SERANGOON JUNIOR COLLEGE
General Certificate of Education Advanced Level
Higher 2

Candidate Name

Class

CHEMISTRY **9647/01**

Preliminary Examination 24 August 2012

Paper 1 Multiple Choice 1 hour

Additional Materials: Data Booklet
Optical Mark Sheet (OMS)

READ THESE INSTRUCTIONS FIRST

On the separate multiple choice OMS given, write your name, FIN/NRIC and class in the spaces provided.
Shade correctly your class and FIN/NRIC number.
Eg. If your NRIC is S9306660Z, shade **S9306660Z** for the item "index number".

There are **forty** questions in 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 using a **soft pencil** on the separate OMS.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

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

Any rough working should be done in this question paper.

This document consists of **19** printed pages and **1** blank page

Section A

For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

1 To determine the percentage of nitrogen present in a snack, 1.0 g of the snack was boiled with concentrated sulphuric acid to convert all the nitrogen into ammonium sulphate. The ammonium salt obtained was then boiled with excess aqueous sodium hydroxide to liberate the ammonia, which was passed into 25.0 cm^3 of 0.20 mol dm^{-3} hydrochloric acid. The unreacted hydrochloric acid required 20.0 cm^3 of 0.10 mol dm^{-3} aqueous sodium hydroxide for complete neutralisation.

What is the percentage by mass of nitrogen in the snack?

A 2.8% **B** 4.2% **C** 7.2% **D** 8.4%

2 In an experiment, 25.0 cm^3 of 0.20 mol dm^{-3} solution of K_2**A**O_4 reacted exactly with 25.0 cm^3 of 0.10 mol dm^{-3} aqueous sodium sulfate(IV). The half-equation for the oxidation of the sulfate(IV) ion is shown below.

$$SO_3^{2-}(aq) + H_2O(l) \rightarrow SO_4^{2-}(aq) + 2H^+(aq) + 2e^-$$

Calculate the final oxidation state of **A**.

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

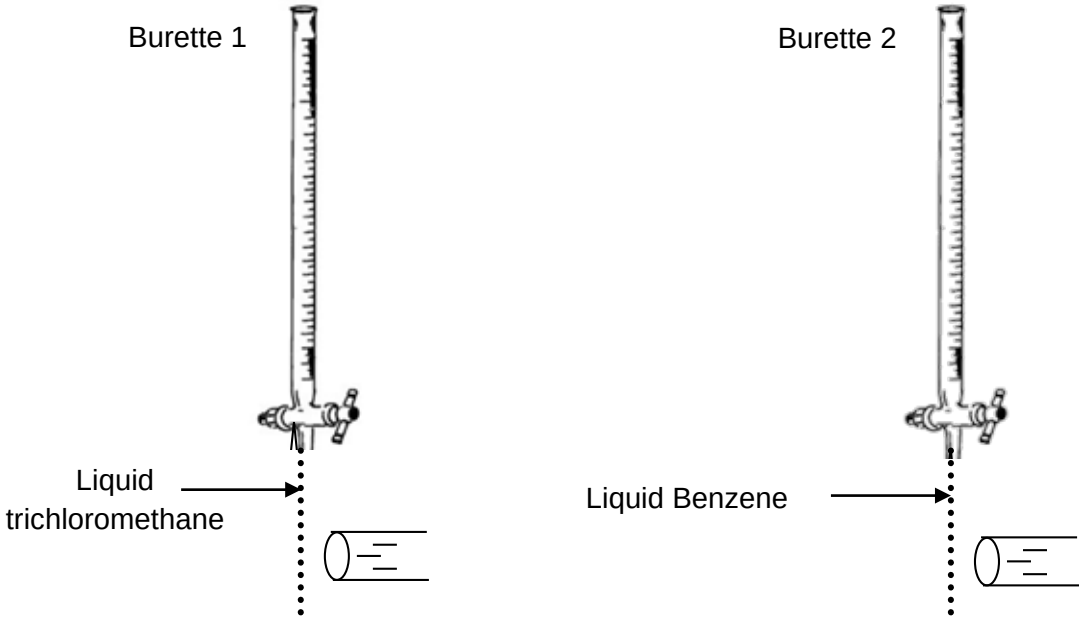
3 Two elements **D** and **E** have the following properties.

