ANGLO-CHINESE JUNIOR COLLEGE
DEPARTMENT OF CHEMISTRY
Preliminary Examination

CHEMISTRY **8872/01**
Higher 1

Paper 1 Multiple Choice

29 August 2016
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 fluids.
Write your name, index number and tutorial class 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 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.

This document consists of **14** 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 Which statement about one mole of a metal is always true?

A It contains the same number of atoms as one mole of hydrogen atoms.

B It contains the same number of particles as $\frac{1}{12}$ mole of ^{12}C.

C It has the same mass as one mole of hydrogen atoms.

D It is liberated by one mole of electrons.

2 The discharge of the nickel-cadmium rechargeable battery is based upon the following overall reaction.

$$Cd + 2NiOOH + 4H_2O \longrightarrow Cd(OH)_2 + 2Ni(OH)_2.H_2O$$

What is the oxidation number of nickel at the beginning and at the end of the reaction?

	beginning	end
A	+1.5	+2
B	+2	+3
C	+3	+2
D	+3	+4

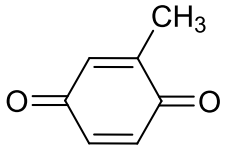
3 Elements **J** and **Q** have the following successive ionisation energies in kJ mol^{-1}

	1st	2nd	3rd	4th	5th	6th	7th
J	587	1817	2745	11577	14842	18379	23326
Q	870	1790	2698	3610	5668	6820	13200

What is the likely formula of the compound that is formed when **J** reacts with **Q**?

A $\mathbf{JQ_3}$ **B** $\mathbf{J_2Q_3}$ **C** $\mathbf{J_3Q_2}$ **D** $\mathbf{J_2Q}$

4 The unsaturated diketone as shown below is excreted by the bombardier beetle.



What are the numbers of sp, sp^2 and sp^3 hybridised carbon atoms in the product formed when this diketone is reacted with HCN in the presence of a trace amount of KCN?

	sp	sp^2	sp^3
A	0	6	3
B	1	5	3
C	2	4	3
D	3	2	4

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

A Some covalent compounds can serve as an electrolyte in water.

B Ionic bonds and covalent bonds cannot occur in the same compound.

C Ionic compounds and metals can conduct electricity in both the solid and liquid states.

D Any covalent compounds that have both hydrogen and oxygen atoms in its molecule can definitely form intermolecular hydrogen bond with itself.

6 In which of the following pairs does the first species have a larger bond angle than the second?

A CH_4, CH_3^+

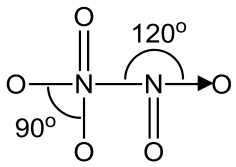
B NCl_3, BH_3

C XeF_4, SF_6

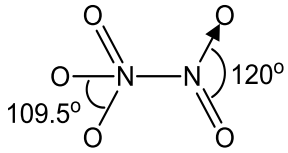
D H_2O, H_2S

7 Which is the most likely structure of a molecule of dinitrogen pentoxide, N_2O_5 showing its bond angles?

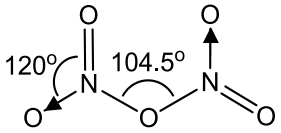
A



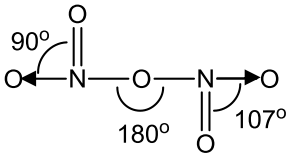
B



C



D



8 Which of the following solids consists of particles held together only by van der Waals' forces?

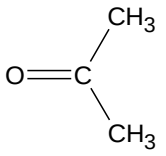
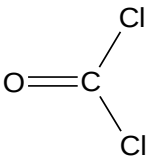
A NaC*l*

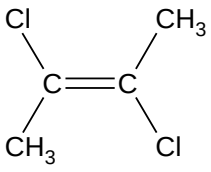
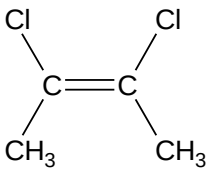
B H_2O

C Cu

D Ar

9 In which one of the following pairs does the first molecule have a larger dipole than the second?

A  and 

B  and 

C HC*l* and HF

D SO_3 and SO_2

10 The radioactive decay of element **M** is a first-order process.

It takes 32 seconds for 4 g of element **M** to decay 2 g.

