH-C$ bond)

Which bonds are made up of a sp^2–sp^2 overlap?

A *w* and *y* only

B *w*, *x* and *y* only

C *w*, *x*, *y* and *z*

D *x*, *y* and *z* only

**17** Testosterone is an important hormone in the development of the male reproductive tissues.
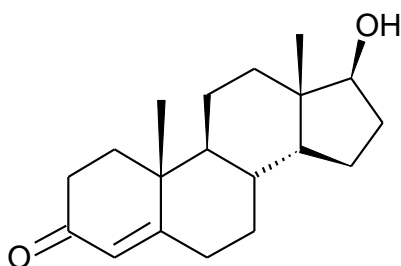
testosterone

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

A It decolourises aqueous bromine.

B It decolourises cold, dilute MnO_4^- ions.

C It can exhibit geometric isomerism to give two isomers.

D It can undergo reduction with sodium borohydride to give a product with the molecular formula, $C_{19}H_{30}O_2$.

18 Which of the following products could be formed by the action of hot alkaline potassium manganate(VII) on an alkene of formula C_4H_8?

A CO_2, $(CH_3)_2CO$, CH_3CH_2COOH

B $HCOO^-$, $CH_3CO_2^-$ $CH_3CH_2CO_2^-$

C CO_3^{2-}, $(CH_3)_2CO$, $CH_3CO_2^-$

D $HCOO^-$, $(CH_3)_2CO$, $CH_3CH_2CO_2^-$

19 Compound **Z** is heated under reflux with alkaline potassium dichromate(VI).
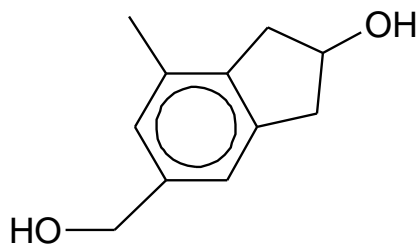
Compound **Z**

What is the main product?

A
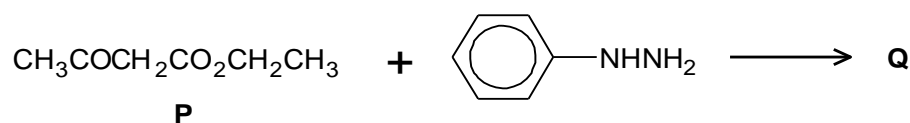

B

C

D

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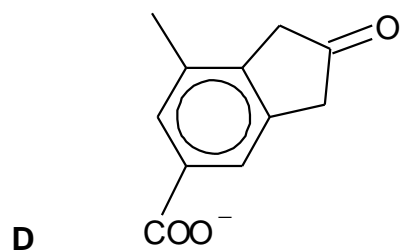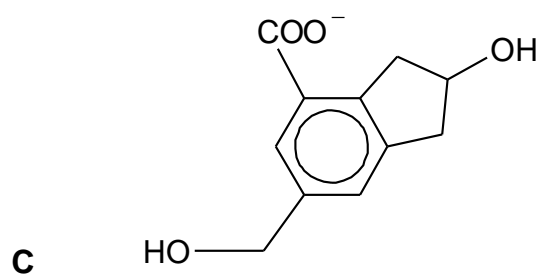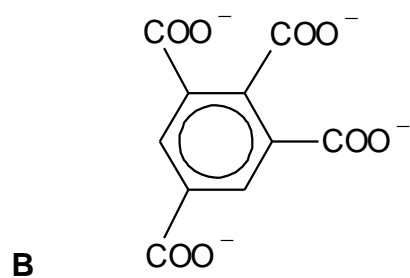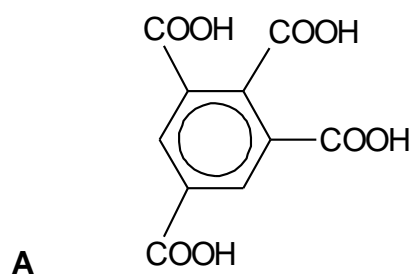
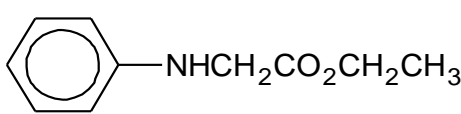**20** 2-bromopropane may be used as the starting material to manufacture $(CH_3)_2CHCO_2H$.

