Candidate Name _____

Class	Reg Number

Meridian Junior College
JC2 Preliminary Examination 2008
H2 Chemistry 9746

17 September 2008   **1 hour**

Paper 1
Multiple Choice Questions

Additional Materials
Data Booklet

INSTRUCTION TO CANDIDATES

Write your name, class and register number in the spaces provided at the top of this page.

There are **forty** questions in this section. Answer **all** questions. For each question, there are four possible answers labelled **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the OMR answer sheet.

Read very carefully the instructions on the OMR answer sheet.

You are advised to fill in the OMR Answer Sheet as you go along; no additional time will be given for the transfer of answers once the examination has ended.

Use of OMR Answer Sheet

Ensure you have written your name, class register number and class on the OMR Answer Sheet.

Use a **2B** pencil to shade your answers on the OMR sheet; erase any mistakes cleanly. Multiple shaded answers to a question will not be accepted.

For shading of class register number on the **OMR sheet**, please follow the given examples:
If your register number is **1**, then shade **01** in the index number column.
If your register number is **21**, then shade **21** in the index number column.

This question paper consists of 22 printed pages.

1 A 10 cm³ sample ethanethiol was exploded with 80 cm³ of oxygen according to the given equation

$$CH_3CH_2SH \;\; + \;\; \frac{9}{2}\,O_2 \;\;\; \rightarrow \;\;\; 2\,CO_2 \; + \; SO_2 \; + \; 3\,H_2O$$
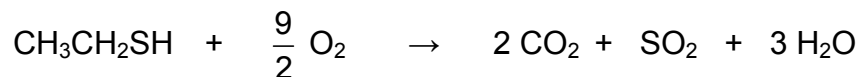
The resultant gas mixture is cooled and passed through aqueous sodium hydroxide. What would be the final volume of the resultant mixture gases at r.t.p after passing through aqueous sodium hydroxide?

A   10 cm³
B   35 cm³
C   45 cm³
D   75 cm³

2 The solubility of a gas in water can be calculated using its Henry's Law constant, K_h, which is defined as:

$$K_h = \frac{\text{concentration of the gas in water}}{\text{partial pressure of the gas in air}}$$

The K_h for CO_2 is 3.8×10^{-2} mol dm⁻³ atm⁻¹.

In an enclosed system containing carbon dioxide, hydrogen and nitrogen and argon, the volumes of each gases were found to be 3 dm³, 1 dm³, 75 dm³ and 0.5 dm³ respectively.

Using K_h, what is the concentration (in mol dm⁻³) of dissolved carbon dioxide in water when the total atmospheric pressure is 2 atmospheres?

A 1.43×10^{-3}
B 2.87×10^{-3}
C 3.00×10^{-3}
D 1.14×10^{-1}

3 Figure 1 shows the first 8 ionisation energies of an element **J** while Figure 2 shows the boiling point of 8 consecutive elements (including element **J**).
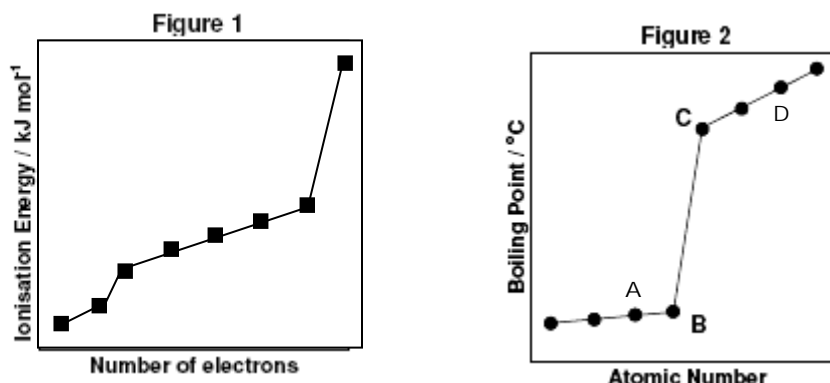
Figure 1

Figure 2

With reference to Figure 2, which of the options **A**, **B**, **C** or **D** corresponds to the boiling point of element **J**?

4 The structure of tetrasulphur tetranitride, S_4N_4, is shown below.
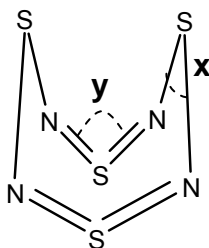
Which of the following statement is **incorrect** about the structure?

A There are 8 σ bonds and 4 π bonds in the molecule S_4N_4.
B There are 10 lone pairs of electrons in the molecule S_4N_4.
C Both bond angle **x** and **y** are 105°.
D All the nitrogen atoms are sp^2 hybridised.

5 The molecules listed below are of the general formula XY_n with $n \geq 2$. Which of the following pairs does the first species have a larger Y-X-Y angle than the second species?

A $XeCl_4$, PH_4^+
B NH_3, PH_3
C BF_3, CO_3^{2-}
D NCl_3, BCl_3

6   The melting point of 4-nitrophenol is higher than that of 2-nitrophenol. Which of the following best explains the above observations?

   A   4-nitrophenol has a closer packing in the solid state.
   B   4-nitrophenol has a larger surface area of contact for hydrogen bonding.
   C   The strength of hydrogen bonding is weaker in 2-nitrophenol.
   D   There is less extensive intermolecular hydrogen bonding in 2-nitrophenol.