- **D** and **E** form ionic compounds Na_2**D** and Na_2**E** respectively.
- Element **E** forms **E**F_6 molecules whereas **D** is not able to do so.

Which pair of electronic configurations for **D** and **E** is correct?

	D	**E**
A	[He] $2s^2\,2p^2$	[Ne] $3s^2\,3p^4$
B	[He] $2s^2\,2p^2$	[Ne] $3s^2\,3p^2$
C	[He] $2s^2\,2p^4$	[Ne] $3s^2\,3p^2$
D	[He] $2s^2\,2p^4$	[Ne] $3s^2\,3p^4$

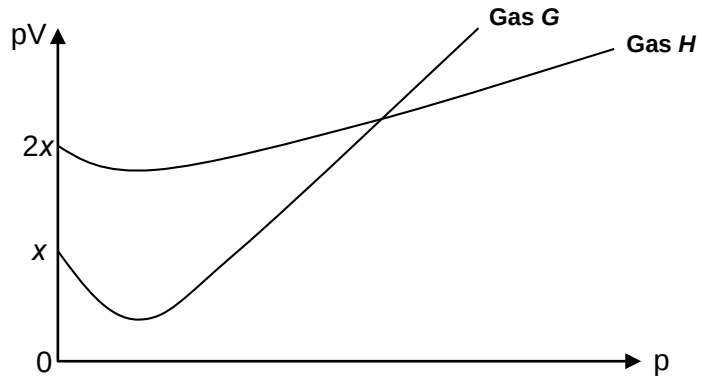
4 The diagram below shows liquid trichloromethane and liquid benzene flowing from burettes 1 and 2 respectively.



What would happen to the flow of the liquids trichloromethane and benzene when a negatively-charged rod is brought near to each of them?

	Liquid trichloromethane	**Liquid benzene**
A	Deflected towards the rod	Deflected towards the rod
B	Undeflected	Deflected towards the rod
C	Deflected towards the rod	Undeflected
D	Undeflected	Undeflected

5 The value of pV is plotted against p for two gases, **G** and **H**, where p is the pressure and V is the volume of the gas.



Which of the following could be the identities of the gases?

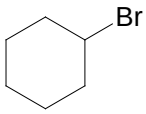
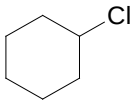
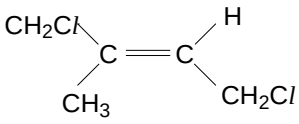
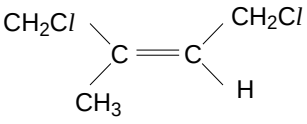
	Gas G	**Gas H**
A	0.5 mol of H_2 at 25 ºC	0.5 mol of H_2 at 50 ºC
B	0.5 mol of H_2 at 25 ºC	1 mol of SO_2 at 25 ºC
C	0.5 mol of SO_2 at 25 ºC	0.5 mol of SO_2 at 50 ºC
D	0.5 mol of SO_2 at 25 ºC	1 mol of H_2 at 25 ºC

6 During an inspection, a small spacecraft of capacity 20 m^3 was connected to another of capacity 50 m^3. Before connection, the pressure inside the smaller craft was 40 atm and that inside the larger one was 150 atm.

Given that all measurements were made at the same temperature, What is the pressure of the system after the connection?

