



**HWA CHONG INSTITUTION**  
**C2 Preliminary Examinations**  
**Higher 1**

CANDIDATE  
NAME

CT GROUP

13S

CENTRE  
NUMBER

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INDEX  
NUMBER

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**CHEMISTRY**

**8872/01**

Paper 1 Multiple Choice

**25 September 2014**

**50 min**

Additional Materials: Optical Mark Sheet (OMS)  
Data Booklet

**READ THESE INSTRUCTIONS FIRST**

Write in soft pencil.

Complete the information on the optical mark sheet (OMS) as shown below.

1. Enter your NAME ( as in NRIC ).



Write your **name**

2. Enter the SUBJECT TITLE.

3. Enter the PAPER NUMBER.

4. Enter your CT GROUP.



Write your **CT group**

5. Date.

6. Enter your NRIC NUMBER or  
FIN NUMBER.

7. Now SHADE the corresponding  
lozenge in the grid for  
EACH DIGIT or LETTER

NRIC / FIN															
S	0	0	0	0	0	0	0	0	0	A	K	U			
F	1	1	1	1	1	1	1	1	1	B	L	V			
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Write and  
shade your  
NRIC  
or FIN number

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 OMS.

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.

## SECTION A

- 1 Bones contain a complex mixture of calcium salts, protein and other material. When a bone is strongly heated in a current of air, the only residue is calcium oxide.

From a sample of 50.0 g of bone, 14.0 g of calcium oxide were obtained.

What is the percentage by mass of calcium in the bone?

- A 10.0%                      B 14.0%                      C 20.0%                      D 23.3%

- 2 Carbon-14 is radioactive and is used by archaeologists in carbon dating.

Which species has both the same number of neutrons and the same number of electrons as an atom of carbon-14?

- A  $^{14}\text{N}^+$                       B  $^{16}\text{O}^{2+}$                       C  $^{17}\text{F}^+$                       D  $^{28}\text{Si}$

- 3 Chromium has four naturally occurring stable isotopes;  $^{50}\text{Cr}$ ,  $^{52}\text{Cr}$ ,  $^{53}\text{Cr}$ , and  $^{54}\text{Cr}$ .

Which statement about its ions is correct?

- A  $^{52}\text{Cr}^{3+}$  ion has less protons than  $^{54}\text{Cr}^{3+}$  ion.  
 B The electronic configuration of  $^{52}\text{Cr}^{3+}$  ion is  $1s^2 2s^2 2p^6 3s^2 3p^6 3d^2 4s^1$ .  
 C The electronic configurations of  $^{52}\text{Cr}^{3+}$  ion and  $^{53}\text{Cr}^{3+}$  ion are different.  
 D  $^{50}\text{Cr}^{3+}$  ion shows a greater angle of deflection than  $^{52}\text{Cr}^{3+}$  ion in an electric field.

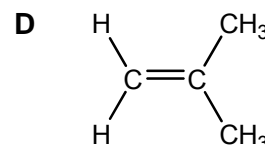
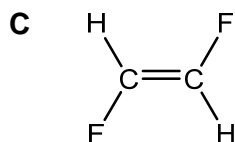
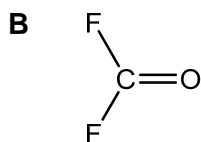
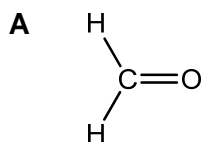
- 4 The successive ionisation energies of two elements, **P** and **Q**, are given below.

Ionisation energies / $\text{kJ mol}^{-1}$	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>
<b>P</b>	740	1450	7720	10540	13630	18020	21700	25660
<b>Q</b>	1011	1907	2910	4960	6270	21270	25431	29872

What is the formula of the compound formed when **P** reacts with **Q**?

- A  $\text{P}_2\text{Q}_3$     B  $\text{P}_3\text{Q}_2$   
 C  $\text{P}_2\text{Q}_5$     D  $\text{P}_5\text{Q}_2$

5 Which molecule has the largest dipole?



6  $\text{HCl}$  is stable to heat, but  $\text{HI}$  decomposes into its elements when heated.

What is the reason for this difference?

