Unit 5

(8) 2009 A/L

b) i) What is meant by the standard enthalpy of formation of $CO_2(g)$.

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ii) When a sample of 72.0 g graphite is burnt in oxygen under standard conditions, the product mixture is found to contain by mass 28% CO(g), 66% $CO_2(g)$ and unburnt C (s).

Standard enthalpy of formation of CO (g) = – 111 kJ mol^{-1}

Standard enthalpy of formation of CO_2 (g) = – 394 kJ mol^{-1}

(C = 12.0, O = 16.0)

I. Calculate the following.

A. The mole ratio of C(s), CO(g) and $CO_2(g)$ in the product mixture.

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B. The number of moles of CO(g) released.

.....

C. The number of moles of CO_2 (g) released.

.....

D. The heat released on burning 1.0 mol of graphite under standard conditions.

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II Using the above thermo chemical data, deduce whether the conversion of CO(g), $CO_2(g)$, under standard conditions, is endothermic or exothermic.

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Unit 6

(1) **1981 AL**

c) If you are provided with a solution of $CuBr_2$, what are the chemical tests that can be done to prove the existence of Cu^{2+} and Br^- in the solution?
(N.B. Flame test for copper is not acceptable)

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(2) **1983 AL**

c) You are provided with an aqueous solution of $Pb(NO_3)_2$. What are the chemical tests that you would follow to prove the existence of Pb^{2+} and NO_3^- ions in the solution?

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d) Different oxidation states of Nitrogen is given in the following diagram. State examples for each of the oxidation states in the given space.

Oxidation number	5+	4+	3+	2+	1+	0	−1	−2	−3
Example									

(3) **1984 AL**

c) Write down the balanced chemical equations for the reactions taken place when ammonia gas is sent through the followings.

i) Heated CuO .....

ii) Aqueous $CuSO_4$ solution

.....

iii) Chiorine water .....

iv) Aqueous silver nitrate solution .....

(4) **1984 AL**

b) i) The hydride of the element X which has the atomic number less than 30 is a gas at room temperature. Identify X.

.....

ii) Name the allotropes of X if present.

.....

c) i) State the oxidation states X can have and give examples for each oxidation states.

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ii) Write the balanced chemical equation for the reaction between the hydride of X and gaseous sulphur dioxide.

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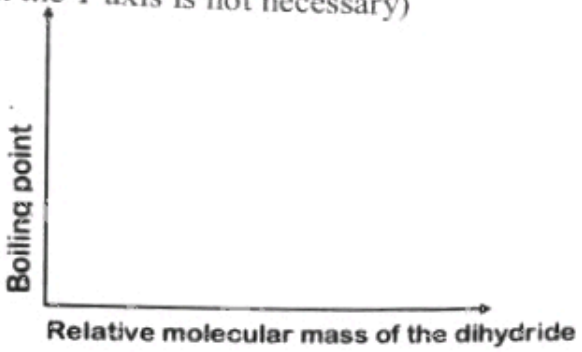
d) State the trend of boiling points of the dihydrides of the elements in the group which X is found in the following diagram. (Showing the accurate values of the boiling points in the Y axis is not necessary)



(5) **1985 AL**

b) Write down balanced chemical equations for the reactions taking place when the following compounds react with H_2S.

i) conc. HNO_3 .....

ii) conc. H_2SO_4 .....

iii) Cl_2 water .....

(6) **1986 AL**

a) The element X makes a chloride with an empirical formula XCl_4 and two oxides of XO and XO_2.

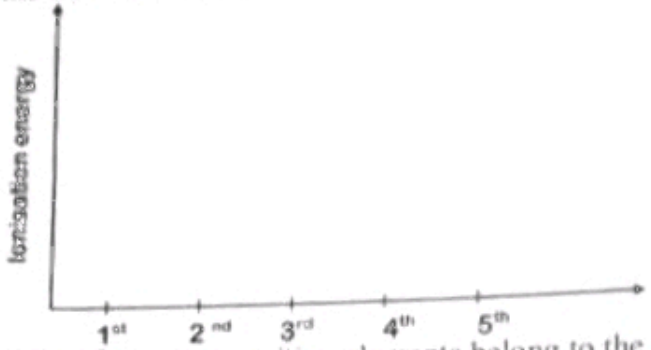
i) Deduce which group of the periodic table X would belong.