7   When a solid **X** is heated in a closed vessel to a temperature T, it forms two gases **Y** and **Z** in the molar ratio of 1:2 according to the equation:

$$2\,\textbf{X}\,(s) \rightleftharpoons \textbf{Y}(g) + 2\,\textbf{Z}(g); \qquad \Delta H = 0$$
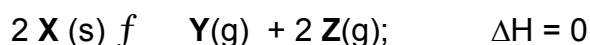
In the closed system, the reaction comes to equilibrium. The equilibrium pressure for the above system at temperature T is p kPa.

Which of the following statements is correct about the above reaction?

   A   The activation energies for both the forward and reverse reactions are zero.
   B   When temperature T increases, the equilibrium position will shift to the right to absorb the heat, thus, producing more products, **Y**(g) and **Z**(g).
   C   The value of K_p for the above reaction is $\dfrac{4}{27}p^3$ kPa^3.
   D   The rate constants do not vary with temperature.

8 For the gaseous reaction $2H_2 (g) + 2NO (g) \rightarrow 2H_2O (g) + N_2 (g)$, the rate equation is:

$$\text{rate} = k[H_2][NO]^2$$

Which graph would confirm the order of reaction with respect to hydrogen gas given in the rate equation above?

A

Rate vs $[H_2]$

B

Rate vs $[H_2]$

C

Rate vs $[H_2]$

D

Rate vs $[H_2]$
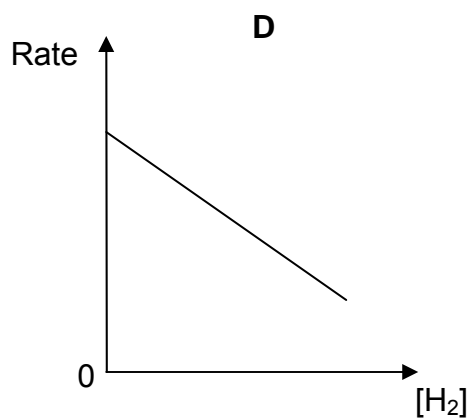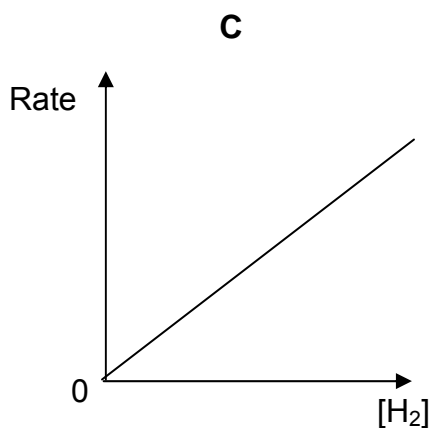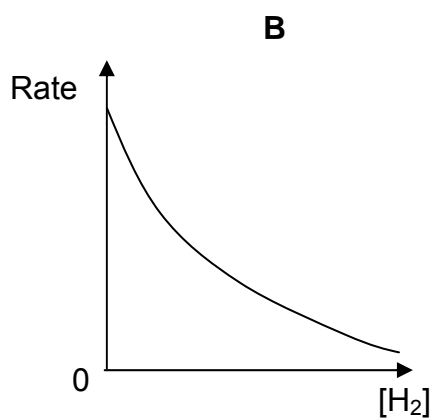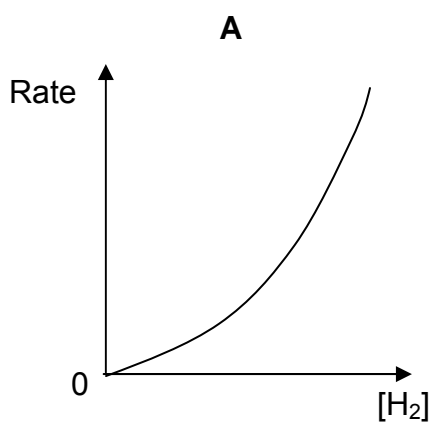
9 The equilibrium constant, K_p, for the following reaction is 4.45 at 25°C:

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

A mixture initially containing one mole each of HI (g) and I_2 (g) at 1 atm is allowed to reach equilibrium in a vessel with constant volume.

What is the partial pressure of H_2 (g) at equilibrium at 25 °C?

A   0.17 atm
B   0.21 atm
C   0.34 atm
D   0.78 atm

10 Two cells, one containing a molten chloride of manganese and the other containing molten chromium (III) chloride were connected in series. 33.0g of manganese and 20.8g of chromium were liberated.

What is the oxidation state of manganese ion in the chloride?

A   +2
B   +3
C   +4
D   +5

11 The K_b of a weak base is 1.80×10^{-6} mol dm^{-3}. What would be the pH of the buffer solution formed by mixing 150 cm^3 of 0.10 mol dm^{-3} of the weak base and 100 cm^3 of 0.20 mol dm^{-3} of its conjugate acid together?

A   4.6
B   5.9
C   8.1
D   9.4

12 Dinitrogen oxide is formed by the reaction of nitrogen monoxide and hydrogen gas according to the following equation:

$$2\ NO(g) + H_2(g) \ \rightleftharpoons \ N_2O(g) + H_2O\ (g)$$
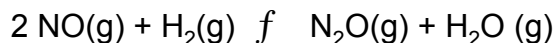
Which one of the following changes, while keeping the pressure constant, is **most** likely to decrease the entropy of this gaseous system?