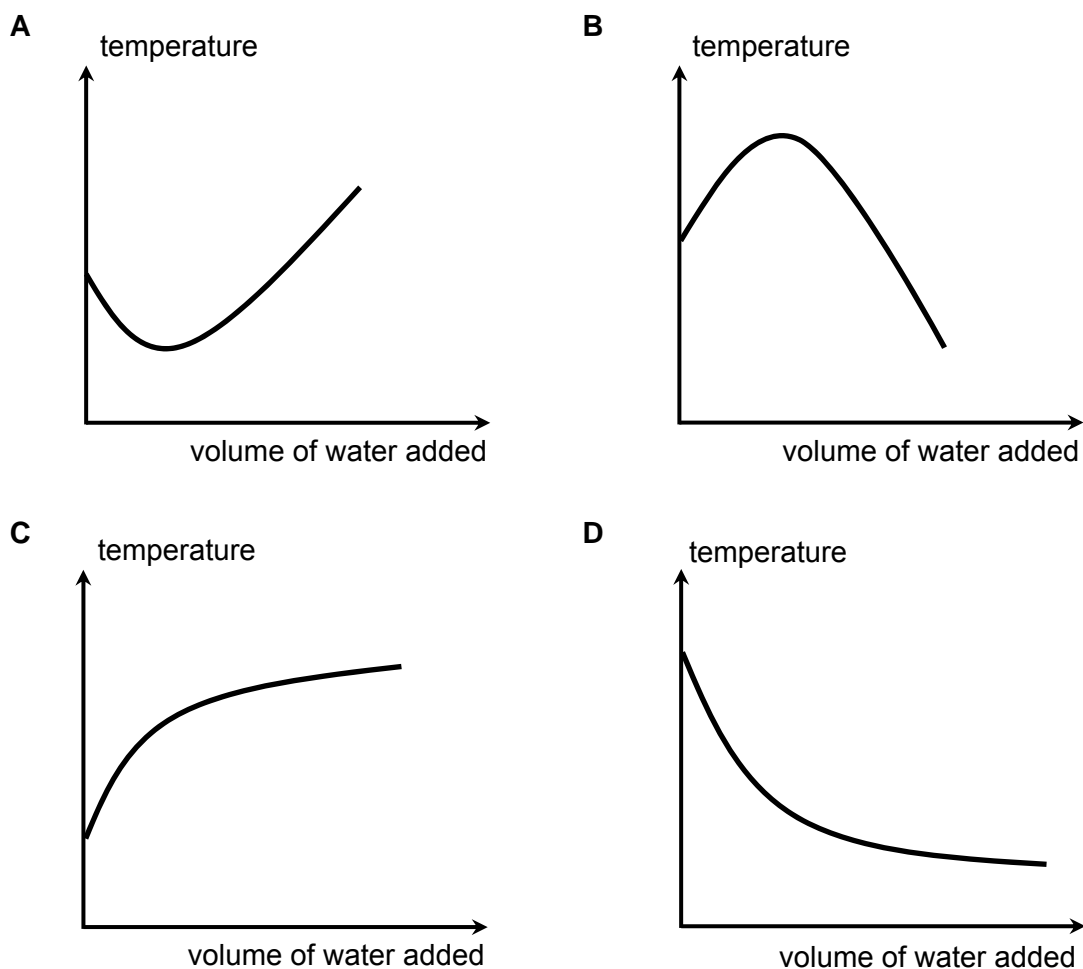
- A**  $\text{H-Cl}$  bond is stronger than  $\text{H-I}$  bond.
- B**  $\text{H-Cl}$  bond is more polar than  $\text{H-I}$  bond.
- C**  $\text{HI}$  has a larger electron cloud than  $\text{HCl}$ .
- D**  $\text{HI}$  is more volatile than  $\text{HCl}$ .

7 When ethanoic acid,  $\text{CH}_3\text{CO}_2\text{H}$ , is dissolved in a non-polar solvent, its relative molecular mass,  $M_r$ , was found to be 120. Which of the following explains this observation?

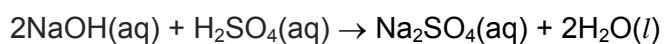
- A**  $\text{CH}_3\text{CO}_2^-$  ions and  $\text{H}^+$  ions bond together in an ionic lattice.
- B**  $\text{CH}_3\text{CO}_2^-$  ions and  $\text{H}^+$  ions form ion-dipole interactions with solvent molecules.
- C**  $\text{CH}_3\text{CO}_2\text{H}$  dimerises by forming dative covalent bonds with another  $\text{CH}_3\text{CO}_2\text{H}$  molecule.
- D**  $\text{CH}_3\text{CO}_2\text{H}$  dimerises by forming hydrogen bonds with another  $\text{CH}_3\text{CO}_2\text{H}$  molecule.

