SERANGOON JUNIOR COLLEGE
General Certificate of Education Advanced Level
Higher 2

CHEMISTRY 9746/01

Preliminary Examination **28th Aug 2008**
Paper 1 Multiple Choice **1 hour**

Additional Materials: Data Booklet
Soft clean eraser
Soft pencil (type B or HB is recommended)
OMR Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, index number on the OMR Answer Sheet in the spaces provided.

Write in soft pencil. Do not use staples, paper clip, highlighters, glue or correction fluid.

There are **fourty** 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 in **soft pencil** on the separate 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.

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 question paper.
You may use a calculator.

This document consists of **18** printed pages and **0** 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 In a titration experiment, 30 cm^3 of 0.05 mol dm^{-3} phosphorous acid, H_3PO_3 was found to exactly neutralise 15 cm^3 of 0.20 mol dm^{-3} aqueous sodium hydroxide. Using this information, deduce the formula of the salt formed in the neutralisation process.

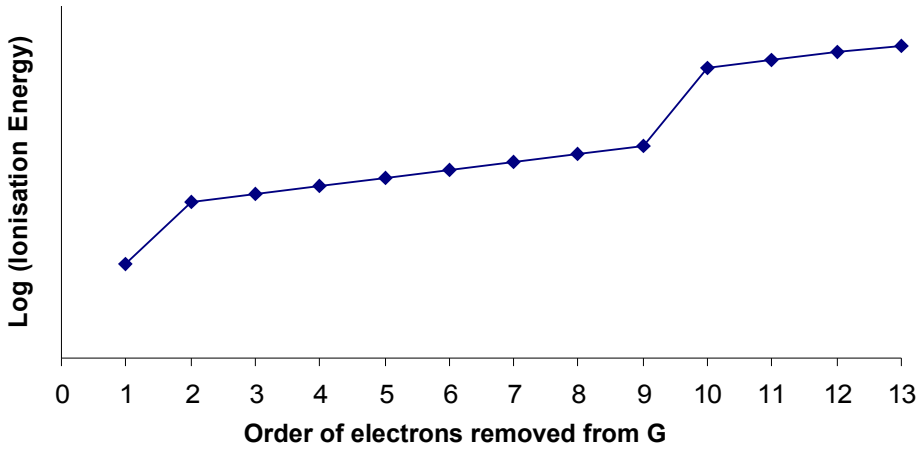
A NaH_2PO_3

B Na_2HPO_3

C Na_3PO_3

D Na_3PO_4

2 **G** is an element in period 4 of the periodic table. The ionisation energies of the first 13 electrons in element **G** is plotted against the order of removal of electrons as shown in the diagram below:



What is the formula of the compound formed when **G** reacts with oxygen?

A GO

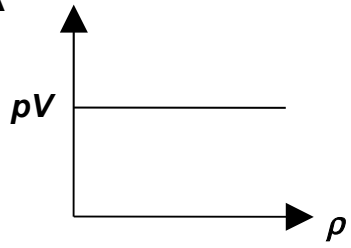
B GO_2

C G_2O

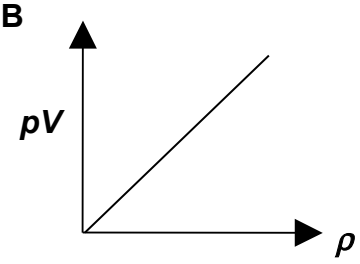
D G_2O_3

3 Which graph is obtained when ***pV*** is plotted against density, ***ρ,*** for a fixed amount of an ideal gas at constant temperature?

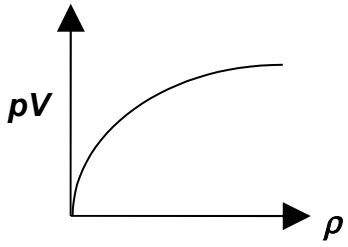
A



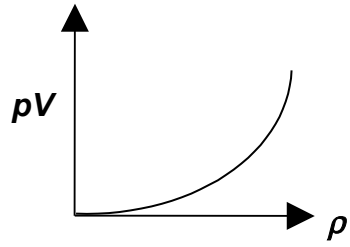
B



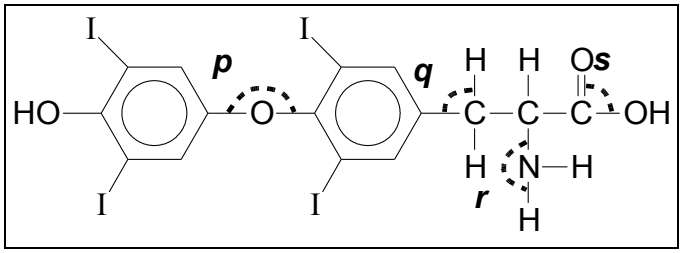
C



D



4 The thyroid gland concentrates iodine and uses it to produce thyroxine, which is a hormone that controls the metabolic rate.