.....

.....

ii) Give the formula of the compound formed in between Al and X .....

iii) Show the trend of the first five successive ionisation energies of X.



iv) State the first four non transition elements belong to the same group.

.....

v) Write the trend of the boiling points of the chlorides made by the highest oxidation states of the above four elements.

.....

b) i) Write the electronic configuration of the element M with the atomic number 27 according to $1s^2\ 2s^2$..... method.

.....

ii) Deduce the most possible oxidation states that could preseut with M considering the electronic configuration.

.....

iii) How does an aqueous cationic solution of stable lowest oxidation states of M would react with an aqueous solution of NaOH?

.....

.....

iv) Write a balaced chemical equation for the above reaction.

.....

v) Under some conditions aqueous NH_3 solution and cationic solutions formed by the lowest oxidation state of M can be reacted and it is different from the reaction given in the iii) above. Explain.

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(7) 1986 AL

c) i) Give balanced chemical equations for each of the states where SO_2 reacts as an oxidant, reluctant and an acid in an aqueous solution.

.....

.....

.....

(8) **1987 AL**

b) i) Write the electronic configuration of the element X with the atomic number is 42 according to $1s^2\ 2s^2$ ..... method.

.....

ii) The oxoanion with the formula XO_n^m forms by the highest valency of X. State the expected figures for m and n.

m = ... n = ...

c) Give two observations which confirm that electrons contribute in making chemical bonds.

.....

.....

(9) **1987 AL**

b) Give one example each to denote the following instances.

i) NH_3 acts as an acid.

.....

ii) HI acts as an oxidant.

N.B. Balanced chemical equations should be provided for the examples.

.....

(10) **1988 AL**

a) Write down the electronic configuration of the element of atomic number 40 in the usual from $1s^2\ 2s^2$ ...

.....

b) The electronic configuration of the element M belongs to the $(n-2)s^2\ (n-1)p^6\ (n-1)d^{10}\ ns^2\ np^2$ type and $n > 3$

i) Write down the main two valences expected by M. .....

ii) Is M a transition element? Write your answer as "yes" or "No" and give reasons for your answer.

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(11) **1990 AL**

c) Give reactions to denote the following instances.

i) Reaction of silver metal as a reductant.

.....

ii) Reaction of nitrogen gas as an oxidant.

N. B. Balanced chemical equations should be provided.

.....

d) You are provided with an aqueous solution of K_2CO_3 and $KHCO_3$. You are not allowed to use any acid – base indicators. Suggest a qualitative method to show, that the solution contains HCO_3^- ions

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(12) **1992 AL**

c) You are provided with an aqueous solution of Ferric ions and permanganate ions. Briefly explain how you would try to determine the concentrations of Ferric ions and permanganate ions in this solution.

N. B. Experimental data are not required.

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(13) **1993 AL**

d) i) Few drops of KCNS solution was added to a solution of $FeCl_3$ solution. State the expected colour change.

.....

ii) To the solution given in i), iron powder was added and was shaken well. If you expect a colour change here, state the colour change clearly. If you do not expect a colour change, state that clearly.

.....

(14) **1993 AL**

c) Write down examples for each of the following instances.

i) Reaction of H_2S as an oxidant.

.....

ii) Reaction of NH_3 as an acid.

(N.B. Balanced chemecal equations should be written)

.....

(15) **1994 AL**

b) The element X forms the oxides X_2O_3 and XO_3. The oxide XO_3 dissolved in aqueous NaOH to produce a yellow colour solution. If the Relative Atomic Mass of X is between 40 and 60. Write the electronic configuration of X in the usual form $1s^2\ 2s^2$....

.....

c) What is the shape of the cationic species BF_2^+ ? .....

d) If the following compounds exist, write down the name. If does not exist, state it clearly in words.

i) $COCO_3$ .....

ii) Cs_2AsO_4 .....

iii) SnS_2 .....

(16) **1994 AL**

c) You are provided with an aqueous solution of Strontium nitrate and Magnesium nitrate. Briefly explain how you would quantitatively determine the concentrations of strontium and magnesium in the above solution.

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(17) **1995 AL**

a) Write the chemical formula of the following compounds in the appropriate spaces given in the table.