- 8 When water is stirred with glucose, strong hydrogen bonds are initially formed between glucose molecules and water molecules, but as more water is added, these hydrogen bonds are broken.

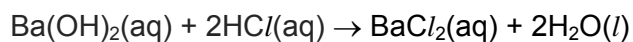
Which graphs best represents the observed temperature changes?



- 9 The heat liberated in the neutralisation given below is  $-114\text{kJ mol}^{-1}$ .

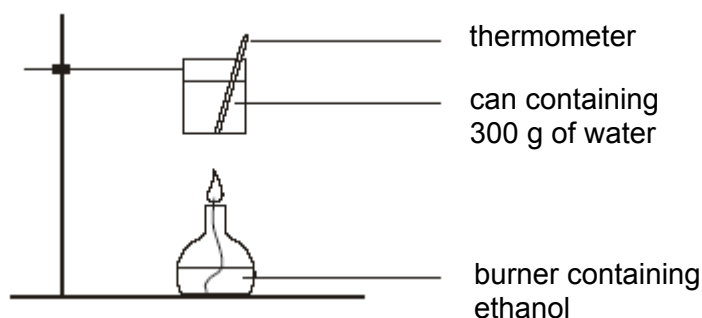


By using this information, what is the most likely value for the heat liberated in the following neutralisation?



- A**  $-57\text{kJ mol}^{-1}$       **B**  $-76\text{kJ mol}^{-1}$       **C**  $-114\text{kJ mol}^{-1}$       **D**  $-228\text{kJ mol}^{-1}$

- 10 An experiment was conducted to determine the efficiency of the heating of a can of water using a spirit burner.



The following data were recorded:

Mass of ethanol burnt  $= m \text{ g}$

Change in temperature of water  $= \Delta T \text{ }^{\circ}\text{C}$

You are also given that:

Relative molecular mass of ethanol  $= 46.0$

Enthalpy change of combustion of ethanol  $= -1371 \text{ kJ mol}^{-1}$

Specific heat capacity of water  $= c \text{ J g}^{-1} \text{ K}^{-1}$

Which expression below gives the percentage efficiency of this heating process?

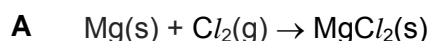
**A**  $\frac{m \times 1371 \times 1000}{300 \times c \times \Delta T \times 46.0} \times 100\%$

**B**  $\frac{m \times c \times \Delta T \times 46.0}{300 \times 1371 \times 1000} \times 100\%$

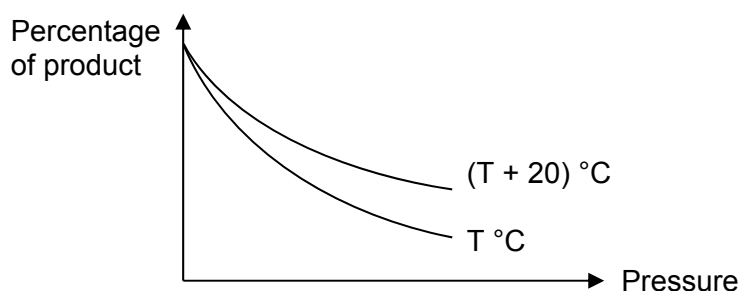
**C**  $\frac{300 \times c \times \Delta T \times 46.0}{m \times 1371} \times 100\%$

**D**  $\frac{300 \times c \times \Delta T \times 46.0}{m \times 1371 \times 1000} \times 100\%$

- 11 Which equation defines the lattice energy of the ionic compound  $\text{MgCl}_2$ ?



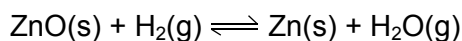
- 12 The graph below shows how the percentage of product present at equilibrium varies with temperature and pressure for a reaction.



Which reaction could the graph represent?

