RAFFLES INSTITUTION
2015 YEAR 6 PRELIMINARY EXAMINATION

Higher 1

CHEMISTRY 8872/01

Paper 1 Multiple Choice **September 2015**

50 minutes

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not open this question booklet until you are told to do so.

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number in the spaces provided on the Answer Sheet.

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 to be correct and record your choice with a soft pencil on the separate Answer Sheet.

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 **12** printed pages.

Section A

There are **thirty** questions in this section. For each question, there are four possible answers, **A**, **B**, **C**, and **D**. Choose the **one** you consider to be correct and record your choice in **soft pencil** on the OMR sheet provided.

1 Azomethane, $CH_3N_2CH_3$, is a pale yellow liquid with a low boiling point. At elevated temperatures, azomethane decomposes into nitrogen and ethane gas.

If 20 cm^3 of gaseous $CH_3N_2CH_3$ is completely decomposed, what is the total volume of gaseous products formed?
[All volumes are measured at the same temperature and pressure.]

A 50 cm^3 **B** 40 cm^3 **C** 25 cm^3 **D** 10 cm^3

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

Dickite, a clay-like material used as a coating for high-quality bond paper, has the following composition.

SiO_2: 46.54% Al_2O_3: 39.50% H_2O: 13.96%

The empirical formula of Dickite is $Si_wAl_xH_yO_z$.

What is the value of *z*?

A 13 **B** 9 **C** 4 **D** 2

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

A sample of 3-chloroprop-1-ene was heated with a halogen-containing reagent and compound **X** was formed. The relative molecular mass of **X** was determined to be 157.4.

What was the reagent used?

A HBr(g) **B** HCl(g) **C** Br_2(g) **D** Cl_2(g)

4 Which of the following elements would be expected to form the largest ion with a noble gas electron configuration?

A Aluminium

B Calcium

C Chlorine

D Sulfur

5 Naturally occurring iron consists of various isotopes. Two ions formed by the isotopes are shown below:

$^{54}_{26}Fe^{2+}$ $^{56}_{26}Fe^{2+}$

Which one of the following statements is correct?

A $^{54}_{26}Fe^{2+}$ has a smaller ionic radius than $^{56}_{26}Fe^{2+}$.

B The electron configuration of both Fe^{2+} ions is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6 4s^2$.

C When subjected to an electric field, $^{56}_{26}Fe^{2+}$ ion gives a greater angle of deflection than $^{54}_{26}Fe^{2+}$ ion.

D The total number of protons and electrons in each of the Fe^{2+} ions is smaller than the nucleon number of the respective ion.

6 Sulfur forms a variety of oxides and oxo-anions.

Which of the following series is arranged correctly in order of increasing bond angle?

A $SO_2 < SO_3 < SO_4^{2-} < SO_3^{2-}$

B $SO_3^{2-} < SO_4^{2-} < SO_3 < SO_2$

C $SO_3^{2-} < SO_4^{2-} < SO_2 < SO_3$

D $SO_2 < SO_3 < SO_3^{2-} < SO_4^{2-}$

7 Phosphorus can form PCl_3 and PCl_5. However, nitrogen can only form NCl_3.

Which statement is a correct explanation of this?

A Nitrogen can attain an oxidation state of +5.

B The N–C*l* bond is weaker than the P–C*l* bond.

C The valence orbitals of P are higher in energy than that of N.

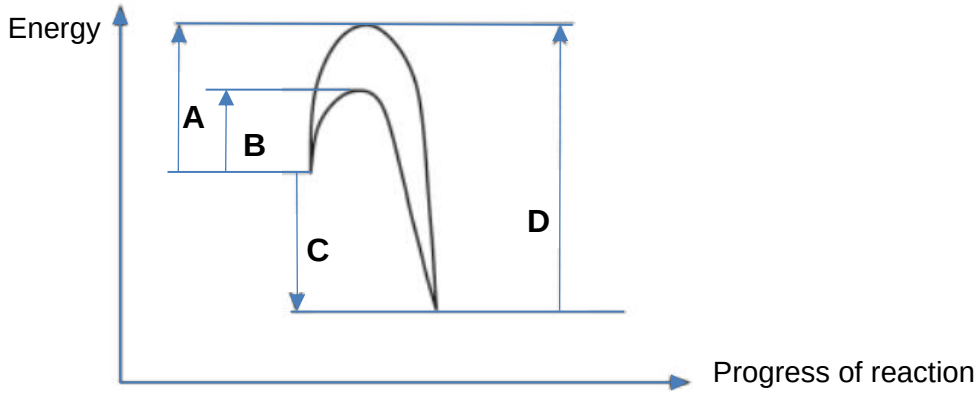
D The n = 2 principal quantum shell can contain a maximum of 8 electrons.