Compound	Chemical formulae
Ammonium chromate	
Aluminium carbonate	
Stanic phosphate	

c) You are provided with a pure NH_3 sample and a pure ND_3 sample. (D = Deuterium). Explain briefly how you would separate these two samples quantitatively.

N.B Usual laboratory facilities are provided.

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(18) **1995 AL**

c) You are provided with separate aqueous solutions of $MgBr_2$, $Sr(OH)_2$ and BaI_2 which are unlabelled. You are provided with test tubes and an aqueous solution of $(NH_4)_2CO_3$. Explain how would you distinguish the above 03 solutions, using only the above four chemical materials.
(N.B. You are not allowed to do flame test or to touch the solutions with the fingers.)

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(19) **1996 AL**

a) The element *X* forms compounds of chemical XH_2 and XS. XH_2 reacts with water. XS dissolves in water. This solution imparts a colour to the bunsen flame.

i) Indicate in the cage below, which one of the following could be *X*.
Na, Mg, Al, K, Ca, Fe, Co, Ni, Cu, Zn

X =

ii) Write the electron configuration of *X* in usual manner as $1s^2\ 2s^2$ ...

.....

b) The compound of molecular formula $H_2S_2O_7$, gives a white precipitate with aqueous $BaCl_2$. In this reaction, a considerable amount of heat is also liberated. The two sulphur atoms of $H_2S_2O_7$ are identical, while four of the oxygen atoms are also identical. Suggest a structural formula for $H_2S_2O_7$.

c) Write chemical formula of the following compounds in the appropriate cages.

compound	chemical formula
i) Beryllium dichromate	
ii) Chromic oxalate	

(20) **1996 AL.**

c) You are provided with aqueous potassium chloride solution as the only initial chemical compound. You are provided with the usual facilities in the laboratory. State how would you distinguish aqueous solutions of Magnesium sulphate and zinc sulphate chemically under these conditions.

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.....

(21) **1997 AL.**

b) Name the chemical compounds shown below, appropriately.

chemical compound	name
Cu_3N	
Li_2O_2	

c) i) The relative atomic mass of the element X is between 50 and 70. The hydrated crystals of XSO_4 are colourless, while XS is a white precipitate. A dioxide of X does not exit. Identify *X*.

.....

ii) Write the electronic configuration of the element of atomic number 28 in the usual form $1s^2\ 2s^2$ .... etc.

.....

iii) Apart from the temperature changes that occur, predict three important changes that could occur when an excess of dilute $FeSO_4$ is gradually added to an aqueous solution of Br_2/KBr.

.....

.....

.....

iv) Apart from the temperature changes that occur, predict three important changes that could occur when a small amount of $Fe(OH)_3$ is added to an aqueous solution of hydrochloric acid.

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(22) **1997 AL**

d) Indicate how you would show that the equilibrium reaction pertaining to the $Cr_2O_7^{2-} / CrO_4^{2-}$ system in aqueous solution is reversible

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(23) **1998 AL**

b) Name the following compounds appropriately.

compound	Name
FeS_2O_3	
$Cr_2(MnO_4)_3$	

(24) **1998 AL**

b) Indicate briefly how you would use an acidified solution of $K_2Cr_2O_7$ for the purpose of distinguishing between a dilute aqueous solution of HBr and a dilute aqueous solution of HI.

N.B. You are not supplied with organic solvents or other reagents. However, you are provided with the normal facilities available in the laboratory.

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(25) **1998 AL**

d) Assume that you are supplied with only H_2S gas and chlorine water as reagents. Propose a suitable method to distinguish between an ammonical solution of $CuSO_4$ and an ammonical solutoin of $NiSO_4$ using the above two substances.

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(26) **1999 AL**

b) i) The element, X belongs to the 4th period of the periodic table. An atom of X forms an anion. The highest valency – state oxide, formed by X is XO_3. Identify X.

.....

ii) The compound, XCl_4 formed by the above element X is reduced with $LiAlH_4$. Write the molecular formula of the hydride of X that is most likely to be formed in this reaction.

.....

iii) Can the hydride reffered to in b) ii) above, act as an oxidizing agent? If so, give an example for that. If not, give reasons for that.

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.....

(27) **2000 AL**

b) i) L and M are two p – block elements belonging to successive periods in the same group of the Periodic Table.
The highest chloride formed by L is LCl_3.
M forms MCl_3 and another chloride in a higher oxidation state.
Identify L and M below.