A   increase the temperature
B   remove H_2O (g) from the system
C   add an inert gas into the system
D   add more NO gas into the system

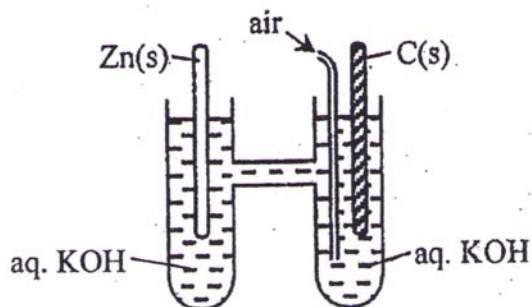**13** An experiment is carried out with the following cell.

$$Fe\ (s)\ |\ Fe^{2+}\ (aq)\ ||\ Ni^{2+}\ (aq)\ |\ Ni\ (s)$$
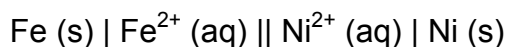
The following graph of cell potential against time was obtained when a change was continuously made to the half-cell.
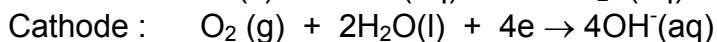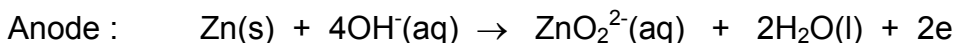

Cell Potential / V

Time / s
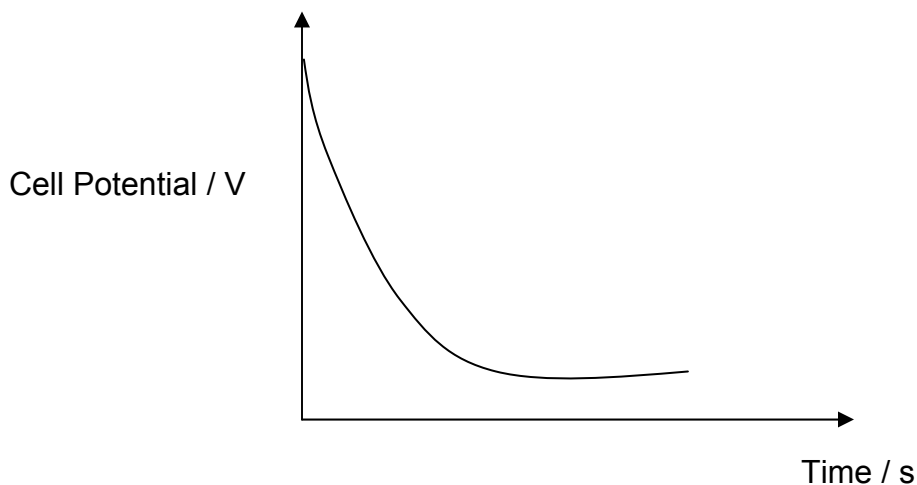
What continuous change could produce these results?

A   add nickel (II) chloride to the nickel half-cell
B   add aqueous cyanide ions to the iron half-cell
C   add water to the nickel half-cell
D   Increases the surface area of iron immersed in the solution.

14 A cell is constructed with zinc and carbon electrodes, each weighing 40g, partly immersed in aqueous KOH. Oxygen is supplied in the half-cell containing the carbon electrode by bubbling air into it. When connected in a circuit, some zinc passes into the solution as zincate (II) ions, $ZnO_2^{2-}(aq)$.

The electrode reactions can be presented as shown:

Anode : $Zn(s) + 4OH^-(aq) \rightarrow ZnO_2^{2-}(aq) + 2H_2O(l) + 2e$
Cathode : $O_2(g) + 2H_2O(l) + 4e \rightarrow 4OH^-(aq)$

The cell delivers a current of 13.7 mA. The zinc electrode is replaced once 60% of it is used up.

What is the quantity of electricity required to pass through the cell and the time taken before replacement of zinc electrode becomes necessary?

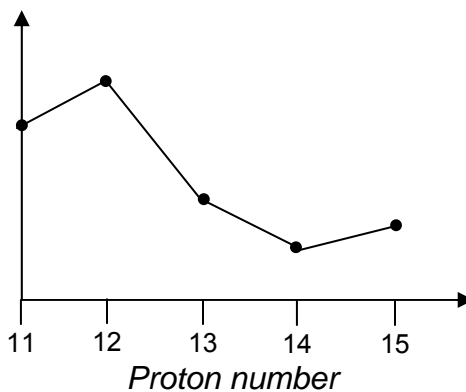|	Quantity of electricity / C	Time / s
A	7.08×10^4	5.17×10^6
B	1.18×10^5	8.63×10^6
C	1.41×10^5	1.03×10^7
D	2.36×10^5	1.72×10^7