A 78 atm **B** 95 atm **C** 119 atm **D** 190 atm

7 In which of the following pairs of compounds will compound **II** have a higher boiling point than compound **I**?

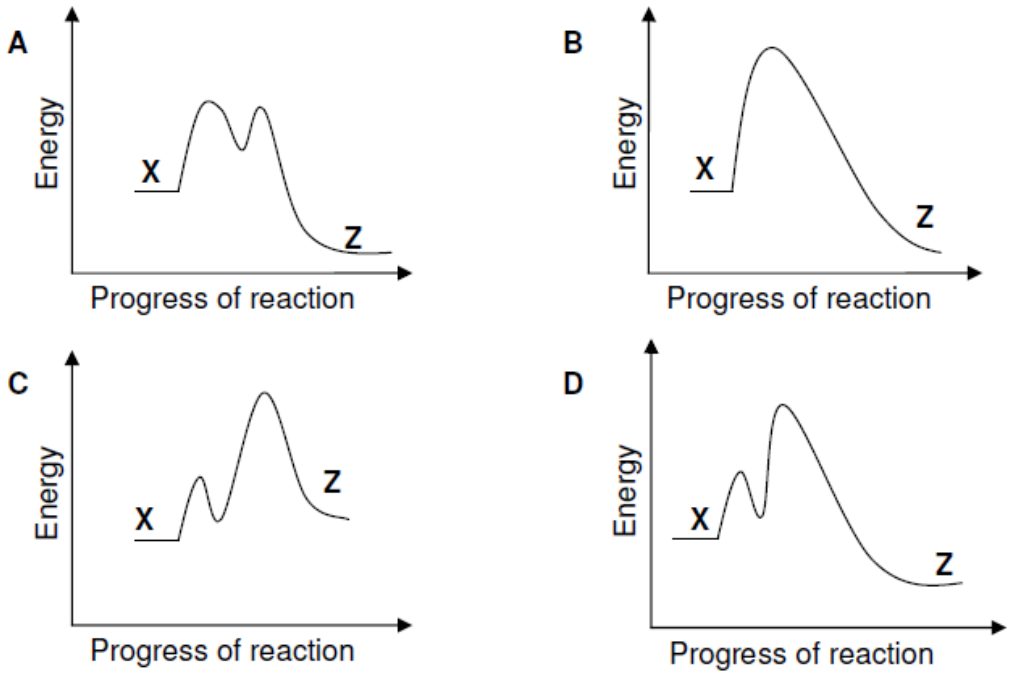
	I	**II**
A		
B	$CH_3CH_2CH_2CH_2CH_3$	$C(CH_3)_4$
C	$CH_3CH_2CH_2COOH$	$CH_3CH_2CH_2OH$
D		

8 The conversion of compound **X** into **Z** was exothermic and proceeded by two steps, where **Y** was the intermediate. The steps involved were:

Step 1: **X** ® **Y**

Step 2: **Y** ® **Z**

It was found that Step 1 is the rate-determining step. Which diagram represents the energy level diagram for the reaction?



9 Pure nitrosyl chloride, NOC*l* gas, was heated at 320°C in a 2.0 dm^3 vessel. At equilibrium, 30% of the NOC*l* gas had dissociated according to the equation below and the total pressure was p atm.

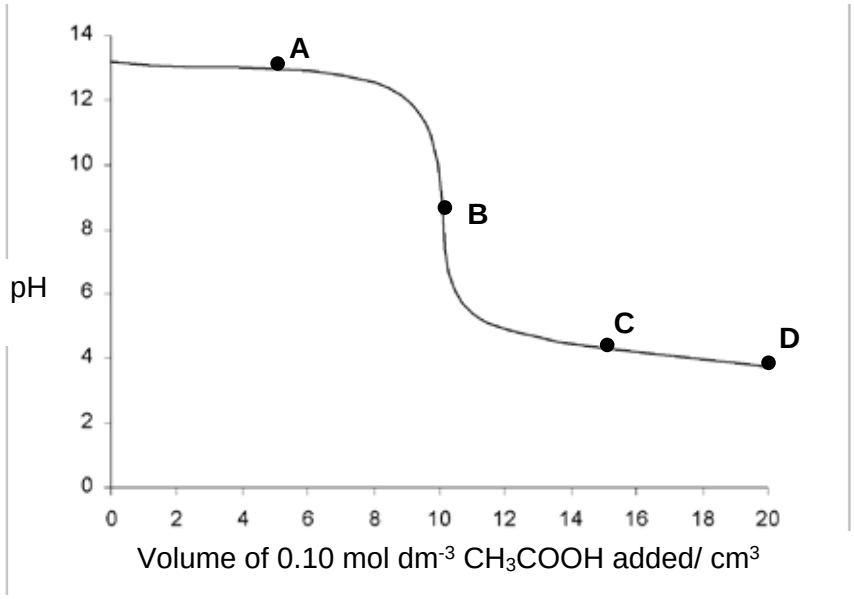
$$2NOCl\ (g) \rightleftharpoons 2NO\ (g) + Cl_2\ (g)$$

What is value of the equilibrium constant, K_p?