How long will it take 0.25 g of **M** to decay to 0.0625 g?

A 32 seconds

B 64 seconds

C 128 seconds

D 160 seconds

11 This question concerns the magnitude of lattice energies of the following four ionic compounds.

$CaBr_2$ LiC*l* $MgCl_2$ NaBr

Which sequence gives the lattice energies in order of increasing magnitude?

A $CaBr_2$ LiC*l* $MgCl_2$ NaBr

B LiC*l* NaBr $MgCl_2$ $CaBr_2$

C $MgCl_2$ $CaBr_2$ NaBr LiC*l*

D NaBr LiC*l* $CaBr_2$ $MgCl_2$

12 H_3PO_4 is a triprotic acid which has three acid dissociation constants. The table below shows the first, second and third acid dissociation constants, K_a, respectively.

dissociation	equilibrium in aqueous solution	K_a/mol dm^{-3}
first	$H_3PO_4(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + H_2PO_4^-(aq)$	7.5×10^{-3}
second	$H_2PO_4^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + HPO_4^{2-}(aq)$	6.2×10^{-8}
third	$HPO_4^{2-}(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + PO_4^{3-}(aq)$	2.2×10^{-13}

Which of the following ranks the conjugate bases in order of increasing basicity?

	lowest	⟶	highest
A	PO_4^{3-}	HPO_4^{2-}	$H_2PO_4^-$
B	$H_2PO_4^-$	HPO_4^{2-}	PO_4^{3-}
C	HPO_4^{2-}	PO_4^{3-}	$H_2PO_4^-$
D	HPO_4^{2-}	$H_2PO_4^-$	PO_4^{3-}

13 Which of the following compounds is **not** a product of the reaction between an oxide of a Period 3 element and water?

A NaOH
B H_3PO_4
C $Al(OH)_3$
D H_2SO_3

14 Which of the following statements concerning the third period elements (sodium to sulfur) and their compounds is **incorrect**?

A The elements become more electronegative from sodium to chlorine.

B Aluminium oxide is the only oxide which is amphoteric.

C pH of the chlorides increases.

D Phosphorus is the only element that burns in air to form a solid white oxide, which reacts vigorously with water to form an acidic solution.

15 Across a period, the elements show an increase in their maximum oxidation number in their oxides.

Which of the following explains this?

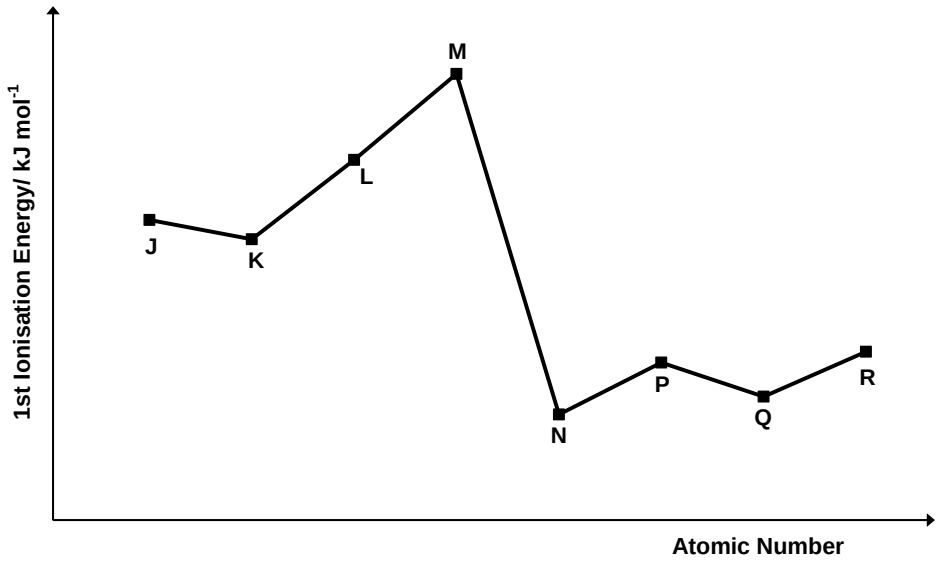
A an increase in the number of electrons in the outer shell

B an increase in the electronegativity of the element

C an increase in the ease of losing an electron

D an increase in the size of an atom

16 The following graph shows the first ionisation energies of eight consecutive elements **J** to **R**, which have atomic numbers between 3 to 20 in the Periodic Table.