L is ..... M is .....

ii) LCl_3 and MCl_3 are hydrolysed easily. On hydrolysis, LCl_3 gives a base and an acid while MCl_3 gives two acids.
Identify below the products of the hydrolysis by name:

From LCl_3 hydrolysis ..... and .....

From MCl_3 hydrolysis ..... and .....

Using chemical symbols, write below separate balanced chemical equations for the hydrolysis of these two chlorides.

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(28) **2001 AL**

a) Q and R are two non – transition elements in the same group belonging to two consecutive periods of the periodic table. They form the compounds RQ_2 and RQ_3.

i) Identify Q and R below.

Q : ..... R : .....

ii) Indicate below all the stable oxidation states shown by Q and R.
Indicate also the chemical formula of an illustrative compound for each such stable oxidation state of each element.
(N.B. Against each such chemical formula, the oxidation state of the relevant element must also be correctly given)

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(29) **2002 A1.**

a) Identify the elements described in (i) – (iv) below and write down their chemical symbols in the appropriate cages in the skeletal periodic table given in page 3

i) The element which is a liquid at room temperature and shows the maximum oxidation state of +7. .....

ii) The element which forms a stable dichloride without completing the electron octet is, ...

iii) The non – metallic element of which an allotropic forms is a good conductor of electricity is, ...

iv) The first row (3d) transition element forming a highly stable white coloured dioxide is, ...

b) A is non – transition element. It forms an oxide with molecular formula A_2O_3. The highest chloride formed by *A* is ACl_3 identify *A*.

.....

Write down the chemical symbol of A in the appropriate cage of the skeletal periodic table given in page 3.

Write down the balanced chemical equations for reactions between water and i) A_2O_3 ii) ACl_3 (Use only chemical symbols)

.....

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(30) **2003 A1.**

a) Consider the following elements of the periodic table and answer the questions given below.

I	II	III	IV	V	VI	VII	VIII
Li	Be	B	C	N	O	F	Ne

i) Which element has the largest atomic radius? .....

ii) Which element has the highest melting point? .....

iii) Which element has the highest second ionization enthalpy .....

iv) Which element are capable of forming a triple bond between its atoms?

.....

v) Which elements do not show any positive oxidation states? .....

vi) Which elements form compounds those act as Lewis acids? .....

c) A, D and E are three consecutive non – transition elements of the periodic table. The oxide of A dissolves in aqueous NaOH solution. E forms a chloride which is a liquid at room temperature. The chloride is hydrolysed in water forming two acids.

Identify A, D and E by writing their chemical symbos in the space below.

A : ..... D : ..... E : .....

(31) **2004 AL**

a) Complete the following statements by filling the blanks with an element / elements from the list H, Cl, N, S, O, Cr, Zn and P.

i) The element(s) showing both the + 5 and –3 oxidation states is/are .....

ii) The element with the lowest boiling point is .....

iii) The element(s) forming oxides which are coloured at room temperature is / are .....

iv) The strongest reducing agent in the elemental form is .....

v) The strongest oxidising agent in the elemental form is .....

vi) The element(s) showing allotropy is/are .....

vii) The element(s) giving both an acidic oxide and an acidic hydride is/are .....

b) *X* and *Y* are two elements with atomic number less than 18. *X* reacts with water at room temperature liberating a gas *Z* and forming solution *A*. *Y* does not react with water but reacts with solution *A*, liberating the same gas *Z* and forming a solution *B*.

i) Using chemical symbols only, write all the possibilities for *X*, *Y* and *Z*.

X : ..... Y : ..... Z : .....

ii) What observations can be made when excess dilute HCl is added dropwise to solution *B*?

Initially a white precipitate forms and later with the addition of dil. HCl it dissolves to give a colourless solution.

iii) Using chemical symbols only write the balanced chemical equation for the reaction between A and Y.

.....

(32) **2005 AL**

a) Complete each of the statements given below by filling the blanks with a compound from the following list.

BCl_3, PCl_5, Cl_2O_7, N_2O_5, SiO_2, HF, HI, HCl, H_2S, H_2O

i) The most acidic oxide is .....

ii) The hydrogen halide showing the highest acidity in aqueous solution is .....

iii) The compound with the highest melting point is .....

iv) The compound forming the strongest hydrogen bonds is .....

v) The compound most likely to act as a Lewis acid is .....

vi) The element with the numerically highest oxidation number is found in the compound .....

b) *X* is a non – transition element which does not react with deuterium oxide (D_2O) at room temperature. The hydroxide of *X* is not amphoteric but shows basic properties. The sulphate of *X* is very soluble in water.

i) Identify *X* .....

ii) Give balanced chemical equations for the reactions that occur when *X* is burnt in air.