A $\frac{17.9}{p}$ **B** $\frac{41.7}{p}$ **C** $0.0120p$ **D** $0.0130p$

10 The pH change when 0.10 mol dm^{-3} CH_3COOH is added drop-wise to 10.0 cm^3 of 0.10 mol dm^{-3} NaOH (aq) is shown below.

At which point on the graph does pH = pK_a, where K_a is the acid dissociation constant of the weak acid?



11 In an experiment, 70 cm^3 of water at 25ºC was brought to boiling point by burning butane in excess oxygen. Given that the standard enthalpy change of combustion of butane is –2877 kJ mol^{-1}, calculate the volume of butane needed if this process is only 85% efficient.

Assume that the specific heat capacity of water is 4.2 J g^{-1} K^{-1} and that 1 mole of gas occupies 24 dm^3 under the given conditions.

A 0.0721 dm^3 **B** 0.156 dm^3 **C** 0.184 dm^3 **D** 0.216 dm^3

12 Which of the following changes does not alter the E^q value measured for a Cl_2/Cl^- half-cell that is under standard conditions?

A Adding water into the half-cell.

B Placing the half-cell in an ice bath.

C Adding copper(II) ions into the half-cell.

D Introducing an inert gas into the half-cell at a pressure of 1 atm through a separate inlet from the Cl_2 gas inlet.

13 Which statement concerning the chlorine-containing compounds of elements in the third period, sodium to argon, is correct?

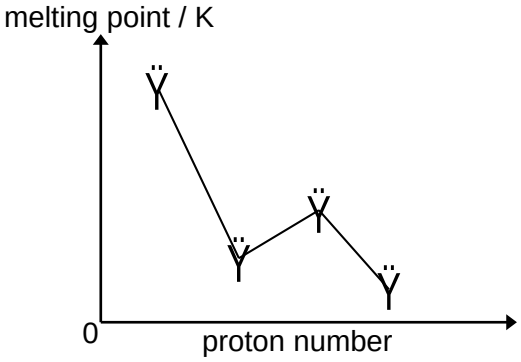
A NaCl dissolves easily in water due to favourable ion-dipole interactions and the compound with the highest electrical conductivity in molten state is $AlCl_3$.

B PCl_3 and Cl_2O_7 are both acidic in nature due to hydration of the compounds in water.

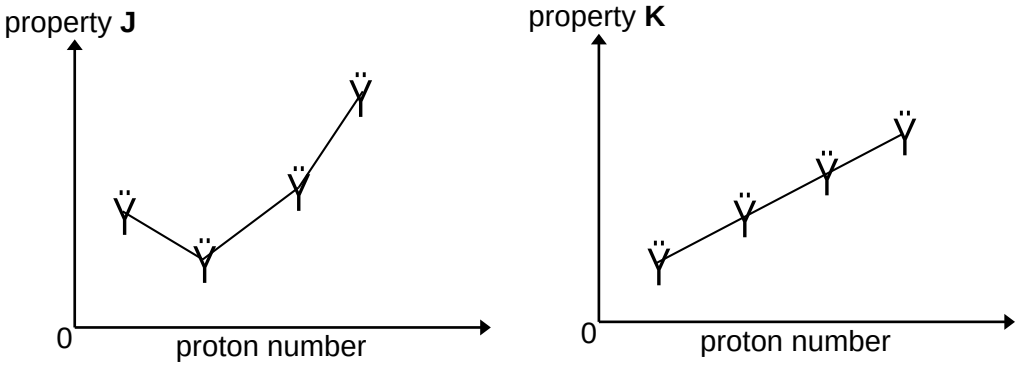
C The low boiling points of PCl_3 and Cl_2O_7 are due to the weak bond energies involved in the P-Cl bonds and the Cl-O bonds.

D The different oxidation states of chlorine in NaCl and Cl_2O_7 are due to the relative electronegativities of the pairing element and chlorine.

14 The diagram represents the melting points of four consecutive elements in the third period of the Periodic Table.



The sketches below represent another two properties of the elements.