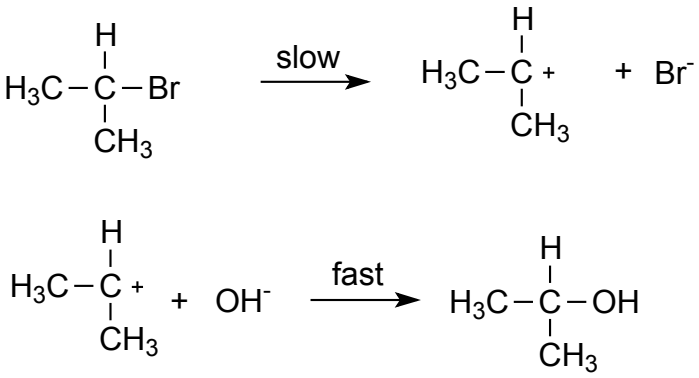


Thyroxine

What are the values of the bond angles ***p***, ***q***, ***r*** and ***s***?

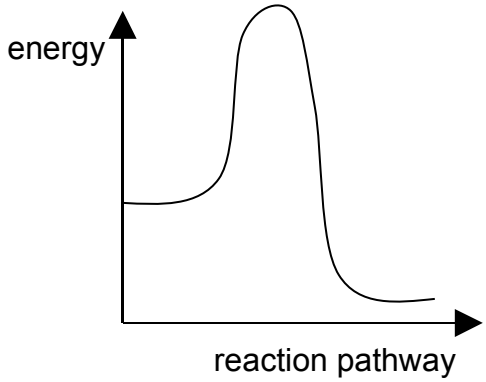
	p	***q***	***r***	***s***
A	180°	90°	180°	90°
B	105°	109.5°	107°	120°
C	180°	90°	120°	180°
D	105°	90°	107°	180°

5 2-bromopropane undergoes nucleophilic substitution with aqueous NaOH via the following mechanism.

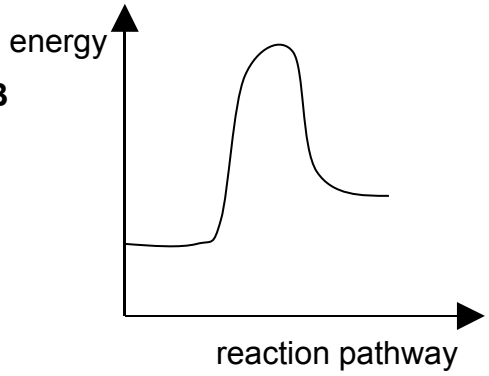


Which of the following diagrams represent the energy profile diagram of the reaction?