.....

.....

(33) **2006 AL**

a) Complete the following statements.

i) The element with the highest melting point among Li, Na and Mg is .....

ii) The element that reacts most vigorously with water among Li, Na and K is .....

iii) The most thermally stable carbonate among Na_2CO_3, $CaCO_3$ and $MgCO_3$ is .....

iv) The most water soluble hydroxide among $Mg(OH)_2$, $Ca(OH)_2$ and $Ba(OH)_2$ is .....

v) The two elements that show the same highest oxidation state among Cl, Mn, P and Cr are ..... and .....

b) The element *M* reacts easily with dilute H_2SO_4 as well as with dilute aqueous NaOH solution at room temperature liberating the same gas. The salts of *M* are not electron deficient compounds.

Identify *M* .....

i) Write balanced chemical equations for the reactions of *M* with i) dil. H_2SO_4 ii) aqueous NaOH.

.....

.....

ii) Give one industrial application of *M*.

.....

.....

(34) **2008 AL**

a) The 3d transition element M shows the highest oxidation state of +7.

i) Identify *M* .....

ii) Write the complete electronic configuration of *M* .....

iii) Give the chemical formula and the colour of the most stable oxide of *M*

.....

(35) **2010 AL**

a) The following questions are based on the first 18 elements in the periodic table.

i) Identify the two elements that form the bond with the highest ionic character

..... and .....

ii) Identify the element that forms the most stable diatomic molecule .....

iii) Identify the element that has the highest first ionization energy. .....

iv) Identify the two elements that form electron-deficient compounds .....

and .....

v) Identify the element that has the highest melting point. .....

vi) Identify the gaseous element that can be used as a fuel. .....

vii) There are seven consecutive elements where the maximum oxidation number of each element increases by one, when moving sequentially from the first to the seventh elements. Identify the first and the seventh elements in this sequence of elements.

first ..... seventh .....

viii) Identify one metallic element that is responsible for hardness in water.

.....

(36) **2012 AL**

a) Answer the questions given below in the space provided.

i) Of the three isolated ions Fe^{3+}, Cr^{3+} and Co^{2+}, which one has three unpaired electrons? .....

ii) Of the three 3 d block elements Ti ,V and Cr, which one has a maximum of five electrons that can participate in bonding? .....

iii) Of the three elements C, N and Si, which one has the lowest electro negativity? .....

iv) Of the three elements Na, Mg and Al, which one has the highest first ionization energy? .....

v) Of the three iso electronic anions N^{3-}, O^{2-} and F^- which one has the largest ionic radius? .....

vi) Of the three cations Na^+, Ca^{2+} and Al^{3+} which one has the smallest ionic radius? .....

(37) **2012 AL**

a) i) Give the formulae of the oxides with the highest oxidation state formed by the elements in the third period.
Comment on their acidic / amphoteric / basic nature using the following list.
Very strongly acidic, strongly acidic, weakly acidic, very weakly acidic, weakly basic, basic, strongly basic, amphoteric, neutral

.....

.....

.....

.....

ii) State **how the electronegativity, atomic radius and first ionization energy vary from left to right across the third period.**

1. **Electro negativity**

.....

2. **Atomic radius**

.....

3. **First ionization energy**

.....

Give the general reaction to show the thermal decomposition of Group II nitrates using M as the metal.

.....

iii) Arrange the group II nitrates in the order of increasing thermal stability (use the notation <). Explain your answer based on polarization of ions.

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b) The following questions are based on the transition metal, Mn and its compounds.

i) Give the electronic configuration of Mn.

.....

ii) State the common oxidation states of Mn.

.....

iii) Give the chemical formulae of the oxides formed by Mn in these common oxidation states. Indicate whether each of these oxides are acidic, amphoteric or basic.

.....

.....

iv) Give the IUPAC name of $KMnO_4$

.....

v) Mn has the lowest melting point and lowest boiling point among the 3d transition elements. Explain why this is so.