What are properties **J** and **K**?

	property **J**	property **K**
A	third ionisation energy	electronegativity
B	number of valence electrons	boiling point
C	ionic radius	nuclear charge
D	electrical conductivity	atomic radius

15 Which of the following is true about the thermal decomposition of magnesium nitrate?

A Sodium nitrate is thermally unstable as compared to magnesium nitrate.

B Every 1 mol of magnesium nitrate burnt gives 2.5 mol of gaseous products.

C The decomposition temperature of magnesium nitrate is higher than that of barium nitrate.

D The solid product of the thermal decomposition of magnesium nitrate readily dissolves in water to give an alkaline solution.

16 Which of the following gives the best description of the reactions of Group II metals and their compounds?

A All Group II metals react with steam to give hydrogen gas.

B Barium oxide is stored in oil due to its explosive reaction with oxygen gas in air.

C All Group II oxides undergo neutralisation with hot acids to give a salt and water.

D Beryllium hydroxide is amphoteric due to the high charge density of the Be^{2+} ion.

17 The table below shows the results of experiments in which the halogens, $\mathbf{P}_2$, $\mathbf{Q}_2$ and $\mathbf{R}_2$ were added to separate aqueous solutions containing $\mathbf{P}^-$, $\mathbf{Q}^-$ and $\mathbf{R}^-$ ions.

	P^- (aq)	**Q^- (aq)**	**R^- (aq)**
P_2	no reaction	no reaction	**R_2** formed
Q_2	**P_2** formed	no reaction	**R_2** formed
R_2	no reaction	no reaction	no reaction

In which sequence is the solubility of the silver halides in aqueous ammonia arranged in **increasing** order?

A Ag**P** < Ag**Q** < Ag**R**

B Ag**Q** < Ag**P** < Ag**R**

C Ag**Q** < Ag**R** < Ag**P**

D Ag**R** < Ag**P** < Ag**Q**

18 Aqueous sodium hydroxide was added to a pale green solution of a mixture of two metal cations. The resulting precipitate was treated with excess ammonia solution giving an intense deep blue mixture. The mixture was filtered giving a reddish-brown residue and a deep blue filtrate. The residue was washed with deionised water and treated with excess acidified ammonium thiocyanate giving a blood red solution.

Which of the following substances best explains these observations?

	reddish−brown residue	*deep blue filtrate*	*blood−red solution*
A	$Fe(OH)_2$	$Cu(OH)_2$	$[Fe(H_2O)_6]^{2+}$
B	$Fe(OH)_3$	$[Cu(NH_3)_4]^{2+}$	$[Fe(H_2O)_6]^{3+}$
C	$Fe(OH)_2$	$[Cu(H_2O)_6]^{2+}$	$[Fe(H_2O)_5SCN]^{2+}$
D	$Fe(OH)_3$	$[Cu(NH_3)_4]^{2+}$	$[Fe(H_2O)_5SCN]^{2+}$

19 Rhodium and its compounds are used as catalysts in many important reactions. Which of the following properties makes rhodium a suitable heterogeneous catalyst?

A Rhodium has vacant d orbitals of suitable energy.

B Rhodium exhibits variable oxidation states.

C Rhodium is able to form stable complexes.

D Rhodium is able to form coloured compounds.

20 Compound **S** was used in the following synthesis route.

Compound **S**

What are the respective numbers of *sp*, *sp²* and *sp³* hybridised carbon atoms in compound **U**?

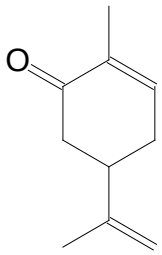
A 0, 6, 4

B 0, 7, 3

C 1, 6, 3

D 1, 7, 2

21 Carvone is the main active ingredient found in spearmint and has the following structure.



Carvone

Carvone can be reduced to compound **V** by heating with hydrogen gas in the presence of nickel.

How many stereoisomers do the molecules of carvone and **V** each have?

	Carvone	**Compound V**
A	0	4
B	0	8
C	2	4
D	2	8

22 How many alcohols (including both structural isomers and stereoisomers) can have the molecular formula $C_4H_{10}O$?

A 3

B 4

C 5

D 6

23 A sample of ethene was added to a solution of Br_2 (aq) and NaC*l* (aq). Which of the following products is **not** likely to be found in the reaction mixture?