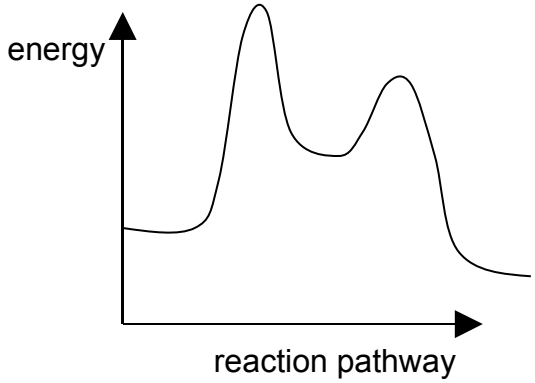
A



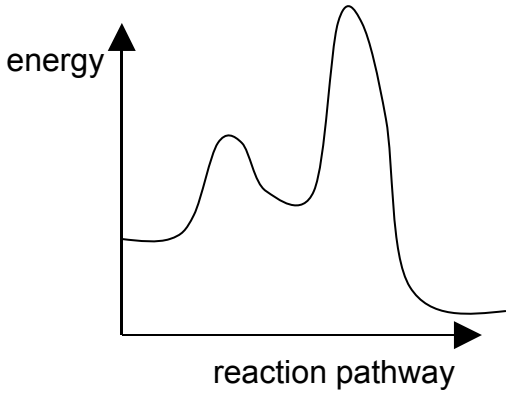
B



C



D



6 For which equilibrium does K_c has **no** units?

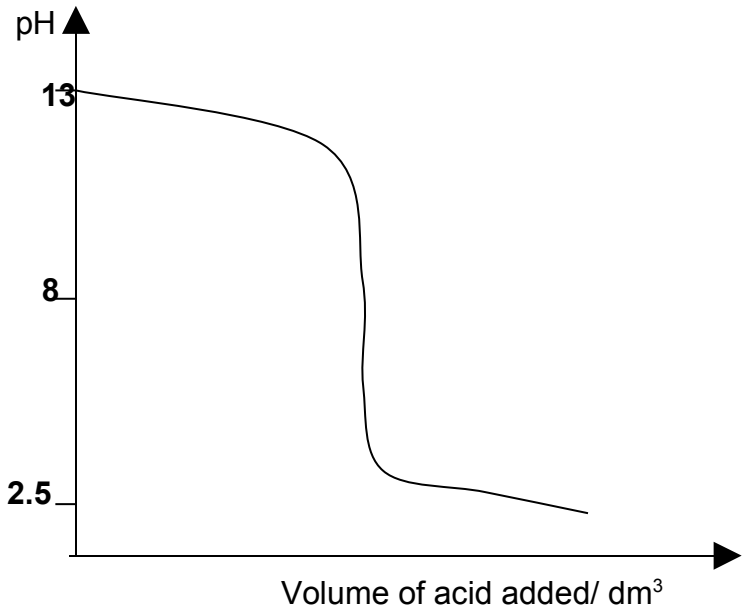
A $C(s) + H_2O(l) \rightleftharpoons CO(g) + H_2(g)$

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

C $Cu^{2+}(aq) + 4NH_3(aq) \rightleftharpoons Cu(NH_3)_4^{2+}(aq)$

D $2NO_2(g) \rightleftharpoons N_2O_4(g)$

7 A titration curve is shown below:



To which pair of substances could this curve apply?

A NaOH titrated with HC*l*

B KOH titrated with CH_3COOH

C NH_3 titrated with HC*l*

D NH_3 titrated with CH_3COOH

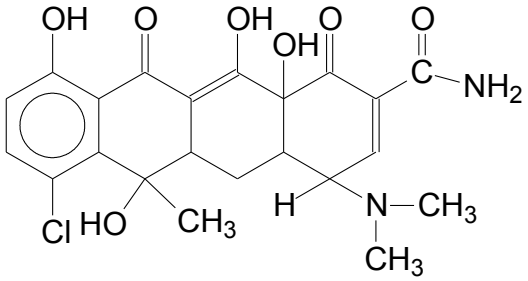
8 A sparingly soluble barium salt dissociates in solution according to the equation:

$$Ba\mathbf{L}_2(s) \rightleftharpoons Ba^{2+}(aq) + 2\mathbf{L}^-(aq)$$

If the solubility product of $Ba\mathbf{L}_2$ is q mol^3 dm^{-9}, what is the concentration of $\mathbf{L}^-$ at equilibrium in a saturated solution of $Ba\mathbf{L}_2(aq)$?

A $\frac{q}{3}$ **B** $2\left(\frac{q}{4}\right)^{\frac{1}{3}}$ **C** $q^{\frac{1}{3}}$ **D** $\left(\frac{q}{4}\right)^{\frac{1}{3}}$

9 *Aureomycin* is a powerful antibiotic. *Aureomycin* has the structure shown below:



How many optical isomers does *Aureomycin* have?

A 5

B 10

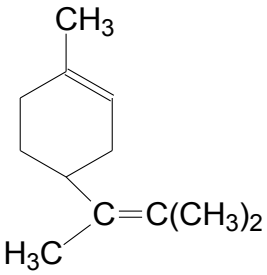
C 16

D 32

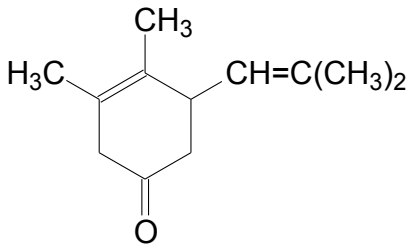
10 An organic compound, on heating with an excess of hot concentrated acidic $KMnO_4(aq)$, produces $CH_3COCH_2COCH_2CH_2COCH_2COOH$ and CH_3COCH_3.

What could the organic compound be?