15 The following graphs show three properties of the elements, Na to P, and their compounds, vary with proton number.
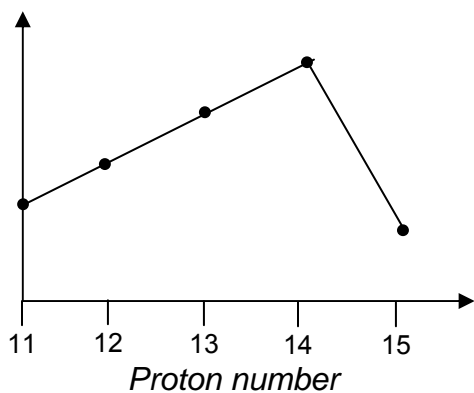
Graph 1
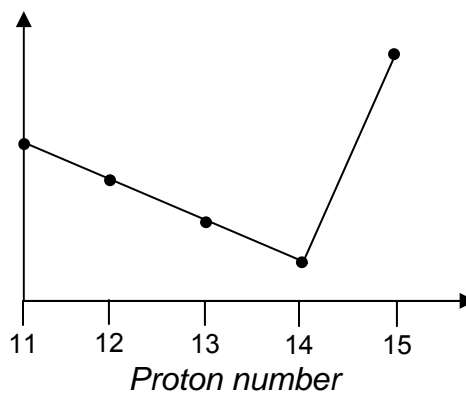
Graph 2

Graph 3

Which properties are shown by the three graphs?

	Graph 1	Graph 2	Graph 3
A	Melting point of oxide	Melting point of chloride	Electrical conductivity of elements
B	Melting point of chloride	Melting point of oxide	Ionic radius of elements
C	Melting point of oxide	Electrical conductivity of elements	Melting point of chloride
D	Melting point of oxide	Ionic radius of elements	Melting point of chloride

16 Which of the following factors best explains why strontium sulphate has a lower solubility than barium sulphate?

A Strontium ion is less electropositive than barium.
B Barium sulphate has a numerically smaller lattice energy than strontium sulphate.
C The charge density of strontium is larger than that of barium ions.
D The hydration of barium ions is more exothermic than that of strontium ions.

17 Which one of the following statements is correct for the hydrides of Group VII, mainly HCl, HBr and HI?

A Reducing power decreases from HCl to HI.
B Polarity of hydrogen halides molecules increases from HCl to HI.
C Acid strength decreases from HCl to HI.
D Enthalpy change of formation become less exothermic from HCl to HI.

18 On heating solid sodium bromide with concentrated sulphuric acid, which of the following observation will **not** be detected?

A reddish brown fumes
B rotten egg smell of H_2S
C dense white fumes
D pungent gas which decolourises acidified $KMnO_4$(aq)

19 EDTA^{4-}(aq) solution is added dropwise until in excess to a solution of $[CrCl_2(H_2O)_4]^+$. The equlibirum constant for this reaction is greater than 1 and the equation for the reaction is as shown below.

$[CrCl_2(H_2O)_4]^+$(aq) + EDTA^{4-}(aq) $\rightleftharpoons$ [Cr(EDTA)]$^-$ (aq) + 2Cl$^-$(aq) + 4H$_2$O(l)

Which one of the following statements about the above reaction is correct?

A There is no change in colour of the solution after addition of EDTA.
B [Cr(EDTA)]$^-$ is a less stable complex ion than $[CrCl_2(H_2O)_4]^+$.
C Both [Cr(EDTA)]$^-$ and $[CrCl_2(H_2O)_4]^+$ are octahedral complexes.
D The above is a redox reaction.

20   Mono-substituted 2-bromobutane can be synthesized by reacting butane with bromine via free radical substitution.

Which of the following statements about the mechanism of the above reaction is **incorrect**?

A   Excess butane is used to ensure majority of the product is mono-substituted 2-bromobutane.
B   A very small amount of 3,4-dimethylhexane is produced as a by-product.
C   2-bromobutane is produced only in the propagation step.
D   The reaction can be carried out easily in the presence of uv light.

21 α-Candinene can be found in juniper berries. Compound **Y** is the minor product formed when α-Candinene is reacted with HCl in CCl_4.

HCl / CCl_4

minor Product **Y**

α-Candinene
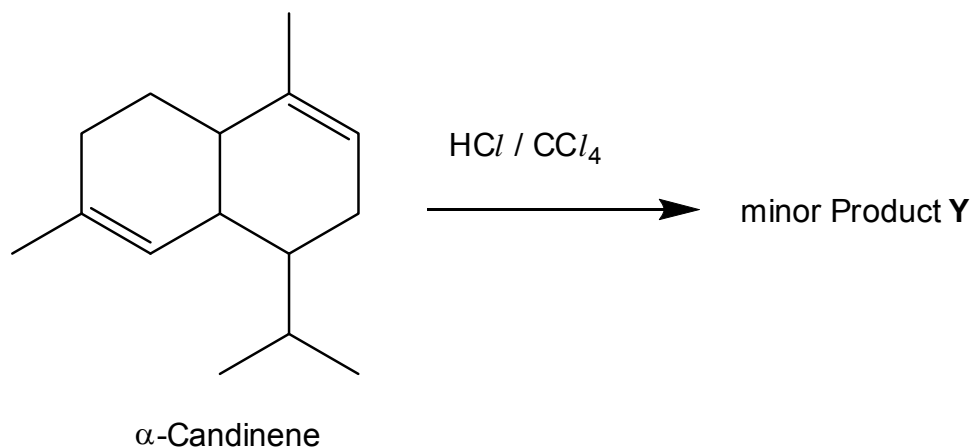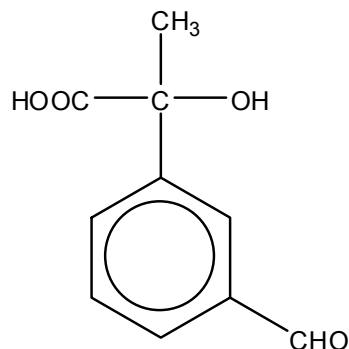
How many stereoisomers does **Y** have?