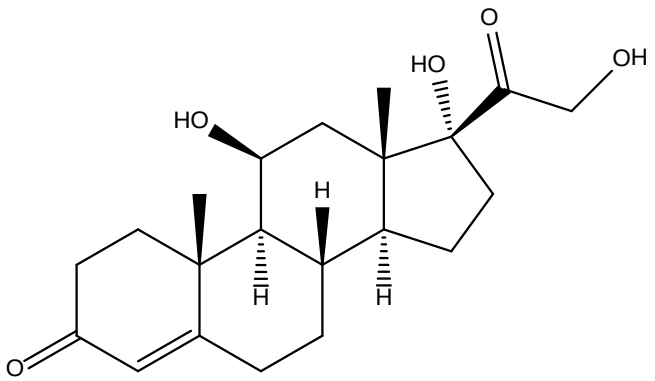
A $CH_2(OH)CH_2Br$

B CH_2BrCH_2Cl

C $CH_2(OH)CH_2Cl$

D CH_2BrCH_2Br

24 Hydrocortisone is a steroid hormone produced by the adrenal gland and is released in response to stress. It is commonly used as an active ingredient in anti-inflammatory creams.



Hydrocortisone

Which of the following statements about hydrocortisone is true?

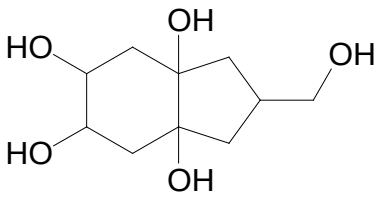
A When treated with an excess of hot concentrated acidified $KMnO_4$, it forms a compound containing seven carbonyl groups.

B When warmed with aqueous alkaline iodine, a yellow precipitate is observed.

C When treated with cold dilute $KMnO_4$, it forms a compound containing two hydroxy groups.

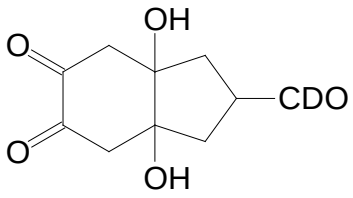
D When treated with $NaBH_4$ in the presence of methanol, it forms a compound containing five hydroxy groups.

25 Deuterium, D, is an isotope of hydrogen, $^{2}_{1}H$.

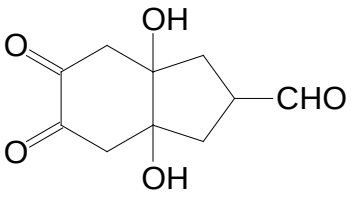


Which of the following is the product formed when the above compound reacts with hot $K_2Cr_2O_7$ in aqueous D_2SO_4 under controlled conditions?

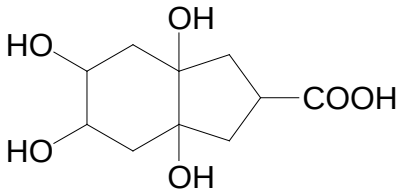
A



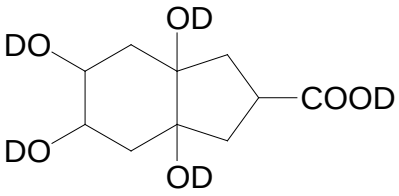
C



B

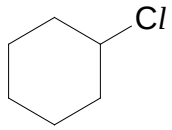


D

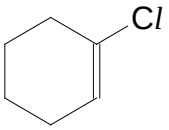


26 Which of the following shows the correct sequence in order of increasing ease of hydrolysis for the compounds below?

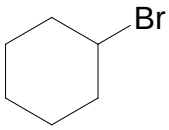
W



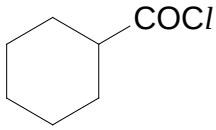
X



Y



Z



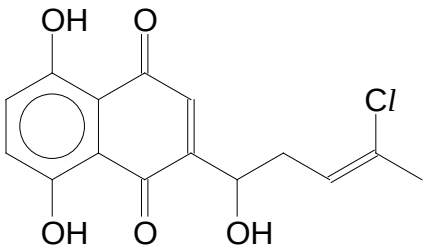
A **X** < **W** < **Y** < **Z**

B **Z** < **X** < **W** < **Y**

C **Z** < **Y** < **X** < **W**

D **W** < **X** < **Y** < **Z**

27 Which of the following statements about compound **A** is true?



Compound **A**

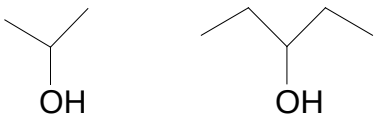
A When treated with alkaline Tollens' reagent, it forms a compound with molecular formula, $C_{15}H_{13}O_5Cl$.