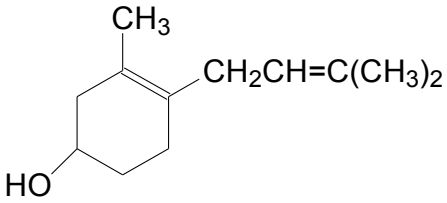
A



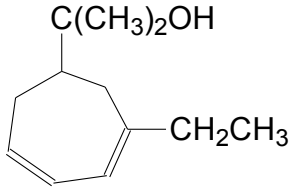
B



C

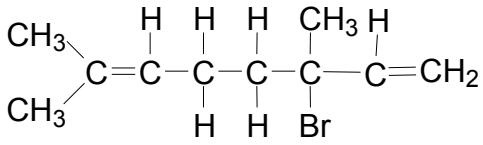


D



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

How many deuterium atom(s) is/are incorporated into a molecule of *Linalo-ol* when it is reacted with bromine in heavy water, D_2O?



Linalo-ol

A 0

B 1

C 2

D 3

12 A halogenoalkane, **M**, can give a primary amine by heating it in a sealed tube with ammonia.

A nitrile, **N**, can give a primary amine by reduction.

Which of the following pairs of **M** and **N** give the same amine?

	M	**N**
	$CH_3OCH_2CH_2Br$	CH_3OCH_2CN
	$ClCH_2CO_2H$	HO_2CCH_2CN
	$C_6H_5CHICH_2CH_3$	$C_6H_5CH(CN)CH_2CH_3$
	$(CH_3)_2CHCl$	$(CH_3)_2CHCN$

13 Which inorganic reagent may be used to distinguish between phenol and ethanol?

A aqueous Na_2CO_3

B aqueous NaOH

C Na metal

D alkaline aqueous I_2

14 An organic compound has the following properties:

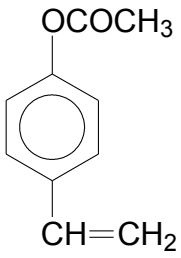
(i) It has isomers which have identical physical properties except in the direction in which they rotate plane-polarised light.

(ii) It does not give a silver mirror with Tollen's reagent

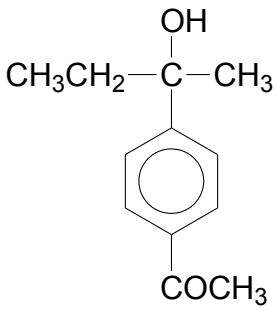
(iii) It can be oxidised by acidified potassium manganate (VII)

What is this organic compound?

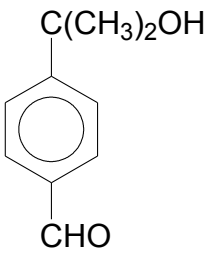
A



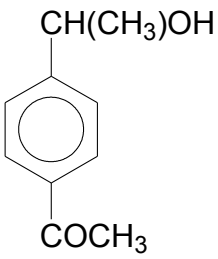
B



C



D



15 The same carboxylic acid can be obtained by the hydrolysis of a nitrile **P** or by oxidation of an alcohol **Q**.

Which of the following pairs could be **P** and **Q**?

	P	**Q**
A	CH_3CH_2CN	CH_3CH_2OH
B	$(CH_3)_2CHCN$	$(CH_3)_3COH$
C	$C_6H_5CH_2CN$	$C_6H_5CH_2CH_2OH$
D	C_6H_5CN	C_6H_5OH

16 A food chemist wants to create the odour of pineapples for a product. An ester with this odour has the formula $C_3H_7CO_2C_2H_5$. Which of the following can be reacted to obtain the specified ester?

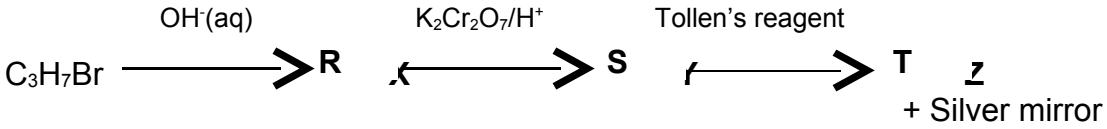
A C_2H_5Cl and $C_3H_7CO_2H$

B C_2H_5OH and $C_3H_7CO_2H$

C C_3H_7OH and $C_2H_5CO_2H$

D C_3H_7OH and C_2H_5COCl

17 The compound C_3H_7Br undergoes a sequence of reactions as follows:



What could be the formulae for **R**, **S** and **T** respectively?

