Class Adm No

Candidate Name: _____

H

millennia institute

2014 Preliminary Examination II
Pre-university 3

H2 CHEMISTRY **9647/01**

Paper 1 Multiple Choice **Thursday, 25 September 2014**

1 hour

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, subject class and registration number on the Answer Sheet in the spaces provided unless this has been done for you.

There are **forty** 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.

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 $KAl(SO_4)_2$ is used in the purification of water. Which one of the following statements about 155 g of this compound is **correct**?

A It contains 0.6 moles of cations.

B It contains 7.22×10^{23} anions.

C There are a total of 2.17×10^{24} ions.

D There are more anions than cations.

2 15 cm^3 of a gaseous hydrocarbon was completely burnt in 50 cm^3 of oxygen. The products were cooled to room temperature and then passed through aqueous NaOH. The total volume of gas decreased to 5 cm^3. What is the molecular formula of the hydrocarbon? All gas volumes were measured at the same temperature and pressure.

A CH_4 **B** C_2H_2

C C_2H_4 **D** C_2H_6

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

Which of the following particles, on losing an electron, has a half-filled set of orbital?

A Co^{3+}

B Mn^{2+}

C P^{2-}

D Se^{+}

4 Which of the following statements can be explained in terms of the existence of intermolecular hydrogen bonding?

A Boiling point of pentane is higher than that of 2,2-dimethylpropane.

B Hydrazine (N_2H_4) can act as a base.

C Propan-2-ol has a higher boiling point than propanone.

D Sodium hydride has a high melting point.

5 In which of the following are both chemical species non-planar?

A $BeCl_4^{2-}$, $\bullet CH_3$

B $COCl_2$, PCl_4^+

C SeO_3, CCl_3^-

D XeF_6, C_2Cl_4

6 For a fixed mass of an ideal gas, which of the following graphs, when plotted, does **not** show a curve? (ρ = density of the gas)

A V against $\frac{1}{T}$ (at constant P)

B P against ρT

C $\frac{P}{T}$ against V

D T against $\frac{1}{PV}$

7 Which of the following statements helps to explain why calcium and oxygen form CaO instead of Ca_2O?

A Less energy is required to form Ca^+ than Ca^{2+} from a calcium atom.

B Lattice energy of Ca_2O is less exothermic than that of CaO.

C More energy is released in forming the oxide ions from oxygen molecules in the formation of CaO than from the formation of Ca_2O.

D When Ca_2O is formed from its elements, more energy is released than when CaO is formed.

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

Ethyne, C_2H_2, reacts with hydrogen iodide to form 1,2-diiodoethane.

What is the standard enthalpy change for the reaction?

A +138 kJ mol^{-1}

B -212 kJ mol^{-1}

C -511 kJ mol^{-1}

D -810 kJ mol^{-1}

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

The standard reduction potential of a chlorate ion is

$$2ClO_3^- + 12H^+ + 10e^- \rightleftharpoons Cl_2 + 6H_2O \quad E^\ominus = +1.47\ V$$

Which of the following statements regarding the mixing of aqueous Sn^{2+} and ClO_3^- under acidic condition is **correct**?

A No reaction occurs.

B pH decreases as the reaction proceeds.

C The oxidation number of chlorine is reduced by 5.

D The oxidation number of tin is reduced by 2.

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

An aqueous chromium(III) solution was electrolysed using a large current. After 30 mins, p mol of chromium and q dm^3 of hydrogen gas were formed at the cathode.

How many moles of electrons were involved in the reaction?

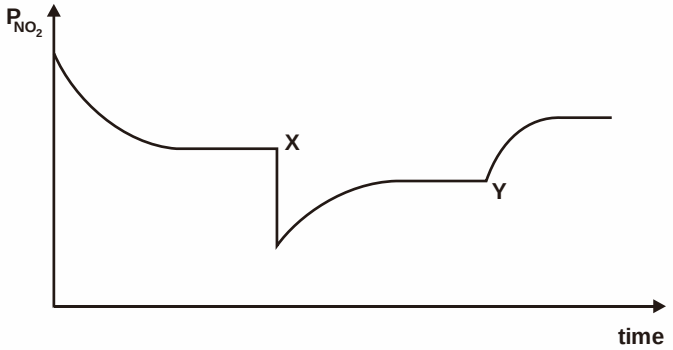
(All volumes were measured at s.t.p.)