8 In which of the following pairs can a hydrogen bond be formed between molecule **I** and molecule **II**?

	I	**II**
A	water	chlorine
B	oxygen	hydrogen
C	ammonia	ethanol
D	propanal	ethanal

9 An energy profile diagram for a chemical reaction is given below.

Which energy change is the activation energy for an uncatalysed reaction?



10 Which equation has a positive enthalpy change?

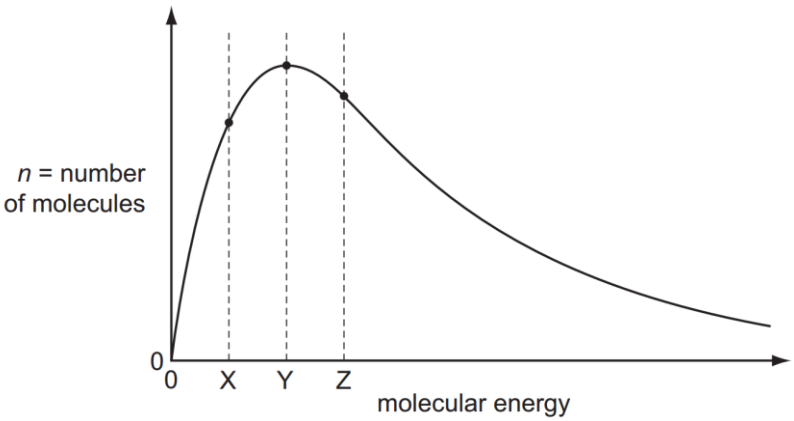
A $C_2H_5OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l)$

B $Li(g) \longrightarrow Li^+(g) + e$

C $2Cl(g) \longrightarrow Cl_2(g)$

D $I_2(g) \longrightarrow I_2(s)$

11 The Maxwell-Boltzmann distribution for a gas at constant temperature is shown below.



If the temperature of the gas is reduced by 10 ^oC, the graph changes shape.

What happens to the values of n for the molecular energies X, Y and Z?

	X	Y	Z
A	higher	higher	higher
B	higher	lower	lower
C	lower	lower	higher
D	lower	lower	lower

12 Water acts as an acid when it reacts with which of the following?

I	CN^-
II	NH_3
III	$HClO_4$
IV	CH_3COO^-

A I and IV only

B II and III only

C I, II and IV only

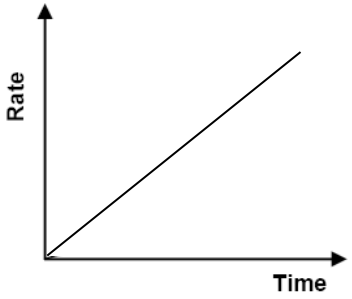
D II, III and IV only

13 In the reaction shown below, the product, Mn^{2+}, also functions as a catalyst for the reaction.

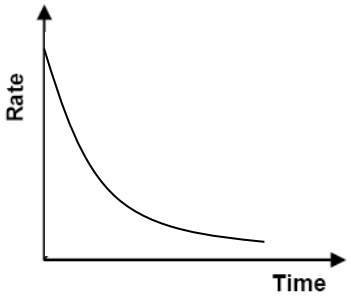
$$2MnO_4^- + 5H_2C_2O_4 + 6H_3O^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 14H_2O$$

Which graph correctly describes the kinetics of the reaction?

A



B



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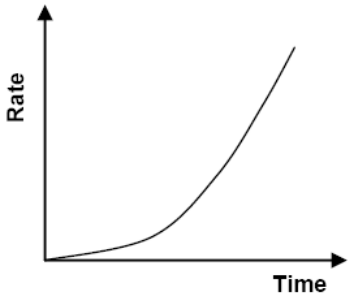
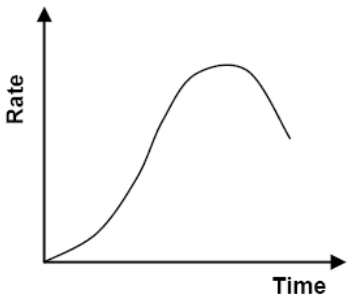