Which of the following statements about the elements is **false**?

A Oxides of **Q** react with dilute H_2SO_4(aq).

B Chlorides of **M** are good conductor of electricity.

C The ionic radius of **J** is larger than the ionic radius of **K**.

D **N** forms a chloride which reacts with water to give a neutral solution.

17 Which one of the following organic compounds does **not** exist?

A An ester which is a structural isomer of a carboxylic acid, $C_3H_6O_2$.

B A carboxylic acid which is a structural isomer of an ester, $C_2H_4O_2$.

C An aldehyde which is a structural isomer of a ketone, C_3H_6O.

D A ketone which is a structural isomer of an aldehyde, C_2H_4O.

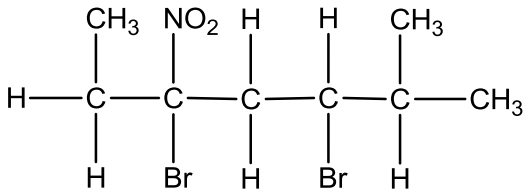
18 How many dichlorinated structural isomers can be formed by the chlorination of butane in the presence of light?

A 4 **C** 6

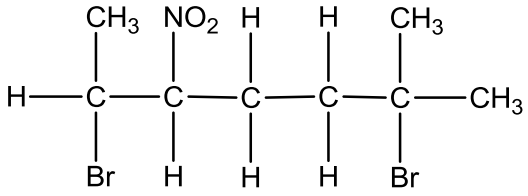
B 5 **D** 7

19 Which of the following is the major product formed when $CH_3CH=C(NO_2)CH_2CH=C(CH_3)_2$ reacts with HBr?

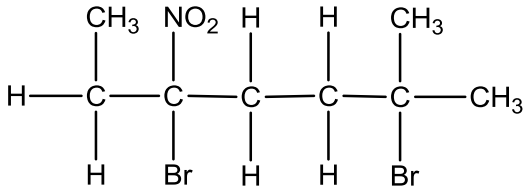
A



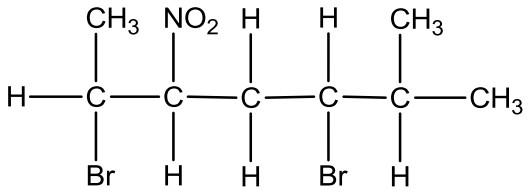
B



C



D



20 Which property does benzene have as a consequence of the delocalisation of electrons in the benzene molecule?

A Benzene is a good conductor of electricity.

B The carbon-carbon bond lengths are between those of C–C bonds and C=C bonds.

C Addition reactions of benzene take place more easily than substitution.

D Substitution in benzene takes place at one particular carbon atom.

21 Why does the reaction $CH_3CH_2X + OH^- \longrightarrow CH_3CH_2OH + X^-$ take place more rapidly in aqueous solution when X is Br than when X is C*l*?

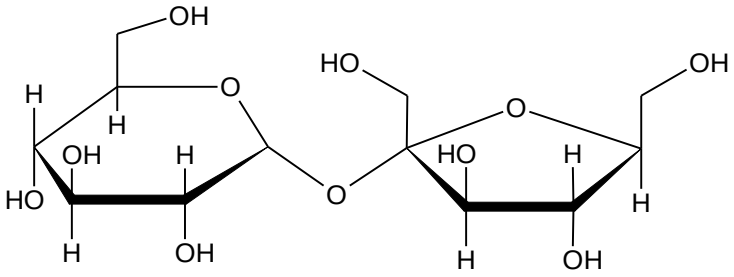
A The Br^- is a stronger nucleophile than Cl^-.