A $p + \frac{q}{22.4}$ **B** $3p + \frac{q}{22.4}$ **C** $p + \frac{q}{11.2}$ **D** $3p + \frac{q}{11.2}$

11 Nitrogen dioxide dimerises into dinitrogen tetroxide:

$$2NO_2 \rightleftharpoons N_2O_4(g) \quad \Delta H^\ominus < 0$$

When the pressure of a sample of nitrogen dioxide in a container of fixed volume was investigated, the following graph was obtained.



Which of the following could best account for the changes at **X** and **Y**?

	X	**Y**
A	NO_2 was added.	Temperature decreased.
B	NO_2 was added.	Temperature increased.
C	NO_2 was removed.	Temperature decreased.
D	NO_2 was removed.	Temperature increased.

12 On a cold planet where water exists as frozen solid and ammonia is running freely as liquid on its surface, which of the following statements regarding ammonia medium based chemistry is **incorrect**?

A CH_3NH_2 acts as an acid.

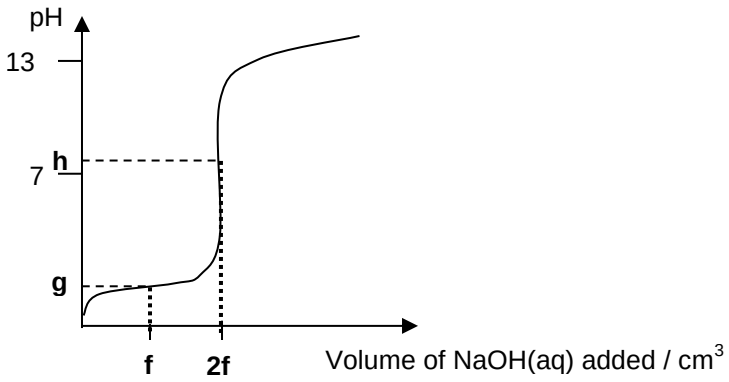
B KNH_2 acts as a base.

C NH_4^+ is the conjugate acid of ammonia.

D The ionic equation for an acid-base reaction is $NH_4^+ + NH_2^- \rightarrow 2NH_3$

13 25.0 cm^3 of 0.100 mol dm^{-3} of monobasic acid **W** is reacted with 0.0500 mol dm^{-3} of aqueous sodium hydroxide.

K_a for acid **W** = 1.76 x 10^{-5} mol dm^{-3}.

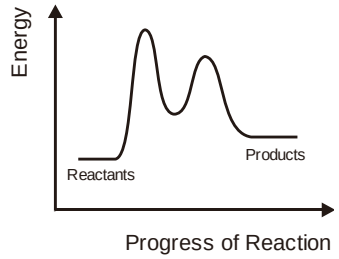


What are the values of **f**, **g** and **h**?

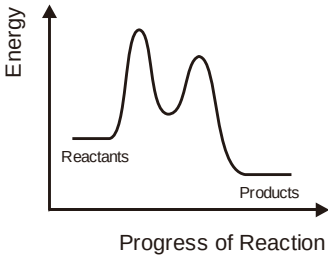
	f	**g**	**h**
A	12.5	3.12	8.73
B	12.5	4.75	8.73
C	25.0	3.03	8.64
D	25.0	4.75	8.64

14 An exothermic reaction is known to proceed in two steps, with the second step being the rate determining step. Which of the following energy profile diagrams best describes the reaction?