A	$CH_3CH_2CH_2OH$	CH_3CH_2COOH	CH_3CH_2CHO
B	$CH_3CH_2CH_2OH$	$CH_3CH(OH)CH_2OH$	CH_3COOH
C	$CH_3CH_2CH_2OH$	CH_3CH_2CHO	CH_3CH_2COOH
D	$CH_3CH(OH)CH_3$	CH_3COCH_3	CH_3COOH

18 One of the earliest biotechnological processes, developed by Weizmann in 1911, was the conversion of starch into propanone and butan-1-ol.

Which reagent could be used to confirm the presence of propanone in a propanone/butan-1-ol mixture?

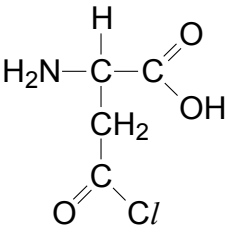
A $AgNO_3$ (aq) with an excess of NH_3 (aq)

B I_2 in NaOH(aq)

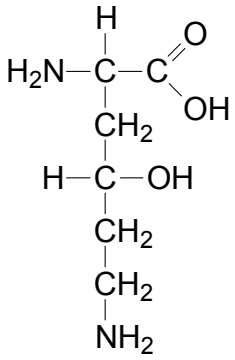
C acidified $K_2Cr_2O_7$(aq)

D Na metal

19 2-amino-4-chloro-4-oxobutanoic acid, which is an acid derivative of the amino acids aspartic acid, and 4-hydroxylysine can be reacted with each other to form amide linkages.



2-amino-4-chloro-4-oxobutanoic acid



4-hydroxylysine

Determine the maximum number of different compounds, each containing one amide linkage, that can be formed from one molecule of 2-amino-4-chloro-4-oxobutanoic acid and one molecule of 4-hydroxylysine?

A 1

B 2

C 3

D 4

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

Aluminium oxide is a stable ionic compound.

$Al\ (s) \rightarrow Al^{3+}\ (g) + 3e$ $\quad \Delta H = +5467\ kJ\ mol^{-1}$

$\frac{1}{2}\ O_2\ (g) + 2e \rightarrow O^{2-}\ (g)$ $\quad \Delta H = +897\ kJ\ mol^{-1}$

Which of the following statements is **<u>false</u>**?

A The enthalpy change of atomisation of aluminium is +330 kJ mol^{-1}.

B The enthalpy change of formation of aluminium oxide is –13625 kJ mol^{-1}.

C The lattice energy of aluminium oxide is more exothermic than the enthalpy change of formation of aluminium oxide.

D The sum of the first and second electron affinities of oxygen is +649 kJ mol^{-1}.

21 Ozone in the upper atmosphere filters damaging ultraviolet light from reaching the Earth's surface. The following is the chemical reaction of the formation of ozone:

$$\frac{3}{2}O_2\,(g) \rightarrow O_3\,(g)$$

Given that the $\Delta H^{\ominus}_f\,(O_3)$ = +142.67 kJ mol^{-1} and $\Delta S^{\ominus}\,(O_3)$ = –68.7 J K^{-1} mol^{-1}, calculate $\Delta G^{\ominus}_f\,(O_3)$ at 298 K and 1.01 x 10^5 Pa.

A + 122 kJ mol^{-1}

B + 163 kJ mol^{-1}

C – 20330 kJ mol^{-1}

D + 20615 kJ mol^{-1}

22 The mass of lead deposited at the cathode by a current of 0.15 A flowing for three hours through a solution of lead (II) nitrate is given by one of the following expressions. Which is correct?

A $\dfrac{207 \times 0.15 \times 3 \times 60 \times 60}{96500}$

B $\dfrac{96500 \times 207 \times 2}{0.15 \times 3 \times 60 \times 60}$

C $\dfrac{207 \times 0.15 \times 3 \times 60 \times 60}{96500 \times 2}$

D $\dfrac{96500 \times 207}{0.15 \times 3 \times 60 \times 60}$

23 Which one of the following groups contains a basic, an acidic and an amphoteric oxide?

A	Na_2O	MgO	Al_2O_3
B	SiO_2	P_4O_{10}	SO_3
C	Al_2O_3	SiO_2	P_4O_{10}
D	MgO	Al_2O_3	SiO_2

24 Figure 1 shows the logarithm of the ten ionisation energies of an element **U** while Figure 2 shows the boiling points of eight consecutive elements (including **U**).