A   32
B   64
C   128
D   256

22 Which of the following reagents may be used to distinguish between the compounds **P** and **Q**?
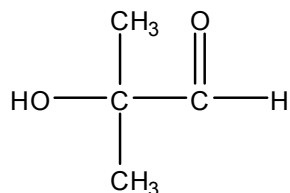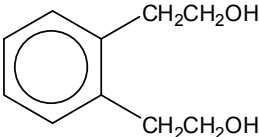

Compound P

Compound Q

A   Hot acidified potassium manganate (VII)
B   Alkaline aqueous iodine
C   Silver nitrate with excess aqueous ammonia
D   Sodium metal

23 **S, U** and **T** are three different organic compounds. Both **U** and **T** can react with **S** to form an ester each, but **T** reacts much less readily than **U**.

Which of the following could be **U**?
A   butan-2-ol
B   butananamide
C   butanoic acid
D   butanoyl chloride

24 The aromatic compound was made to react with an excess hot aqueous acidified potassium manganate (VII) and the product was isolated as white crystalline solid. Subjecting one mole of the solid to strong heating produces one mole of a new compound **R**, with the liberation of one mole of water vapour.

What is the most likely final product **R**?

A

B

C

D
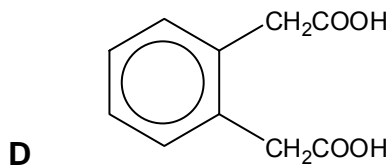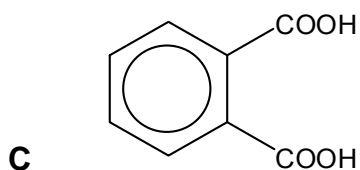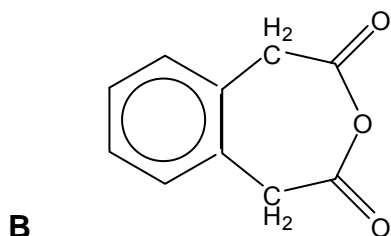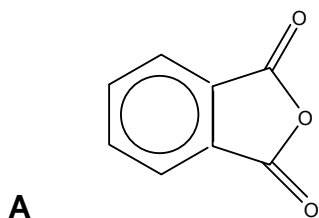
25 In the presence of a hydroxide catalyst, propanal (CH_3CH_2CHO) can react with itself to form a compound as aldol (reaction **I**). Aldol reacts to form another compound on heating (reaction **II**).

I $2CH_3CH_2CHO \rightarrow CH_3CH_2CH(OH)CH_2CH_2CHO$

II $CH_3CH_2CH(OH)CH_2CH_2CHO \rightarrow CH_3CH_2CH=CHCH_2CHO + H_2O$

By examining the equations of the reactions, choose the correct description of the reactions from the following.

	I	**II**
A	nucleophilic substitution	elimination
B	electrophilic substitution	nucleophilic substitution
C	nucleophilic addition	elimination
D	electrophilic addition	nucleophilic substitution

26 Concentrated ammonia was heated in a seal tube with excess 1-bromopropane (C_3H_7Br).

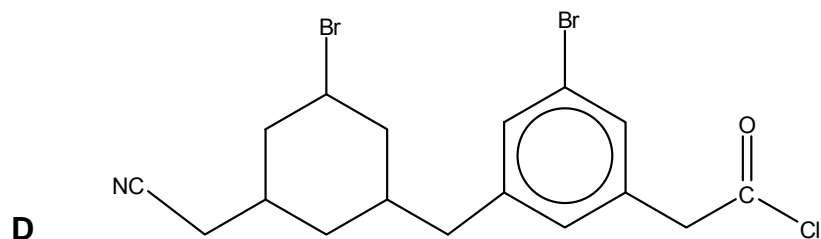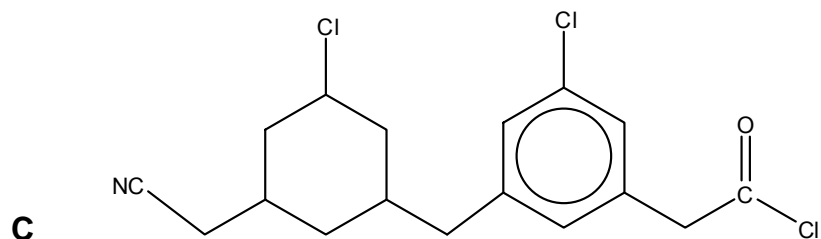Which one of the following products is unlikely to be present at the end of the reaction?

A C_3H_9N
B $C_6H_{15}N$
C $C_9H_{21}N$
D $C_{12}H_{28}N^+Br^-$

27 The reaction scheme below shows the formation of compound **G**:

Aqueous NaOH, heat → **F**; 1. H⁺ (aq), 2. PCl₅ → **G**
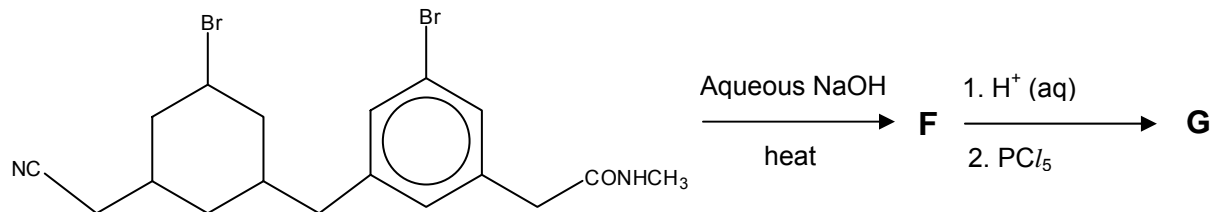
What is the structure of compound **G**?