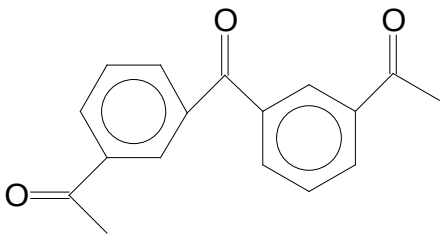
B When reacted with PCl_5, 1 mole of HCl (g) is formed.

C When heated with H_2 (g) in the presence of Ni catalyst, it forms a compound containing three hydroxy groups.

D When treated with sodium hydroxide, hydrolysis occurs.

28 What is the ratio of sodium iodide formed when each of the three compounds reacts with alkaline aqueous iodine?





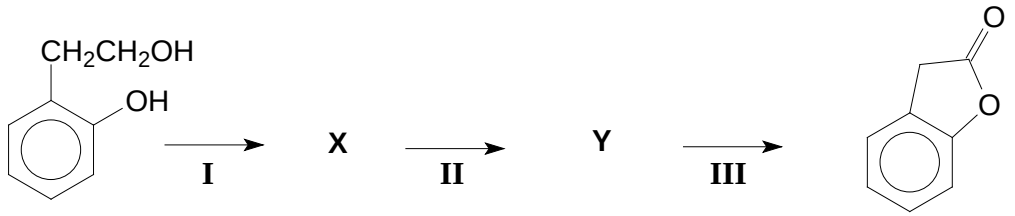
A 1:1:1

B 5:0:6

C 5:0:3

D 1:1:2

29 Compound **B** can be converted to compound **C** as shown below.



Compound **B** Compound **C**

Which of the following statements is correct with regards to the given reaction scheme?

A Step **I** may involve the use of PCl_5.

B Step **I** may involve the use of hot acidified potassium manganate(VII).

C Step **III** may involve the use of aqueous sodium hydroxide.

D Step **III** may involve the use of hot concentrated sulfuric acid.

30 A polypeptide was partially hydrolysed using two different enzymes and the fragments were separated. Analysis of the fragments gave the following results:

Using enzyme D:
glu-val-phe
glu-asp-leu
ala-ser
val-ala

Using enzyme E:
val-phe
ala-glu-asp
val
ser-glu
leu-ala

What is the amino acid sequence of the polypeptide?

A leu-ala-ser-glu-val-phe-val-ala-glu-asp

B ala-glu-asp-leu-ala-ser-glu-val-phe-val

C glu-val-phe-ala-glu-asp-leu-ala-ser-val

D val-ala-glu-asp-leu-ala-ser-glu-val-phe

Section B

For **questions 31-40**, one or more of the 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 The compound ammonium sulfate is primarily used as a fertiliser for alkaline soils. Which type(s) of bonding is/are found in the compound?

1 ionic

2 covalent

3 dative bond

32 The rate of reaction of a strip of magnesium ribbon and 45 cm^3 of 1.5 mol dm^{-3} HNO_3 is determined at 25 °C. Which of the following cases would both conditions contribute to an increase in the rate of reaction?