D



14 The proton number of the element **M** is less than 20.

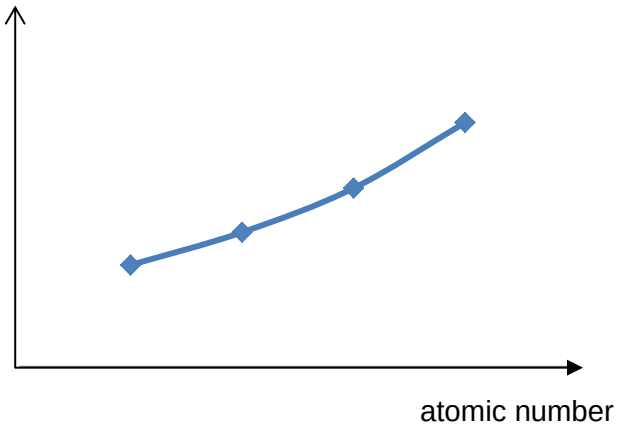
The aqueous chloride of **M** is acidic, and gives a white precipitate when neutralised with NaOH(aq). This precipitate dissolves on reacting either with NaOH(aq) or with H_2SO_4(aq).

In which Group of the Periodic Table is **M** likely to be found?

A II **B** III **C** IV **D** V

[Turn over

15 Which property when plotted against increasing atomic number gives the shape of the following graph?



A Melting point of NaC*l*, MgCl_2, A*l*Cl_3 and SiCl_4

B First ionisation energy of Mg, Ca, Sr and Ba

C Electrical conductivity of Na, Mg, A*l* and Si

D Electronegativity of Si, P, S and C*l*

16 Which statement is correct about the chemical properties of the oxides of the elements in Period 3?

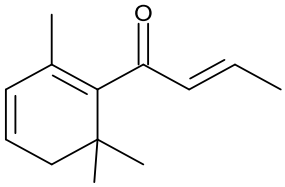
A Al_2O_3 is soluble in both KOH and HC*l*.

B P_2O_5 reacts with water to give OH^- ions.

C SiO_2 forms a solution of pH 6 when added to water at room temperature.

D Na_2O and MgO can be mixed in water to give an approximately neutral solution.

17 Damascenone is part of a class of compounds called rose ketones.



When one molecule of damascenone reacts with bromine by electrophilic addition, how many bonds are broken and formed in damascenone?

	Number of σ bonds broken	Number of π bonds broken	Number of new σ bonds formed
A	0	2	2
B	1	2	4
C	0	3	6
D	1	3	8

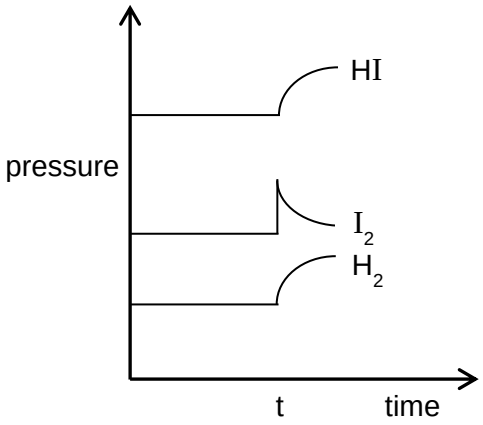
18 The following gaseous equilibrium was established in an experiment.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

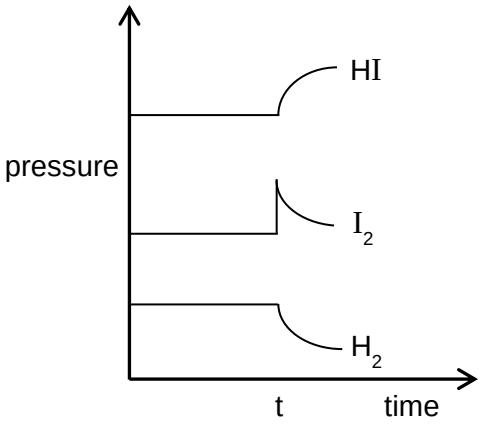
At a particular time, t, extra $I_2(g)$ was added.

Which of the following sets of curves shows how this system responds to the addition?