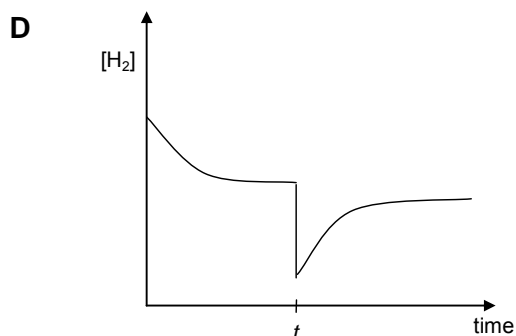
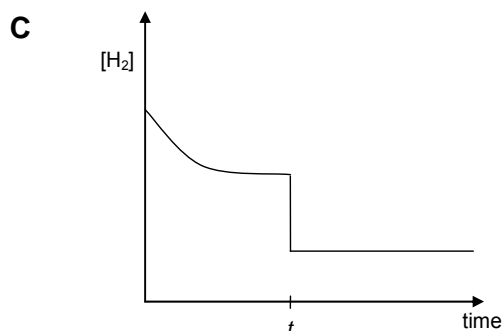
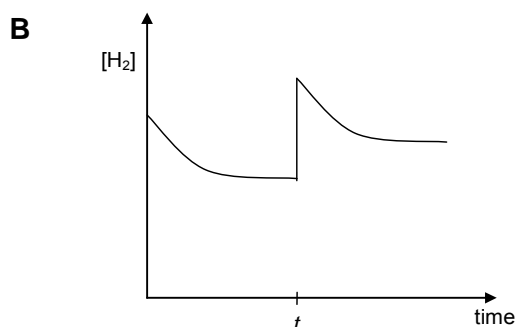
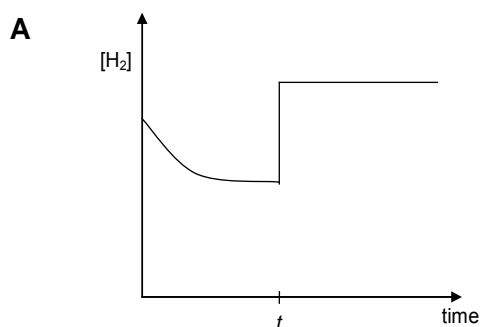
- A**  $4\text{Fe (s)} + 3\text{O}_2\text{(g)} = 2\text{Fe}_2\text{O}_3\text{(s)}$   $\Delta H = -1644 \text{ kJ mol}^{-1}$
- B**  $2\text{C (s)} + \text{O}_2\text{(g)} = 2\text{CO (g)}$   $\Delta H = -222 \text{ kJ mol}^{-1}$
- C**  $\text{N}_2\text{O}_4\text{(g)} = 2\text{NO}_2\text{(g)}$   $\Delta H = +57 \text{ kJ mol}^{-1}$
- D**  $\text{CO(g)} + \text{Cl}_2\text{(g)} = \text{COCl}_2\text{(s)}$   $\Delta H = +86 \text{ kJ mol}^{-1}$

- 13 Zinc oxide reacts with hydrogen according to the following equation.



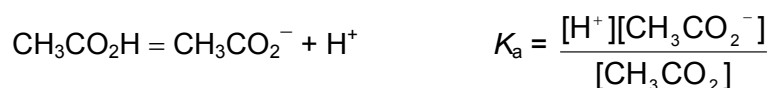
A mixture of zinc oxide and hydrogen was placed in a syringe and brought to equilibrium at time  $t$ . The plunger of the syringe was then pushed in until the volume was half the initial volume.

Which graph correctly shows the variation of  $[\text{H}_2]$  with time?



- 14 Dimethyl sulfoxide, DMSO, is an organic solvent which can dissolve polar and non-polar compounds.

Ethanoic acid ionises in DMSO in the following manner:



The  $K_a$  of ethanoic acid in DMSO is  $2.51 \times 10^{-13} \text{ mol dm}^{-3}$ .

What is the concentration of  $\text{H}^+$  ions at equilibrium if  $1.0 \times 10^{-2} \text{ mol}$  of ethanoic acid was dissolved in  $500 \text{ cm}^3$  of DMSO?

- A  $5.0 \times 10^{-8} \text{ mol dm}^{-3}$                       B  $7.1 \times 10^{-8} \text{ mol dm}^{-3}$   
 C  $2.5 \times 10^{-15} \text{ mol dm}^{-3}$                       D  $5.0 \times 10^{-15} \text{ mol dm}^{-3}$
- 15 The table gives the concentrations and pH values of the aqueous solutions of two alkaline compounds, **P** and **Q**.