Which sequence would be the most suitable?
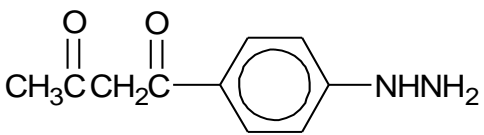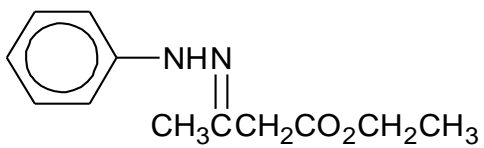
A $(CH_3)_2CHBr \rightarrow (CH_3)_2CHOH \rightarrow (CH_3)_2CHCO_2H$

B $(CH_3)_2CHBr \rightarrow (CH_3)_2CHCN \rightarrow (CH_3)_2CHCO_2H$

C $(CH_3)_2CHBr \rightarrow (CH_3)_2CHOH \rightarrow (CH_3)_2CHCN \rightarrow (CH_3)_2CHCO_2H$

D $(CH_3)_2CHBr \rightarrow (CH_3)_2CHCN \rightarrow (CH_3)_2CHCH_2OH \rightarrow (CH_3)_2CHCO_2H$

21 The first stage in the synthesis of *Antipyrine*, a drug used in reducing fever, is the reaction between compound **P** and phenylhydrazine.

$$CH_3COCH_2CO_2CH_2CH_3 \quad \textbf{+} \quad \text{⬡—NHNH}_2 \longrightarrow \textbf{Q}$$

P

What would be the product **Q**?

A ⬡—$NHCOCH_2COCH_3$

B ⬡—$NHCH_2CO_2CH_2CH_3$

C
$$CH_3\overset{O}{\overset{||}{C}}CH_2\overset{O}{\overset{||}{C}}\text{—⬡—}NHNH_2$$

D
⬡—NHN
$$||$$
$$CH_3\overset{}{C}CH_2CO_2CH_2CH_3$$
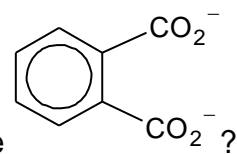
22 Which compound will react with alkaline aqueous iodine to give

 ?

(a benzene ring with two ortho CO_2^- groups)

A (benzene with ortho CH_2COCH_3 and CH_2COCH_3)

B (benzene with ortho $COCH_3$ and $CH(OH)CH_3$)

C (benzene with ortho $CH(OH)CH_3$ and CH_3)

D (benzene with ortho $CH_2CH(OH)CH_3$ and CHO)

23 This question is about the four organic compounds shown below:

(**I**) $CH_3CH_2CH_2CH_2CHO$

(**II**) $CH_3CH_2CH_2CHClCOOH$

(**III**) $CH_3CH_2CH_2CH_2CH_2OH$

(**IV**) $CH_3CH_2CH_2CH_2COCl$

What is the relative order of decreasing pK_a of these compounds?

A I > III > IV > II

B I > III > II > IV

C II > IV > III > I

D IV > II > III > I

24 Gluconic acid has the following formula, $HOCH_2(CHOH)_4COOH$.

What reagent reacts completely with 1 mol of gluconic acid?