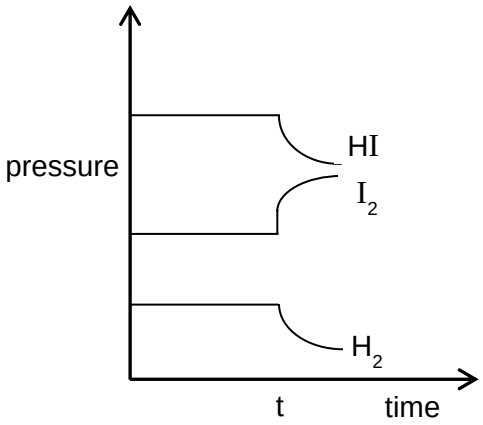
A



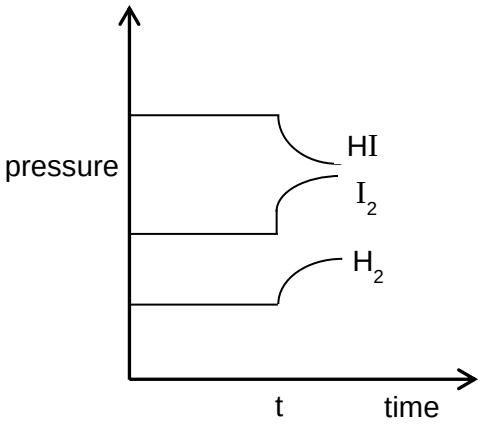
C



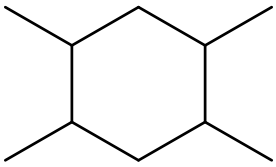
B



D



19 What is the ratio of monochlorinated products when the molecule below reacts with chlorine in UV light?



A 3:1:1 **B** 2:1:2

C 3:1 **D** 2:1

20 Which statement best explains why benzene does **not** undergo addition reactions?

A It has three π bonds.

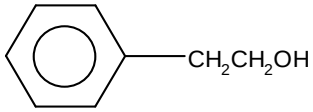
B It is resonance stabilised.

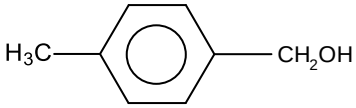
C It is an unsaturated compound.

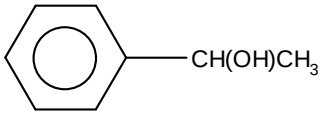
D It is a liquid at room temperature.

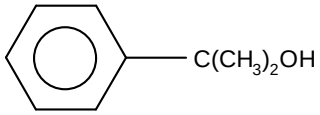
21 An alcohol was treated with hot acidified potassium dichromate(VI). The separated organic product gave an orange precipitate with 2,4-dinitrophenylhydrazine reagent, but no silver mirror with Tollens' reagent.

What is the alcohol used?

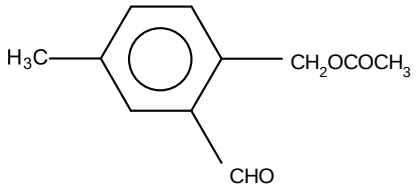
A 

B 

C 

D 

22 When added to compound **V**, which reagent will **not** give an observable change?



Compound **V**

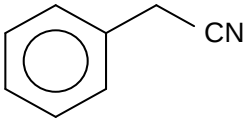
A 2,4-dinitrophenylhydrazine

B Tollens' regent

C bromine dissolved in tetrachloromethane

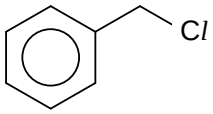
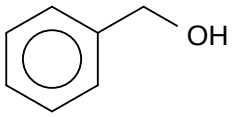
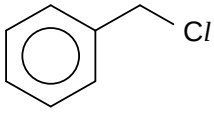
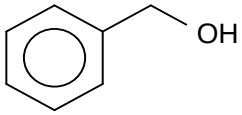
D hot acidified potassium manganate(VII) solution

23



Compound **K** reacts with a reagent **L** to form .

What could **K** and **L** be?

	K	**L**
A		HCN(aq)
B		HCN(aq)
C		NaCN in ethanol
D		NaCN in ethanol

24 Which of the following **cannot** be used to synthesise butanoic acid in less than 3 steps?

A $CH_3CH_2CH_2CH_2OH$

B $CH_2=C(CH_3)CHClCH_3$

C $CH_3CH_2CH_2Br$

D $CH_3CH_2CH_2COOCH_2CH_3$

25 Which sequence shows the organic compounds in order of increasing pKa?

A $CH_3CH_2CH_2OH < CH_3CH_2COOH < CH_3CHClCOOH < CH_3CHFCOOH$

B $CH_3CH_2CH_2OH < CH_3CH_2COOH < CH_3CHFCOOH < CH_3CHClCOOH$

C $CH_3CHClCOOH < CH_3CHFCOOH < CH_3CH_2COOH < CH_3CH_2CH_2OH$

D $CH_3CHFCOOH < CH_3CHClCOOH < CH_3CH_2COOH < CH_3CH_2CH_2OH$

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 that you consider to be correct).

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

A	B	C	D
1, 2, 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.