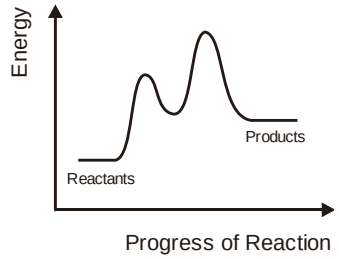
A



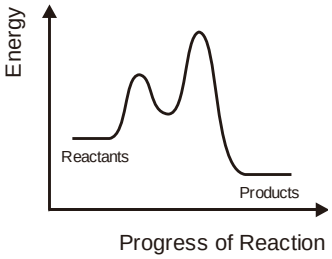
B



C



D



15 For a reaction between molecules **E** and **F**:

$$\mathbf{E} + 2\mathbf{F} \rightarrow 2\mathbf{G}$$

Experiment	Initial concentration of **E** / mol dm^{-3}	Initial concentration of **F** / mol dm^{-3}	Initial rate / mol dm^{-3} s^{-1}
1	1.5	2.0	1.25×10^{-4}
2	3.0	4.0	5.0×10^{-4}
3	6.0	4.0	1.0×10^{-3}

Which of the following statements is **incorrect**?

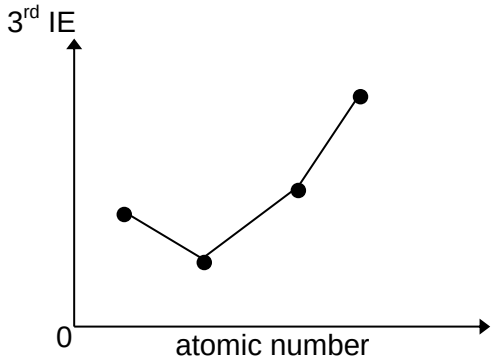
A Only 1 molecule of **F** is involved in the rate determining step.

B The overall order of reaction is 2.

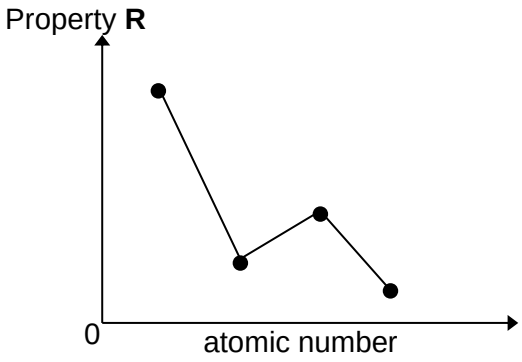
C The reaction occurs in one step.

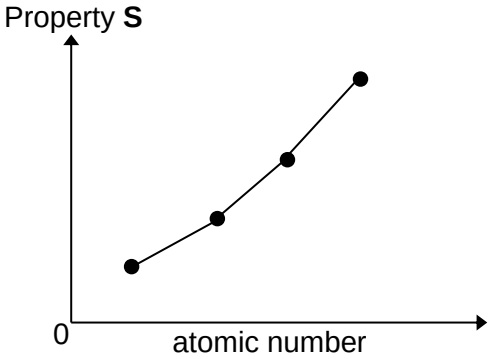
D The unit for the rate constant is mol^{-1} dm^3 s^{-1}.

16 The following diagram shows the third ionisation energies of four consecutive Period 3 elements.



Two other properties of the same elements are shown in the following diagrams.





What are properties **R** and **S**?

	Property **R**	Property **S**
A	electrical conductivity	boiling point
B	electronegativity	effective nuclear charge
C	melting point	electronegativity
D	second ionisation energy	ionic radius

17 Which of the following statements about Group II elements is **correct**?

A The electronegativity increases down the group.

B The ionic radius increases down the group.

C The ionisation energy increases down the group.

D The reducing power decreases down the group.

18 The temperature required to decompose Group II carbonate increases down the group. Which of the following offers the best explanation?

A Decreasing magnitude of the lattice energy.
B Increasing size of the cation.
C Increasing ionic character of the carbonate.
D Increasing polarising power of the cation.

19 A hot glass rod was dipped into a jar containing a mixture of hydrogen chloride, hydrogen bromide and hydrogen iodide. Which of the following observations is **correct**?

A A gas that turned moist blue litmus paper red and then white was detected.
B No apparent reaction.
C Reddish−brown fumes were seen.
D Purple fumes were seen.

20 Many copper(I) compounds are white in colour. Which of the following best explains this phenomenon?

A d-d transition cannot take place.
B Copper forms very stable complexes.
C Copper has more than one oxidation state.
D The d-d transition absorbs only ultra-violet light.