	<b>P</b>	<b>Q</b>
concentration	$1 \times 10^{-3} \text{ mol dm}^{-3}$	$1 \times 10^{-3} \text{ mol dm}^{-3}$
pH	11	9

Student M concluded that **P** is a strong base.

Student N concluded that the extent of dissociation is lower in **P**(aq) than in **Q**(aq).

Which of the students are correct?

- A both M and N                      B neither M nor N  
 C only M                      D only N
- 16 The Haber process for the manufacture of ammonia is represented by the following equation.

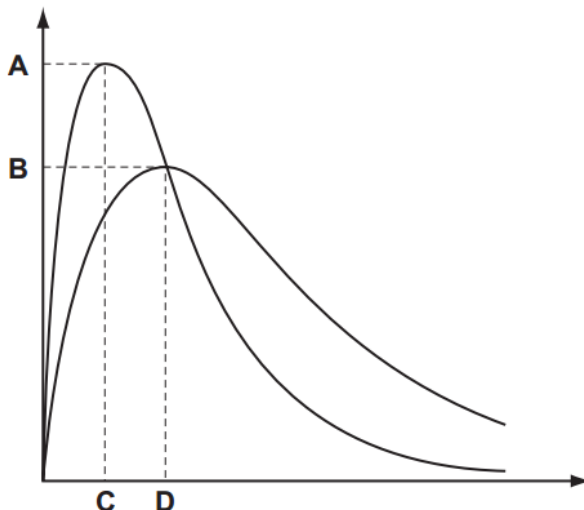


Which of the following about the rate of forward and backward reaction is correct for the Haber process when finely divided iron is added?

	forward rate	backward rate
A	increase	decrease
B	decrease	decrease
C	decrease	increase
D	increase	increase

- 17 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 most probable energy of the molecules at the lower temperature?



- 18 Consecutive elements **X**, **Y** and **Z** are in the third period of the Periodic Table. Element **Y** has the highest first ionisation energy and the lowest melting point.

What could be the identities of **X**, **Y** and **Z** respectively?

- A silicon, phosphorus, sulfur
  - B aluminium, silicon, phosphorus
  - C magnesium, aluminium, silicon
  - D sodium, magnesium, aluminium
- 19 In some fireworks there is a reaction between powdered aluminium and powdered barium nitrate in which heat is evolved and an unreactive gas is produced.

What is the equation for this reaction?

- A  $2Al + Ba(NO_3)_2 \rightarrow Al_2O_3 + BaO + 2NO$
- B  $10Al + 3Ba(NO_3)_2 \rightarrow 5Al_2O_3 + 3BaO + 3N_2$
- C  $4Al + 4Ba(NO_3)_2 \rightarrow 2Al_2O_3 + 4Ba(NO_2)_2 + O_2$
- D  $10Al + 18Ba(NO_3)_2 \rightarrow 10Al(NO_3)_3 + 18BaO + 3N_2$



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

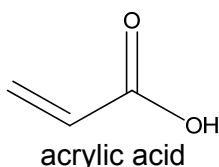
The period 4 elements gallium (Ga), germanium (Ge), arsenic (As) and selenium (Se) are the elements below aluminium, silicon, phosphorus and sulfur in the Periodic Table.

The properties of each period 4 element resemble those of the period 3 element directly above it.

Which statement about these elements or their compounds is correct?

- A** Only  $\text{GaCl}_3$  has high boiling point..
- B** The atomic radius increases from Ga to Se.
- C**  $\text{Ga}_2\text{O}_3$  is an amphoteric oxide which dissolves in water to give a neutral solution.
- D** Only oxides of As and Se dissolve in water to give an acidic solution.

**21** Acrylic acid is produced from propene, a gaseous product of oil refineries.

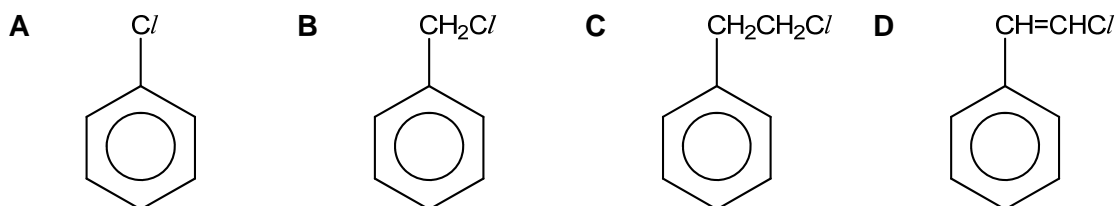


Which statement about acrylic acid is correct?