A

B

C

D

15
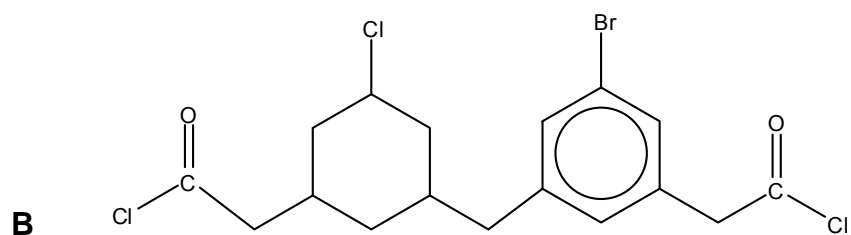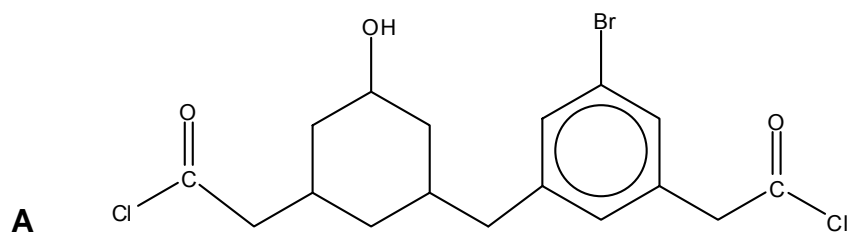
28 *Acetaminophene* is a drug used in headache remedies.
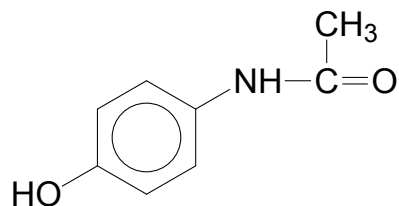
Acetaminophene

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

A   It forms violet colouration with neutral aqueous iron (III) complex.
B   It reacts with hot aqueous NaOH to give sodium ethanoate.
C   It gives an orange precipitate with 2,4-dinitrophenylhydrazine.
D   It reacts with sodium metal to give hydrogen gas.

29 Equimolar aqueous solution of compounds **W**, **X**, **Y** and **Z** are made.

W   X   Y   Z
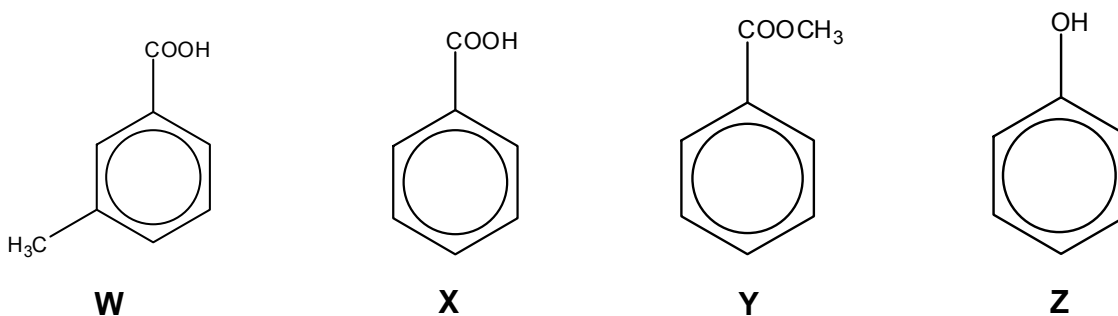
Which one of the following gives an increasing order of the pK_a values for compounds **W**, **X**, **Y** and **Z**?

A   X, W, Z, Y
B   W, X, Z, Y
C   Y, Z, W, X
D   Y, X, W, Z

16

30 Which sequence shows the correct order of increasing ease of hydrolysis of the following compounds?

R	S	T	U

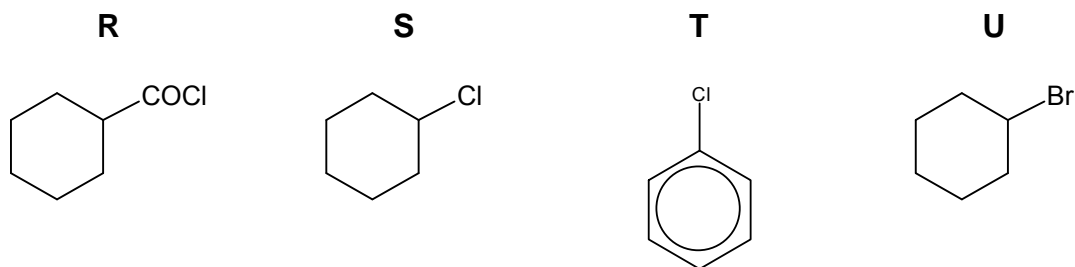COCl   Cl   Cl   Br

A $T < U < S < R$
B $T < S < U < R$
C $R < S < U < T$
D $R < U < S < T$

For questions 31 to 40, 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

31 The electronic configurations of elements **X**, **Y** and **Z** are as follows:
X: $[Ar]3d^{10}4s^24p^1$
Y: $[Ar]3d^{10}4s^24p^4$
Z: $[Ar]3d^{10}4s^1$

Which of the following statement(s) is / are true?