B The Br^- is less hydrated in solution than Cl^-.

C The C-C*l* bond is more polar than C-Br bond.

D The C-Br bond is weaker than the C-C*l* bond.

22 The following shows the structure of the sugar, sucrose.



How many moles of hydrogen gas will be produced when 1 mol of sucrose reacts with sodium metal?

A 4

B 8

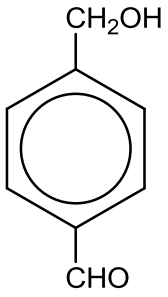
C 10

D 14

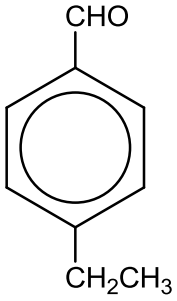
23 Which pure compound would give the following observations for the three tests listed below?

reagents and conditions	observations
Na metal	effervescence observed
Fehling's reagent, warm	no precipitate observed
Tollens' reagent, warm	silver mirror observed

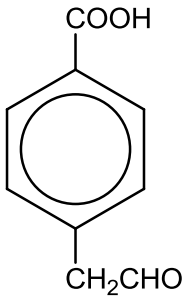
A



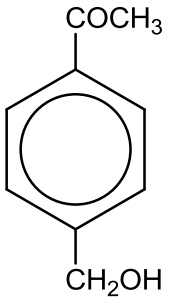
C



B



D



24 Which of the following synthetic routes **does not** produce ethanoic acid?

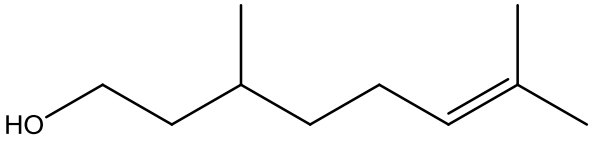
A $CH_3CH(OH)CH_3 \xrightarrow[\text{heat}]{\text{aqueous alkaline iodine}} \xrightarrow[\text{r.t.p.}]{H^+}$

B $CH_3CH(OH)CH_2CH_3 \xrightarrow[180\ ^oC]{\text{excess conc } H_2SO_4} \xrightarrow[\text{heat}]{\text{acidified } K_2Cr_2O_7}$

C $CH_3Br \xrightarrow[\text{heat under reflux}]{\text{alcoholic KCN}} \xrightarrow[\text{heat}]{\text{dilute HC/}}$

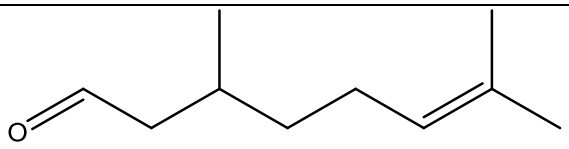
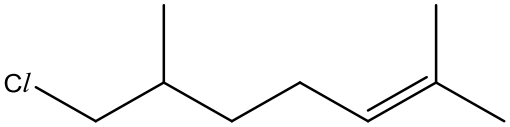
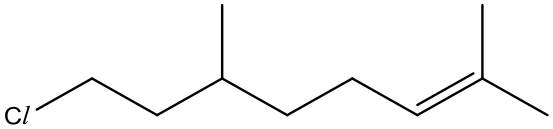
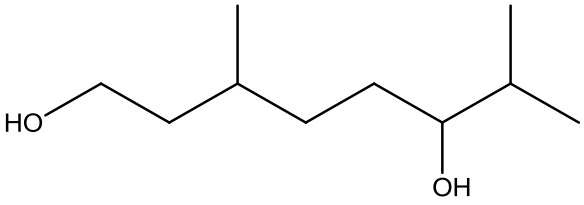
D $CH_3CHO \xrightarrow[\text{heat}]{[Ag(NH_3)_2]^+} \xrightarrow[\text{r.t.p.}]{H^+}$

25 Citronellol is a colourless oily liquid with a rose-like odour. It is used in perfumes and insect repellents, and as a mite attractant. Citronellol is a good mosquito repellent at short distances, but protection greatly lessens when the subject is slightly further from the source.



citronellol

Compound **X** and **Y** react to form citronellol. Which of the following could **X** and **Y** be?