Figure 1

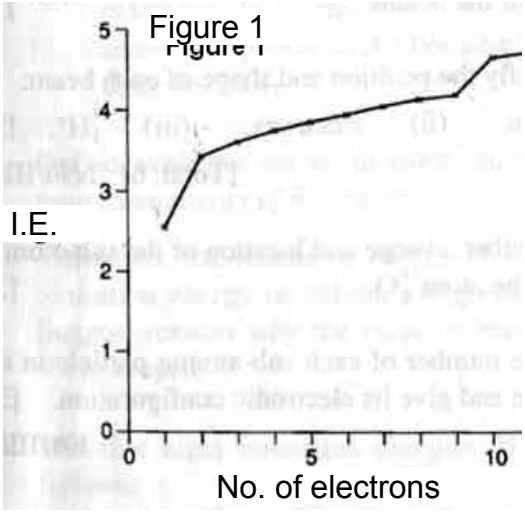
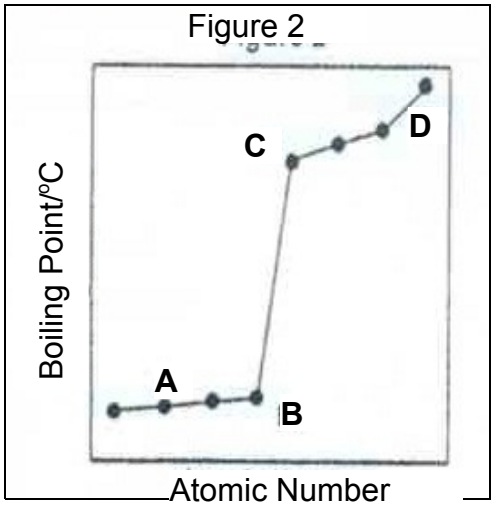


Figure 2



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

25 Which of the following statements regarding Group II elements or their compounds is correct?

A Beryllium chloride has a higher melting point than magnesium chloride.

B Magnesium is a stronger reducing agent than strontium.

C Calcium hydroxide is less soluble in water than barium hydroxide.

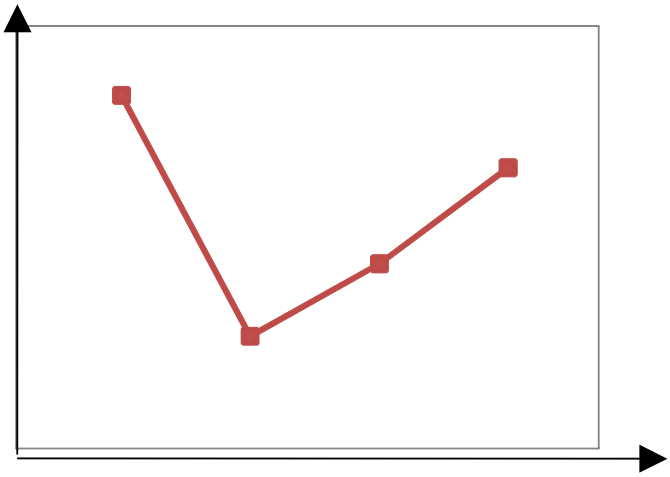
D Strontium reacts more readily with oxygen that radium.

26 What are the trends of the following properties going down Group II of the Periodic Table?

- Second ionisation energy
- Solubility of sulphates
- pH of the solutions when 1 mol of oxides are dissolved in 1 dm^3 of water

	Second ionisation energy	**Solubility of sulphates**	**pH of oxides solutions**
A	decreases	increases	decreases
B	increases	increases	increases
C	increases	decreases	decreases
D	decreases	decreases	increases

27 The following graph describes the trend of a certain property of Group VII elements (fluorine to iodine) or their compounds (fluoride to iodide) down the group.



Which of the following description best match the graph?

A Boiling point of the halogens.

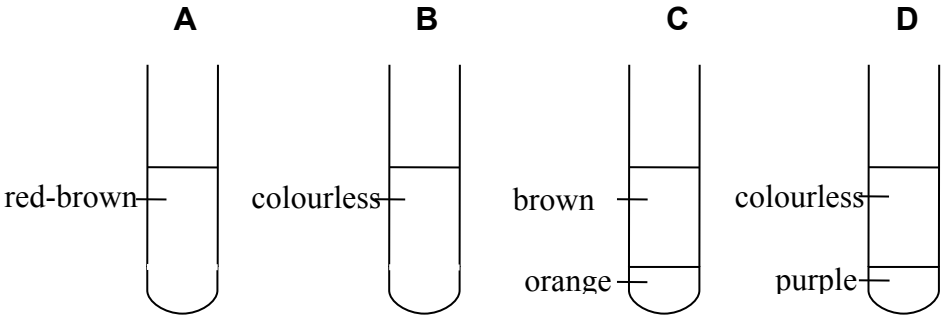
B Boiling point of the hydrogen halides.