21 Copper(II) sulfate solution reacted as shown in the scheme below.

$$CuSO_4(aq) \xrightarrow[\textbf{I}]{NH_3(aq)} \textbf{J} \xrightarrow[\textbf{II}]{\text{excess } NH_3(aq)} \textbf{K} \xrightarrow[\textbf{III}]{\text{excess conc HC}l} \text{solution } \textbf{L}$$

Which of the following statements is **correct**?

A **J** is a deep blue solution.
B Reaction **II** is a redox reaction.
C Solution **L** is yellow in colour.
D The NH_3 functions as a ligand in reaction **I**.

22 A compound of chromium with the general formula $Cr(H_2O)_6Cl_2I$ forms an aqueous solution. When this solution is treated with an excess of aqueous silver nitrate, a mixture comprising equal amounts of AgCl and AgI was precipitated. Which of the following represents the structure of the chromium-containing ion present in the aqueous solution?

A Cr^{3+}

B $Cr(H_2O)_6^{3+}$

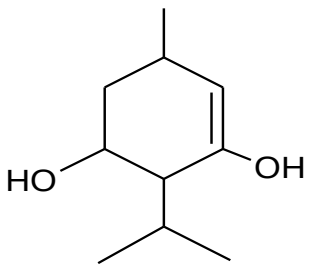
C $[Cr(H_2O)_5Cl]^{2+}$

D $[Cr(H_2O)_4Cl_2]^{+}$

23 When excess propane was reacted with chlorine gas in the presence of *uv* light, two products **T** and **U**, in the ratio of 3:1 were formed. What could be the possible identities of **T** and **U**?

	T	**U**
A	$CH_3CH_2CH_2Cl$	$CH_3CHClCH_3$
B	$CH_2ClCH_2CH_2Cl$	$CH_3CCl_2CH_3$
C	$CH_3CHClCH_3$	$CH_3CH_2CH_2Cl$
D	$CH_3CCl_2CH_3$	$CH_2ClCH_2CH_2Cl$

24 Compound **Q** is reduced by catalytic hydrogenation to **R**. What is the maximum number of optical isomers that **R** could have?



Q

A 2 **B** 4 **C** 8 **D** 16

25 Reaction of 2-methylpropene with iodine chloride, IC*l*, yields a number of products. Which of the following would be the major product?

A $(CH_3)_2CCl CH_2Cl$

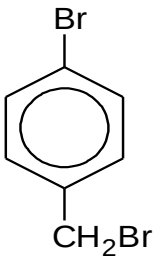
B $(CH_3)_2CCl CH_2I$

C $(CH_3)_2CICH_2Cl$

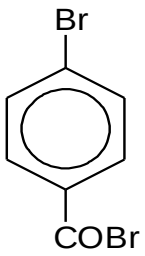
D $(CH_3)_2CICH_2I$

26 Pure samples of equal mass of each of the following compounds (**H1** to **H4**) were heated with aqueous sodium hydroxide. The mixture was then acidified with dilute nitric acid, followed by excess silver nitrate solution. Which of the following pairs would give equal masses of precipitates?

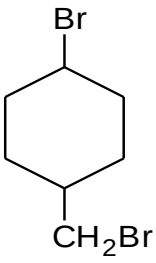
H1



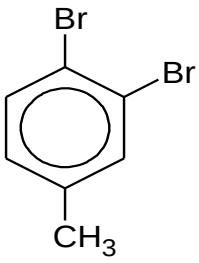
H2



H3



H4



A **H1** and **H2**

B **H1** and **H3**

C **H2** and **H3**

D **H2** and **H4**

27 Which of the following pairs of compounds can be differentiated by warming with aqueous alkaline iodine?

A CH_3OCH_3 and CH_3OH

B CH_3CH_2OH and CH_3CHO

C $CH_3CH_2COCH_2CH_3$ and $(CH_3)_2CO$

D $CH_3COCH_2CH_3$ and CH_3CHO

28 A compound **L** of molecular formula C_2H_3N is hydrolysed with dilute acid and then purified. The purified product is treated with PCl_5 to form **M**. **L** can also be directly reduced with $LiAlH_4$ in dry ether to form **N**. What would be formed when **M** is reacted with **N**?