	X	**Y**
A		$LiAlH_4$
B		aqueous NaOH
C		KOH in ethanol
D		conc H_2SO_4 at 170°C

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 The following reaction between carbon monoxide and steam occurs in the presence of a suitable catalyst.

$$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g) \qquad \Delta H = -40 \text{ kJ mol}^{-1}$$

A higher equilibrium yield of hydrogen would be expected by using

1 a lower temperature

2 a higher pressure

3 a more finely powdered catalyst

27 Water can undergo auto-ionisation as follows.

$$H_2O \rightleftharpoons H^+ + OH^-$$

K_w at 25 °C	K_w at 60 °C
1.00×10^{-14}	9.5×10^{-14}

Which of the following statements about this reaction is true?

1 The auto-ionisation of water is endothermic.

2 The pOH of water is 7.49 at 60 °C.

3 Water is acidic at 60 °C.

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.

28 Which of the following reactions have a positive enthalpy change of reaction?

1 $H_2(g) + ½\ O_2(g) \longrightarrow H_2O(g)$

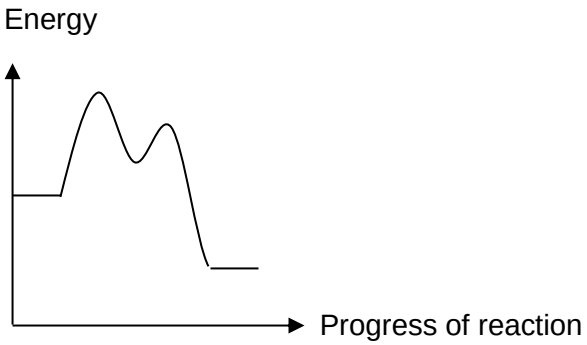
2 $Br_2(g) \longrightarrow 2Br(g)$

3 $Na(g) \longrightarrow Na^+(g) + e$

29 In a chemical reaction, **X** reacts with **Y** to form **Z**. The initial rates of the reaction are shown for the following experiments:

experiment	[**X**]/ mol dm^{-3}	[**Y**]/ mol dm^{-3}	initial rate/ mol dm^{-3}
1	0.150	0.250	2.80×10^{-5}
2	0.150	0.500	5.60×10^{-5}
3	0.075	0.500	2.80×10^{-5}
4	0.075	0.250	1.40×10^{-5}

The energy profile diagram for the reaction is as shown:



Which of the following are possible overall equations based on the above energy profile diagram?

1 $2\mathbf{X} + \mathbf{Y} \longrightarrow \mathbf{Z}$

2 $\mathbf{X} + 2\mathbf{Y} \longrightarrow \mathbf{Z}$

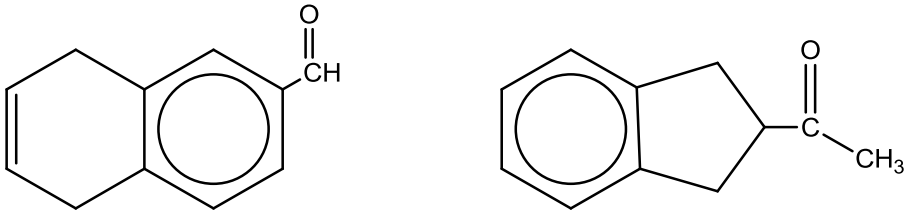
3 $\mathbf{X} + \mathbf{Y} \longrightarrow \mathbf{Z}$

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 Which of the following can be used to distinguish between the two compounds?



1 I_2(aq) in sodium hydroxide

2 hot acidified potassium manganate(VII)

3 dilute aqueous hydrochloric acid

2016 H1 Prelim Paper Answers									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
A	C	B	C	A	D	C	D	A	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
D	B	C	C	A	B	D	C	C	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
D	A	A	B	A	D	D	C	B	D