C Bond dissociation energy of the X-X bond.

D Bond dissociation energy of the H-X bond.

28 Aqueous chlorine is added to aqueous sodium iodide in a test-tube. Thereafter, some trichloromethane is added to the mixture and the test tube is shaken.

Which one of the following observations would be seen?



29 Which one of the following does **not** form six coordinate complexes?

A Beryllium (II)

B Cobalt (II)

C Copper (II)

D Iron (II)

30 The following data refer to copper as a typical transition element and to calcium as an s block element.

For which property are the data under the correct element?

	Property	*copper*	*calcium*
A	Density (g cm^{-3})	8.92	1.54
B	Electrical conductivity(MS m^{-1})	50	80
C	Melting point (^oC)	810	1083
D	Metallic radius (nm)	0.197	0.117

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 correct response.

31 The first six ionisation energies of an element, **W**, are as follows:

786, 1580, 3230, 4360, 16000, 20000 kJ mol^{-1}

Which of the following statement(s) is/are consistent with these data?

1 The outer electronic configuration of an atom of **W** is ns^2np^2.

2 The chemistry of **W** and its compounds is similar to that of aluminium and its compound.

3 **W** is in group VI of the periodic table and forms an oxide with the molecular formula **W**O_3.

32 In 1886, Henri Moissan succeeded in obtaining fluorine by the electrolysis of molten potassium hydrogendifluoride, KHF_2.

What type(s) of bonding occur(s) within its anion, HF_2^-?

1 Covalent bonding

2 Hydrogen bonding

3 Coordinate bonding

33 The gallium hydrate hydrolyses as shown below.

$[Ga(H_2O)_6]^{3+}$ (aq) $\rightleftharpoons$ $[Ga(H_2O)_5OH]^{2+}$ (aq) + H_3O^+ (aq) $\triangle H$ = positive

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

1 $[Ga(H_2O)_6]^{3+}$ is more stable at low pH values.

2 Increasing the temperature will favour the formation of $[Ga(H_2O)_5OH]^{2+}$

3 Increasing the concentration of $[Ga(H_2O)_6]^{3+}$ will increase K_c as the forward reaction is being favoured.

34 For the reaction **X** (aq) + **2Y** (aq) → **Z** (aq), the rate equation is

Rate = k $[H^+][\mathbf{Y}]^2$

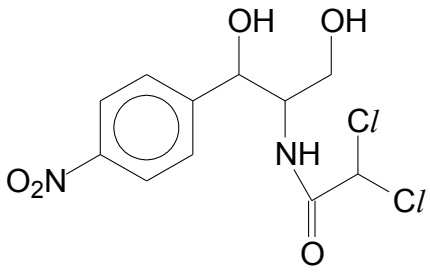
Which of the following is **true**?

1 H^+ is a catalyst in the reaction.

2 The units for the rate constant is mol^{-2} dm^6 s^{-1}

3 When [**Y**] is doubled and the $[H^+]$ is doubled, the rate of the experiment increases by 6 times.

35 Chloramphenicol is an antibiotic secreted by certain bacteria; it has a large number of functional groups.



Which of the following deductions about the reaction of chloramphenicol can be made from this structure?

1 It gives a yellow precipitate with alkaline aqueous iodine.

2 It undergoes alkaline hydrolysis, one product of which contains an amino group and the other a carboxylate ion.

3 It decolourises acidified potassium manganate (VII) on warming.

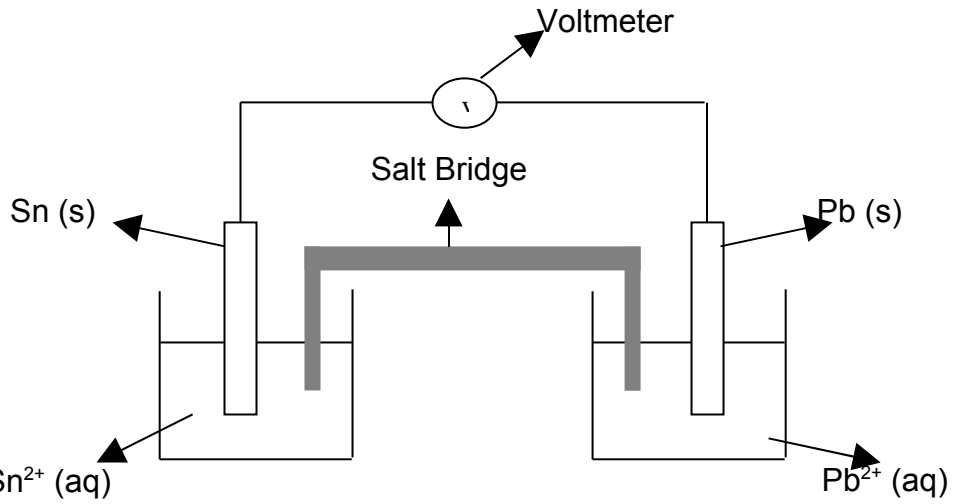
36 Which compound(s) liberate ammonia when boiled with aqueous sodium hydroxide?