1 X^{3+} shows the greatest deflection towards the negatively charged plate with constant electric field compared to Y^+ and Z^{2+}.

2   Each of the X^{2+}, Y^{2+} and Z^{2+} ions contains at least one unpaired electron.

3   Compounds X_2Y_3, ZY and XZ_3 are likely to be formed.

17

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

32 Which of the following is correct when 60 cm^3 of 0.10 mol dm^{-3} Ba(OH)$_2$ is added to 200 cm^3 of 0.10 mol dm^{-3} ethanoic acid?

(K$_a$ of ethanoic acid = 1.8 x 10^{-5} mol dm^{-3})

1 The pH of the final solution is less than 7.
2 The pH would increase significantly if a further 40 cm^3 of 0.10 mol dm^{-3} of Ba(OH)$_2$ was added.
3 When a few drops of phenolphthalein are added, the final solution turns pink.

33 Ethane-1,2-diammine, en, is a ligand found in complexes.

The rate of exchange of chloride between $\left[Pt^{IV}(en)_2 Cl_2\right]^{2+}$ and $^*Cl^-$ is very slow, but the rate is enhanced in the presence of $\left[Pt^{II}(en)_2\right]^{2+}$ catalyst:

$$\left[Pt^{IV}(en)_2 Cl_2\right]^{2+} + {}^*Cl^- \xrightarrow{\left[Pt^{II}(en)_2\right]^{2+}} \left[Pt^{IV}(en)_2 {}^*ClCl\right]^{2+} + Cl^-$$
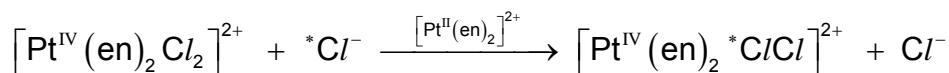
The initial rates determined as a function of concentrations are as follows:

Expt	$\left[\left[Pt^{IV}(en)_2 Cl_2\right]^{2+}\right]$ / mmol dm^{-3}	$\left[^*Cl^-\right]$ / mmol dm^{-3}	$\left[\left[Pt^{II}(en)_2\right]^{2+}\right]$ / mmol dm^{-3}	initial rate / mmol dm^{-3} s^{-1}
1	0.80	0.10	0.20	0.409
2	0.40	0.05	0.10	0.049
3	0.40	0.05	0.20	0.102
4	0.20	0.05	0.10	0.025

What of the following statements is/are true?

1 Doubling the concentration of $\left[Pt^{II}(en)_2\right]^{2+}$ doubles the rate of reaction.
2 The value of rate constant, k is 25.6 mmol^{-2} dm^6 s^{-1}.
3 The overall order of reaction is 3.

18

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

34 A cell consisting of a V^{2+} (aq), V^{3+} (aq) | Pt (s) half-cell and a Au^{3+} (aq) | Au (s) half-cell is shown below using conventional notation.

Pt(s) | V^{2+} (aq), V^{3+} (aq) || Au^{3+} (aq) | Au (s) E^{θ}_{cell} = +1.76 V
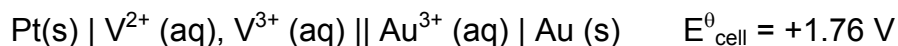
Which of the following statement(s) is / are true?

1 Electron flows in the external circuit from Pt to Au.
2 Reduction occurs at the Au terminal.
3 The standard electrode potential for Au^{3+} (aq) / Au (s) is +1.50V.

35 Which of the following statements about Group II elements from Mg to Ba is correct?

1 The melting point of the oxides increases down the group.
2 The reactivity of the elements with chlorine gas increases down the Group.
3 The decomposition temperature of the nitrates increases down the Group.

36 Which of the following enthalpy change would be required to estimate the lattice energy of the compound NaH?

1 The electron affinity of hydrogen.
2 The standard enthalpy change of formation of NaH.
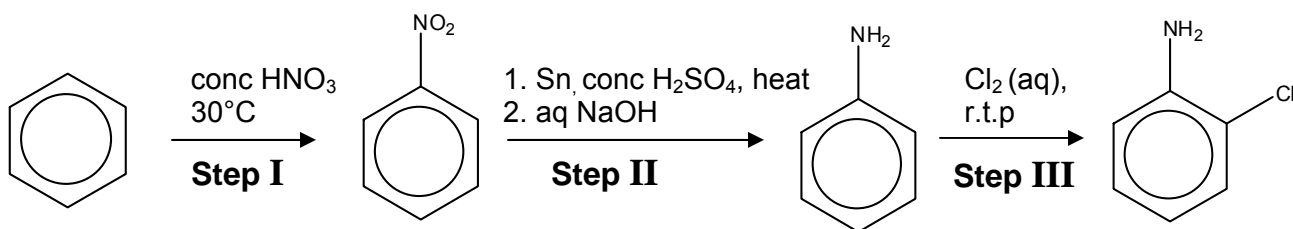**3** The sodium-hydrogen bond energy.