- A** All the bond angles are approximately  $120^\circ$ .
- B** It can be formed from the hydrolysis of prop-2-enenitrile,  $\text{CH}_2=\text{CHCN}$ .
- C** It gives an orange precipitate with 2,4-dinitrophenylhydrazine reagent.
- D** It decolourises hot acidified potassium manganate(VII) reagent and produces an equimolar  $\text{CO}_2$ .

**22** When a compound **K** is boiled under reflux for some time with aqueous sodium hydroxide, cooled, acidified with dilute nitric acid and then aqueous silver nitrate added, a white precipitate readily forms. Compound **K** can undergo an elimination reaction to form an alkene.

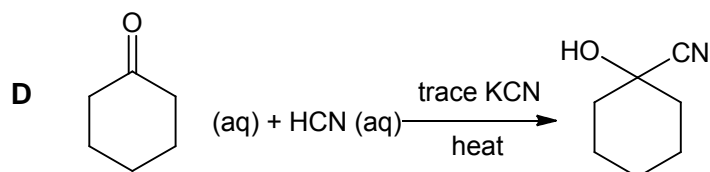
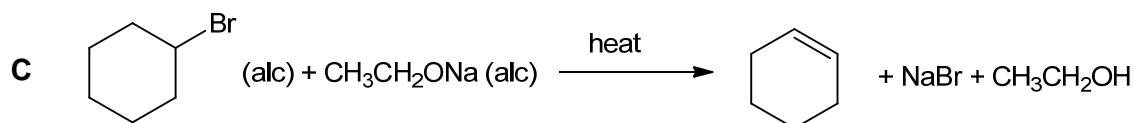
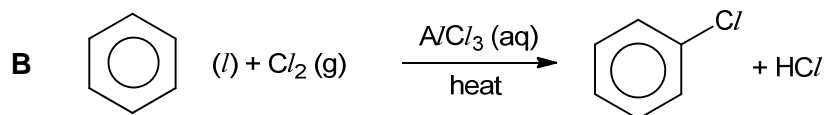
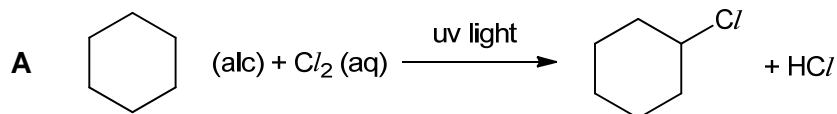
What could compound **K** be?



23 The reaction conditions for four different transformations are given.

Which transformation has the correct conditions?

[(alc) indicates an alcoholic solution.]

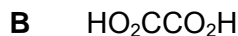
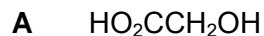


24 Which compound will **not** give tri-iodomethane on warming with alkaline aqueous iodine?

- A Cl<sub>3</sub>CH(OH)CH<sub>2</sub>Cl
- B ICH<sub>2</sub>COCH<sub>2</sub>CH<sub>3</sub>
- C C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>COCH<sub>3</sub>
- D CH<sub>3</sub>OCOCH<sub>3</sub>

25 Which compound reacts with each of the following

- PCl<sub>5</sub>
- CH<sub>3</sub>OH under reflux with concentrated H<sub>2</sub>SO<sub>4</sub>
- acidified K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> under reflux?



## 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

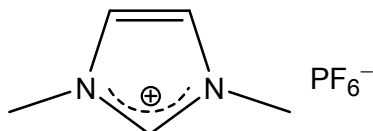
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>1, 2 and 3</b> are correct	<b>1 and 2</b> only are correct	<b>2 and 3</b> only are correct	<b>1</b> only is correct

No other combination of statements is used as a correct response.

**26** Which of the following statements are correct?

- 1** The number of atoms in a 2.0 g sample of  $^1\text{H}_2$  is twice of that in a 12.0 g sample of  $^{12}\text{C}$ .
- 2** 1 mol of potassium sulfate,  $\text{K}_2\text{SO}_4$  dissolves in water to form  $1.8 \times 10^{24}$  ions.
- 3** 48 g of ozone,  $^{16}\text{O}_3$ , contains  $1.8 \times 10^{24}$  molecules.