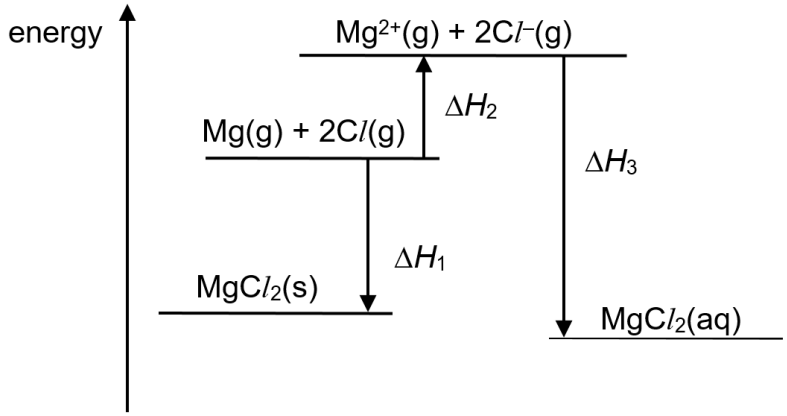
26 Which of the following shows a disproportionation reaction?

1 $3ClO^- \longrightarrow ClO_3 + 2Cl^-$

2 $H_2C_2O_4 \longrightarrow H_2O + CO + CO_2$

3 $H_2O + 2NO_2 \longrightarrow HNO_3 + HNO_2$

27 The energy level diagram shown represents the dissolving of $MgCl_2$ in a large volume of water.



Which statements concerning the diagram above is **incorrect**?

1 ΔH_1 represents the enthalpy change of formation of $MgCl_2(s)$.

2 ΔH_2 represents the sum of the first and second ionisation energies of Mg.

3 The enthalpy change of the dissolving of $MgCl_2$ is given by $-\Delta H_1 + \Delta H_2 + \Delta H_3$.

28 A bromoalkane, **J**, was heated with aqueous NaOH. The following kinetics data was obtained.

experiment	[**J**] / mol dm^{-3}	[NaOH] / mol dm^{-3}	initial rate / mol dm^{-3} min^{-1}
1	0.10	0.10	0.0005
2	0.20	0.05	0.0005
3	0.30	0.10	0.0015

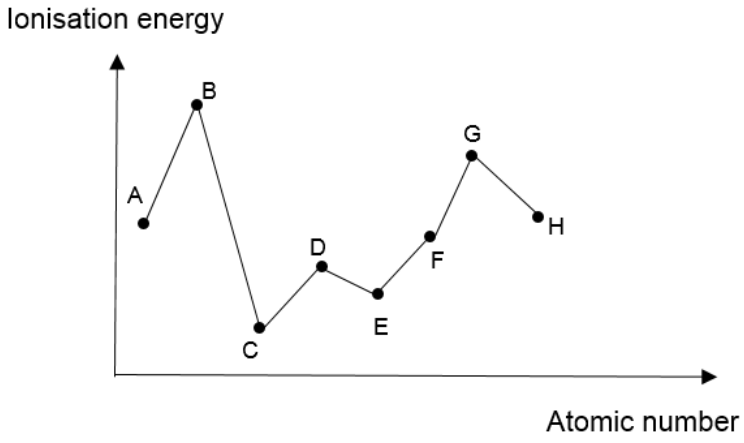
Which conclusion can be drawn from this information?

1 Changing the [NaOH] has no effect on the initial rate.

2 The overall order of reaction is 2.

3 The numerical value of the rate constant is 0.05.

29 The following graph shows the first ionisation energy of eight consecutive elements, from **A** to **H** in the Periodic Table with atomic number between 3 to 20.



Which of the following statements are correct?

1 The chloride of **D** conducts electricity in the molten state.

2 **A** reacts with **C** to form a compound with giant ionic lattice structure.

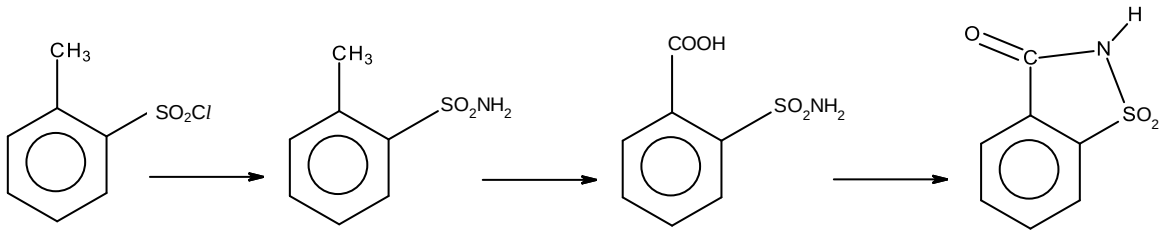
3 The melting points of **A** to **H** follow the trend as shown by the graph.

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

A	B	C	D
1, 2, 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 What type of reactions can be seen in the reaction sequence?



1 oxidation

2 substitution

3 condensation