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

37 Which of the following statements is / are correct with regards to the compound **X** shown below?
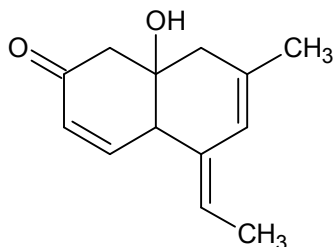
Compound **X**

1 1 mole of **X** reacts with excess gaseous HBr to yield a major product with 7 chiral centres.

2 1 mole of **X** reacts with hot acidified $KMnO_4$ to give a tribasic carboxylic acid as one of the products.

3 1 mole of **X** reacts with 4 moles of H_2 in the presence of nickel catalyst to yield a saturated compound.

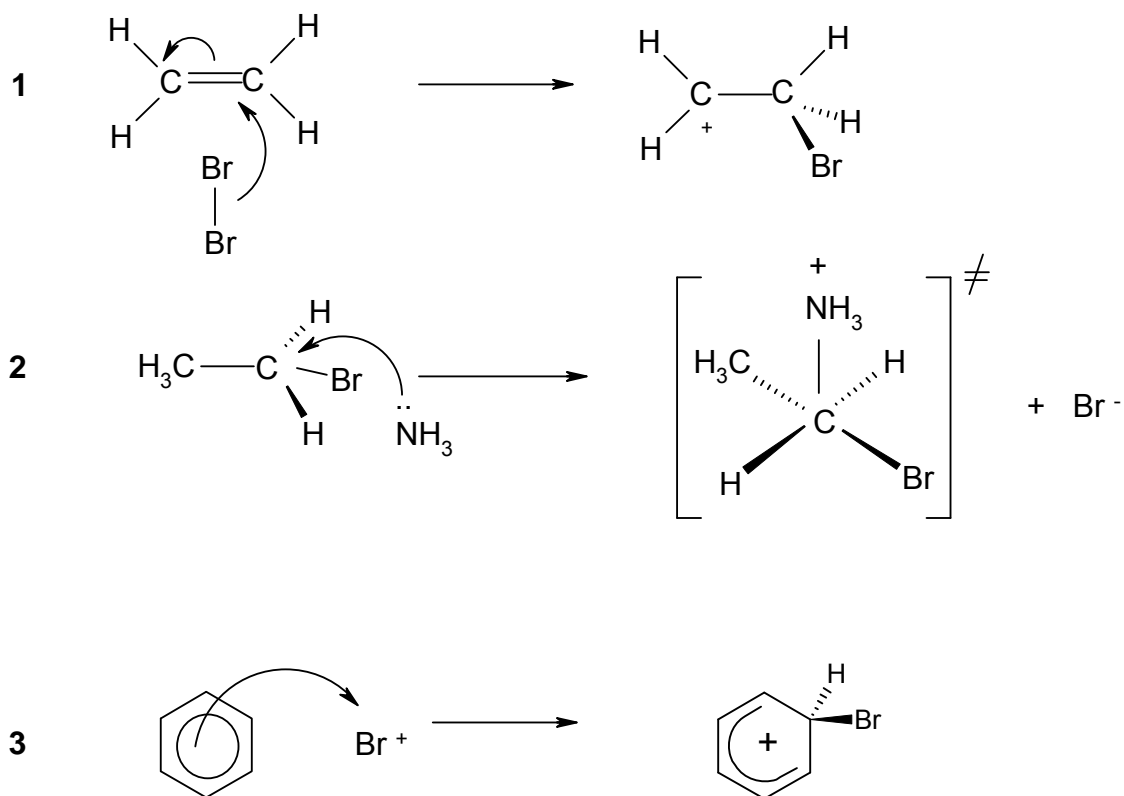**38** A student proposed the following reaction scheme for the preparation of 2-chlorophenlyamine.

Which of the following steps would lead to unsuccessful synthesis?

**1** Step I
2 Step II
3 Step III

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

39 Which of the following steps in the mechanism is/are **incorrect**?

1

2

3

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

40 Urea liberates ammonia gas under the action of an enzyme, urease. The graph below shows the number of moles of ammonia liberated in 5 minutes, at different temperatures, by the action of an urease solution on 5 cm^3 of 1.0 mol dm^{-3} solution of urea.
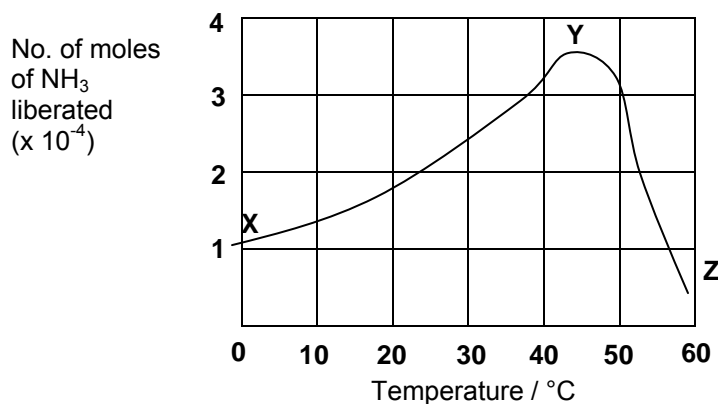
Which of the following statements explained the trend observed from **X** to **Z**?

1 The peptide linkages in the primary structure of urease were broken.

2 The bonding in the secondary and tertiary structures of urease was disrupted.

3 Denaturation of the enzyme started at **Y**.

- End of Paper