**27** Ionic liquids (salts in liquid state) have garnered much attention amongst chemists due to their wide applications in chemical industries. The structure of an imidazolium-based ionic liquid is shown below.



Which statements about this ionic liquid are correct?

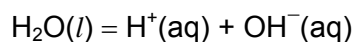
- 1** It has low volatility.
- 2** It could be used as an electrolyte.
- 3** It is miscible with ethanol.

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

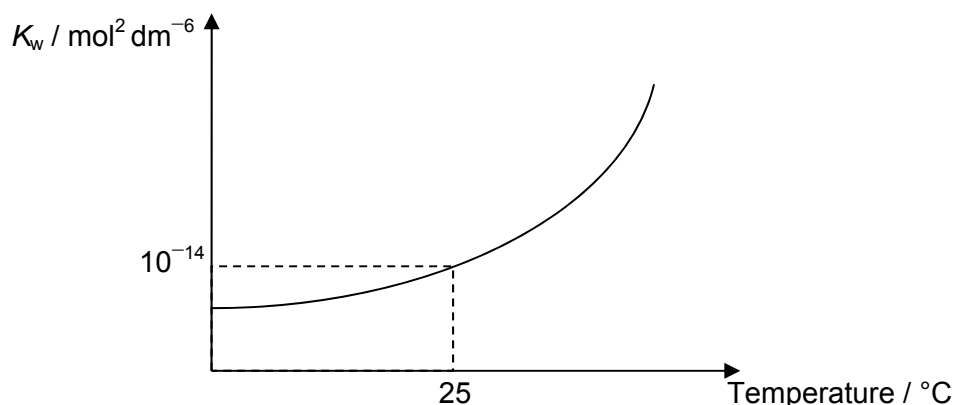
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>1, 2 and 3</b> are correct	<b>1 and 2</b> only are correct	<b>2 and 3</b> only are correct	<b>1</b> only is correct

No other combination of statements is used as a correct response.

**28** Water dissociates as shown:



The ionic product of water,  $K_w$ , varies with temperature as shown in the graph below.



Which statements about the above equilibrium system are correct?

- 1** The concentrations of  $\text{H}^+$  and  $\text{OH}^-$  are equal at all temperatures.
- 2** The pH of water increases as temperature increases.
- 3** The pH of water is less than 7 at all temperatures.

**29** Naphthalene, like benzene, is an aromatic compound that has a wide range of industrial applications.



Which statements about naphthalene are correct?

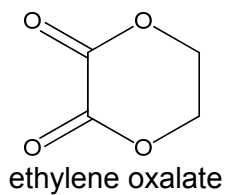
- 1** It undergoes substitution rather than addition reactions.
- 2** All carbon-carbon bond lengths are intermediate between those of a C–C bond and a C=C bond.
- 3** It reacts with bromine in the presence of a suitable catalyst to form two monobromo compounds.

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

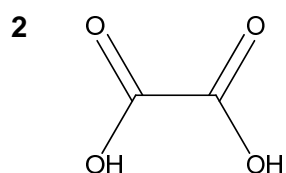
<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>1, 2 and 3</b> are correct	<b>1 and 2</b> only are correct	<b>2 and 3</b> only are correct	<b>1</b> only is correct

No other combination of statements is used as a correct response.

**30** What are the products when ethylene oxalate undergoes complete acid hydrolysis?



**1**  $\text{CO}_2$



**3**  $\text{HOCH}_2\text{CH}_2\text{OH}$

1	2	3	4	5	6	7	8	9	10
<b>C</b>	<b>B</b>	<b>D</b>	<b>B</b>	<b>A</b>	<b>A</b>	<b>D</b>	<b>B</b>	<b>C</b>	<b>D</b>
11	12	13	14	15	16	17	18	19	20
<b>C</b>	<b>C</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>C</b>	<b>A</b>	<b>B</b>	<b>D</b>
21	22	23	24	25	26	27	28	29	30
<b>B</b>	<b>C</b>	<b>C</b>	<b>D</b>	<b>A</b>	<b>B</b>	<b>A</b>	<b>D</b>	<b>A</b>	<b>C</b>