A $CH_3CONHCH_2CH_3$

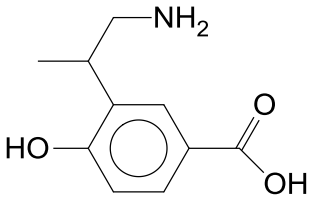
B $CH_3CH_2CONHCH_2CH_3$

C $(CH_3CO_2^-)(CH_3CH_2NH_3^+)$

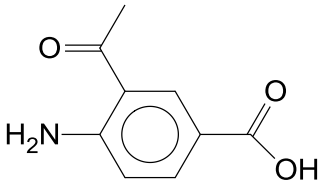
D $(CH_3CH_2CO_2^-)(CH_3CH_2NH_3^+)$

29 One mole of compound **O** produces one mole of hydrogen gas on reaction with excess sodium and one mole of ammonia gas on heating with aqueous sodium hydroxide. **O** also turns acidified potassium dichromate(VI) to green. Which of the following is a possible structure for **O**?

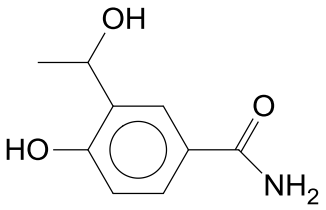
A



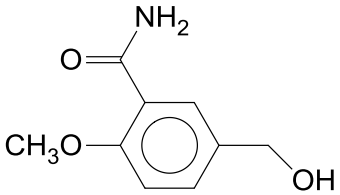
B



C



D



30 A peptide with 12 amino acids has ser as the N-terminal residue and cys as the C-terminal. Partial acid hydrolysis gave these peptide sequences:

ser-leu-tyr
tyr-cys
leu-tyr-glu
glu-leu-glu
ser-val-cys
cys-ser-val
glu-asp-tyr

Which of the following is the **correct** primary structure of the peptide?

A ser-val-cys-glu-leu-glu-asp-tyr-ser-leu-tyr-cys
B ser-val-cys-ser-leu-tyr-glu-leu-glu-asp-tyr-cys
C ser-leu-tyr-ser-val-cys-glu-leu-glu-asp-tyr-cys
D ser-leu-tyr-glu-leu-glu-asp-tyr-cys-ser-val-cys

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.

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 to be used as a correct response.

31 Iodate(V) ions react with iodide ions under acidic conditions as shown below.

$$IO_3^- + 5I^- + 6H^+ \rightarrow 3I_2 + 3H_2O$$

A strong monobasic acid **Q** was added to an aqueous solution containing excess iodate(V) and iodide ions. The iodine formed was then titrated with sodium thiosulfate solution. 10.00 cm^3 of 0.200 mol dm^{-3} sodium thiosulfate solution was required to react with the iodine produced when 50.0 cm^3 of acid **Q** was used.

Which of the following statements about this series of reactions are **correct**?

1 IO_3^- underwent reduction.

2 When thiosulfate reacted with the iodine liberated, thiosulfate underwent oxidation.

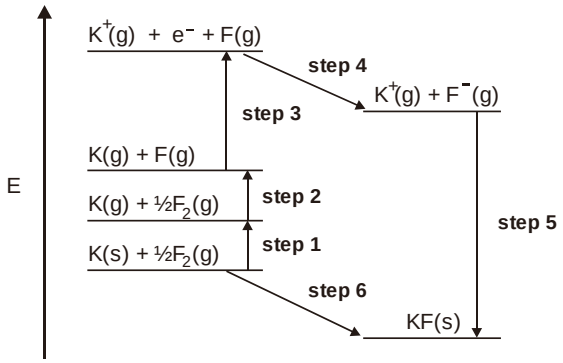
3 The concentration of acid **Q** was 0.0400 mol dm^{-3}.

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 to be used as a correct response.

32 The Born-Haber cycle for the formation of potassium fluoride is shown below.
Which of the following statements are **correct**?



1 **Step 1** represents the enthalpy change of sublimation of potassium.

2 The enthalpy change for the reaction $\frac{1}{2}F_2(g) + e^- \rightarrow F^-(g)$ can be calculated from combining **steps 2** and **4**.

3 The F–F bond energy is represented by **step 2**.

33 *Use of the Data Booklet is relevant to this question.*
The 'etching' of copper on printed circuit boards can be done in two ways.