1 hexane-1,6-diamine
2 ammonium propanoate
3 ethanamide

37 Which of the following process(es) is/are more exothermic for gaseous magnesium ions than that of gaseous calcium ions?

1 conversion of gaseous ions into gaseous atoms
2 formation of an ionic oxide lattice
3 hydration of gaseous ions

38



A student set up an electrochemical cell as above and made the conclusion listed below. Which of the conclusion is/are correct?

1 The reaction is feasible and reversible.
2 Electrons flow from the Sn electrode to the Pb electrode.
3 Sn is the positive electrode while Pb is the negative electrode

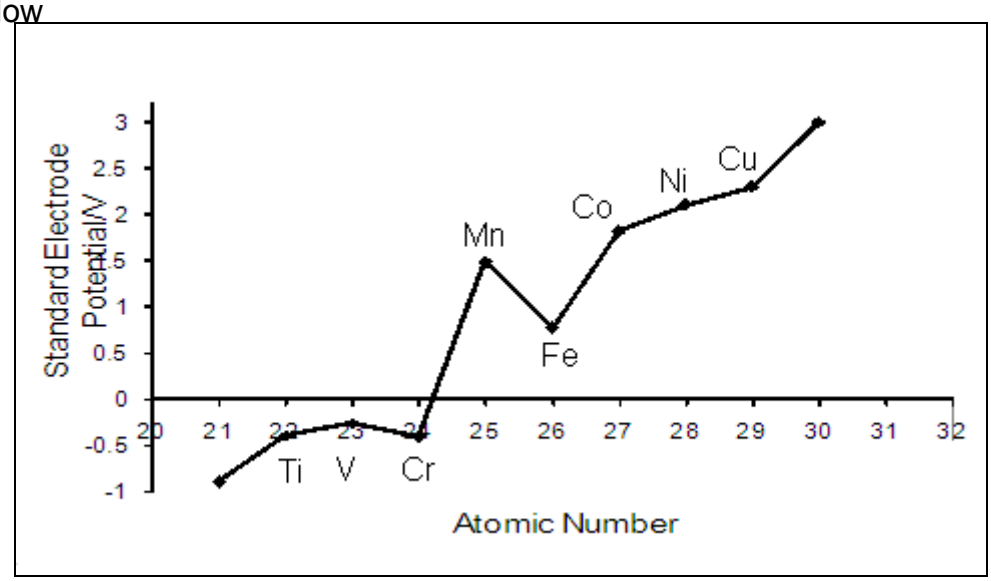
39 In an experiment, **r** mol of chlorine gas was bubbled into excess hot aqueous potassium hydroxide. Which of the following statement(s) is/are **incorrect** regarding the above reaction?

1 Oxidation number of chlorine changes from 0 to -1 and 0 to +5

2 A disproportionation reaction occurred and the final products obtained included potassium chlorate (I) and potassium chlorate (V).

3 3**r** mol of potassium hydroxide was required and $\frac{5}{3}$**r** mol of potassium chloride was produced.

40 The E^{θ} value for the M^{3+} (aq) / M^{2+} (aq) systems for some transition element is shown below



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

1 The relative stabilities of the +2 with respect to +3 state increases from left to right.

2 Effective nuclear charge increases from left to right.

3 Reduction is favoured for Mn^{3+} to Mn^{2+} as compared to that of Fe^{3+} to Fe^{2+}.

-END OF PAPER-

Answer Key:

1	B		16	B	31	D
2	C		17	C	32	B
3	A		18	B	33	B
4	B		19	B	34	B
5	C		20	B	35	C
6	B		21	B	36	C
7	B		22	C	37	A
8	B		23	D	38	B
9	D		24	C	39	C
10	C		25	C	40	A
11	C		26	D		
12	A		27	B		
13	B		28	D		
14	D		29	A		
15	C		30	A		