1 Mg powder and 90 cm^3 of 1.5 mol dm^{-3} HNO_3

2 Mg powder and 45 cm^3 of 2.0 mol dm^{-3} HNO_3

3 45 cm^3 of 2.0 mol dm^{-3} HNO_3 at 35°C

33 Which of the following statements is/are correct for the following equilibrium?

$$3H_2\,(g) + N_2\,(g) \rightleftharpoons 2NH_3\,(g) \qquad \Delta H < 0$$

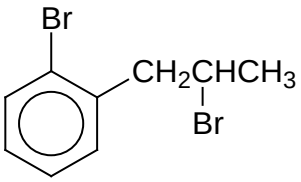
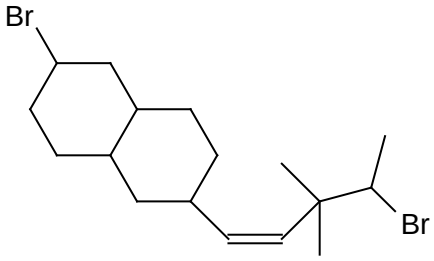
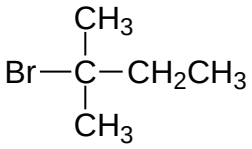
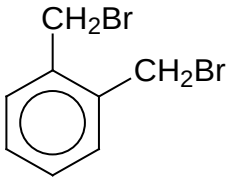
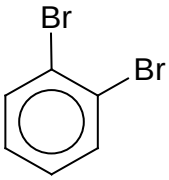
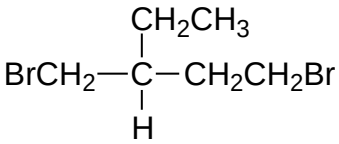
	Condition	**Position of equilibrium**	**K_p**	**Rate of formation of NH_3**
1	Increase in pressure	Right	No change	Increase
2	Decrease in temperature	Right	Increase	Decrease
3	Addition of catalyst	Left	No change	Increase

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 Which of the following indicators can be used for the titration between ethylamine and hydrochloric acid?

	Indicator	**pH transition range**
1	Naphtholphthalein	7.3 – 8.7
2	Congo red	3.0 – 5.0
3	Azolitmin	4.5 – 8.3

35 In which of the following pairs will compound **I** and compound **II** give the same number of cis-trans isomers after reaction with hot ethanolic potassium hydroxide?

	I	**II**
1		
2		
3		

36 Which of the following processes lead(s) to an increase in entropy?

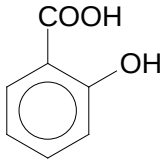
1 Diffusion of CFCs into the stratosphere.

2 Combustion of a piece of charcoal to form CO_2 (g) and H_2O (g).

3 Desalination of sea water by reverse osmosis (solvent passes from a more concentrated solution to a more dilute solution).

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

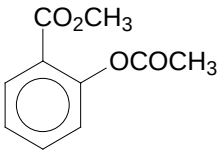
37 The diagram shows the structure of salicylic acid:



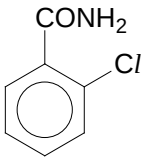
salicylic acid

Which compound(s) give(s) salicylic acid on acidic hydrolysis?

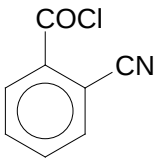
1



2

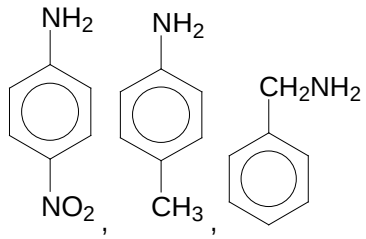


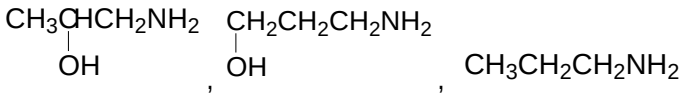
3

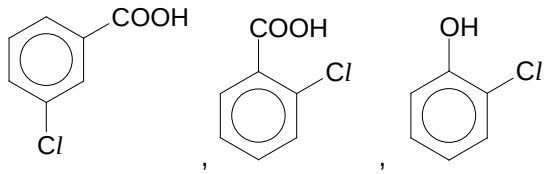


A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

38 In which of the following sequences does the value of pK_b decrease?

1 

2 

3 

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

A student set up an electrolytic cell for the purpose of purifying copper metal. However, the set-up did not lead to successful purification of copper.

Which of the following could explain the failure of the set-up?

1 The electrolyte used was aqueous chromium(III) chloride.

2 The impure copper was used as the cathode and the anode was made of pure copper metal.

3 The E^{q}_{cell} for the reaction is a negative value.

40 Vanadium has the electronic structure $1s^2 2s^2 2p^6 3s^2 3p^6 3d^3 4s^2$. Which of the following vanadium compounds is/are likely to exist?

1 V_2O_5

2 VO*Cl*

3 $K_2V_2O_7$

END