Method 1 : Using $FeCl_3(aq)$: $Cu + FeCl_3 \rightarrow FeCl_2 + CuCl$

$FeCl_3 + CuCl \rightarrow FeCl_2 + CuCl_2$

Method 2 : Using $CuCl_2(aq)$: $CuCl_2 + Cu \rightarrow 2CuCl$

Which of the following statements about these two methods are **correct**?

1 A deposit of $CuCl$ is found at the end of the reaction if $FeCl_3$ is used.

2 $CuCl$ undergoes disproportionation in Method 2.

3 The copper(I) ions are more oxidising than iron(III) ions.

34 Bromine and methanoic acid reacts in a single step reaction.

$$Br_2(aq) + HCO_2H(aq) \rightarrow 2Br^-(aq) + 2H^+(aq) + CO_2(g)$$

Which of the following about the reaction are **true**?

1 The overall order of reaction is 2.

2 Tripling the concentration of bromine only, triples the rate of change of pH.

3 When an equal volume of water is added to the reaction mixture, the rate of reaction is halved.

35 Which of the following best describes the trend of the elements and their compounds (excluding Argon) across Period 3?

1 Nature of the oxides progresses from basic to amphoteric to acidic.

2 Oxidising power of the elements increases.

3 The ionic radius consistently increases.

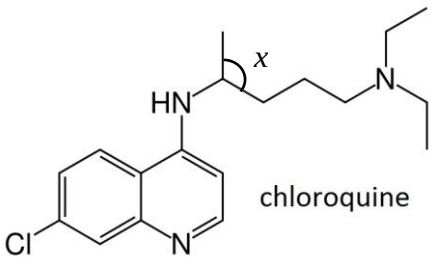
36 CFCs are responsible for the depletion of the ozone layer. When 1,2-difluoroethane is reacted with chlorine in the presence of *uv* light, which of the following chemical species would be detected in the reaction mixture?

1 HC*l*

2 HF

3 F_2

37 Chloroquine is used as an anti-malarial drug.



chloroquine

Which of the following statements about chloroquine are **correct**?

1 More than one of the nitrogen atoms can be protonated.

2 Nine sp^2 hybridised carbon atoms are present in a molecule of chloroquine.

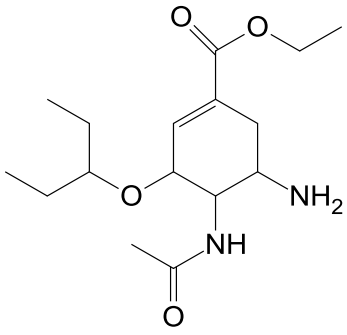
3 The value of bond angle *x* is about 109^o.

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 to be used as a correct response.

38 Tamiflu, the medication for bird flu, has the following chemical structure.



Tamiflu

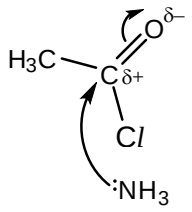
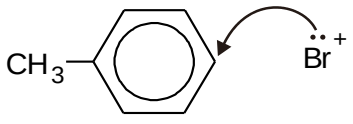
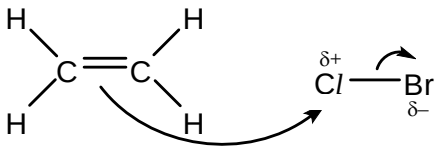
Which of the following statements about Tamiflu are **correct**?

1 After refluxing with dilute sulfuric acid, 2 organic products are formed.

2 It does not form an orange-yellow precipitate with 2,4-dinitrophenylhydrazine.

3 The purple colour of acidified $KMnO_4$ is discharged after heating with Tamiflu.

39 Which of the following mechanistic illustrations for the corresponding types of reaction are **correct**?

	Mechanisms	**Step**
1	Nucleophilic addition	
2	Electrophilic substitution	
3	Electrophilic Addition	

40 Which of the following are **correct** regarding amino acids?

1 They exist as crystalline solids.

2 They have relatively high melting points due to ionic bonds.

3 When amino acids are melted, covalent bonds are broken.

END OF PAPER

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