A 5 mol of Na(s)

B 6 mol of HCl(g)

C 6 mol of NaOH(aq)

D 6 mol of $SOCl_2$

25 Which of the following pairs of reactants are best used to synthesise propyl butanoate?

A $CH_3CH_2CH_2COOH + CH_3CH_2CH_2OH$

B $CH_3CH_2COOH + CH_3CH_2CH_2CH_2OH$

C $CH_3CH_2CH_2COCl + CH_3CH_2CH_2OH$

D $CH_3CH_2COCl + CH_3CH_2CH_2CH_2OH$

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 In which of the following pairs of species is the sulfur in the same oxidation state in both members of the pair?
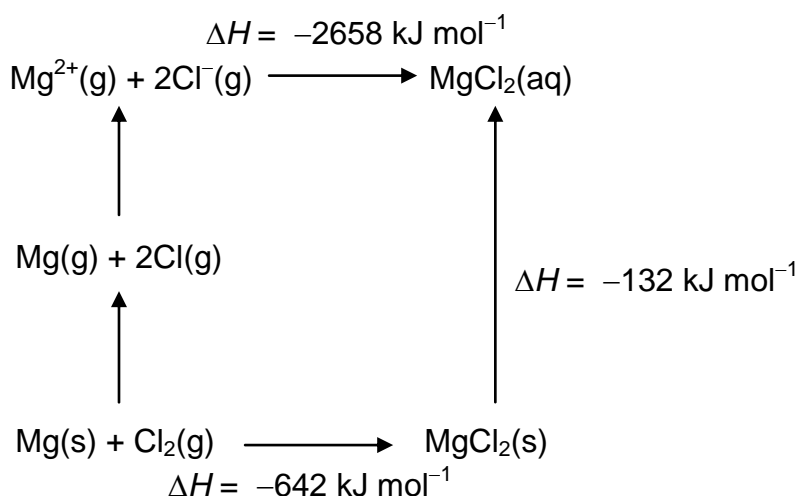
  1 SF_6 and SO_4^{2-}

  2 SO_2 and HSO_3^{-}

  3 $S_2O_3^{2-}$ and $S_4O_6^{2-}$

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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 diagram illustrates the energy changes of a set of reactions.

$$\Delta H = -2658 \text{ kJ mol}^{-1}$$

$$Mg^{2+}(g) + 2Cl^{-}(g) \longrightarrow MgCl_2(aq)$$

$$Mg(g) + 2Cl(g)$$

$$\Delta H = -132 \text{ kJ mol}^{-1}$$

$$Mg(s) + Cl_2(g) \longrightarrow MgCl_2(s)$$
$$\Delta H = -642 \text{ kJ mol}^{-1}$$

Which statements about the process are **incorrect**?

1 The enthalpy change for the following reaction:

$Mg(s) + Cl_2(g) \rightarrow Mg^{2+}(g) + 2Cl^{-}(g)$ is -132 kJ mol^{-1}.

2 The enthalpy change for the following reaction:

$2MgCl_2(aq) \rightarrow 2Mg(s) + 2Cl_2(g)$ is $+774$ kJ mol^{-1}.

3 The enthalpy change for the following reaction:

$MgCl_2(s) \rightarrow Mg^{2+}(g) + 2Cl^{-}(g)$ is $+2526$ kJ mol^{-1}

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

The element selenium is immediately below sulfur in the Periodic Table.
Which statements are correct?

1 Selenium has a lower first ionisation energy than sulfur.

2 Se^{2-} has a larger ionic radius than S^{2-}.

3 Se^{2-} has a smaller ionic radius than Br^{-}.

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 An organic compound, **X**, contains 46.2% carbon, 7.7% hydrogen and 46.2% oxygen. One mole of **X** reacts with two moles of sodium metal to give one mole of hydrogen. On heating with acidified potassium dichromate, a colour change from orange to green was observed.

Which of the following statement is correct about compound **X**?

1 The empirical formula of **X** is $C_4H_8O_3$.

2 Its aqueous solution is acidic.

3 **X** contains a tertiary alcohol.

30 Nail varnish consists of a mixture of pigments, gloss, plasticiser and adhesive dissolved in a suitable solvent. A common solvent is a mixture of propanone and pentyl ethanoate.

Which reagents will give a yellow or orange precipitate with this solvent?

1 2,4-dinitrophenylhydrazine

2 alkaline aqueous iodine

3 Tollens' reagent