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vi) What would you expect to observe when a dilute ammonia solution is added to an aqueous solution of Mn^{2+} and then left exposed to the air?

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vii) When conc. KOH was added to an aqueous $KMnO_4$, the solution turned green. When this green solution was diluted using water or acid, a purple solution and a blackish brown precipitate are obtained. Write balanced chemical equations to explain these observations.

.....

.....

.....

viii) Give one important use of each of the following.

I. $KMnO_4$ (other than as an oxidizing agent)

.....

II. Mn metal.

.....

ix) Give half reactions to show how $KMnO_4$ behaves as an oxidizing agent in acidic and basic media.

Acidic medium

.....

Basic medium

.....

x) Indicate two problems you may expect when using $KMnO_4$ as an oxidizing agent.

.....

.....

.....

(38) **2013 AL**

a) Element A belongs to the s – block. Its first ionization energy is the highest in the group. A reacts with water liberating a gas *B*. The resulting solution from this reaction gives a red colouration to a Bunsen burner flame and the metal oxide on evaporation. A reacts with $N_2(g)$ to give compound C. The reaction of A with $H_2(g)$ gives a salt – like basic compound D. On treatment with H_2O_2, C gives a gas E which turns red litmus blue.

i) Identify *A*, *B*, *C*, D and *E* giving their chemical formulae.

A = ... B = ... C = ...

D = ... E = ...

ii) Give balanced chemical equations for the reactions described above.

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b) The following questions are based on the transition metals, V and Cr and their compounds.

i) Give the ground state electronic configuration of *V*.

.....

ii) State the positive oxidation states of *V* .....

iii) Give the chemical formulae of the oxides formed by V in the positive oxidation states given in ii) above. Indicate whether each of these oxides is acidic, amphoteric or basic.

.....

.....

iv) Write the chemical formulae of two oxocations formed by *V*. State their colours in aqueous acidic medium.

.....

v) What is the simplest ion that chromium forms in aqeuous solution? State its colour. Predict what you would expect to observe when solid Na_2CO_3 is added to an aqueous solution of this ion.

.....

.....

vi) Give one use of the metal *V*.

.....

.....

vii) What would you observe when a green coloured aqueous solution of $CrCl_3$ is subjected to the following?

I. Addition of a few drops of dilute NaOH.

.....

II. Addition of excess dilute NaOH followed by H_2O_2. and then heated.

.....

viii) When a concentrated solution of $K_2Cr_2O_7$ is treated with conc. H_2SO_4, the bright red acidic oxide *X* of chromium is precipitated. On heating *X*, the green amphoteric oxide *Y* is obtained. *Y* could also be obtained on heating $(NH_4)_2Cr_2O_7$. Give the chemical formulae of *X* and *Y*.

X = ... Y= .....

ix) What would you observe when dil. NaOH is added to a solution of $K_2Cr_2O_7$.

.....

x) Give one advantage and one disadvantage of using $K_2Cr_2O_7$ in titrations.

advantage .....

disadvantage .....

(39) **2014 AL (New)**

a) Arrange the following in the decreasing order of the property indicated in parenthesis.

i) Li, Na, Mg, Al, Si (first ionization energy)

..... > ..... > ..... > ..... > .....

ii) C, O, F, Cl (first electron affinity)

..... > ..... > ..... > .....

iii) $BeCl_2$, $CaCl_2$, $BaCl_2$ (melting point)

..... > ..... > .....

iv) NCl_3, $SiCl_4$, ICl_4^- (bond angle)

..... > ..... > .....

v) H_2O, H_3O^+, OH^- (electronegativity of oxygen atom)

..... > ..... > .....

vi) NO^+, FNO_2, ClNO, NH_2OH (N – O bond length)

..... > ..... > ..... > .....

(40) **2014 AL**

a) *X* is an element in the third period of the periodic table. Its first five successive ionization energies, in kJ mol^{-1} are respectively, 577, 1816, 2744, 11577 and 14842. X reacts with both dilute HCl and dilute NaOH separately, liberating the same colourless and oduorless diatomic gas.

i) Identify element X .....

ii) Write the grond state electronic configuration of *X* .....

iii) Give the most stable positive oxidation state of *X* .....

iv) Give balanced chemical equations for the reaction of element *X* with

I. dilute HCl

.....

II. diluteNaOH

.....

.....

v) X burns readily in air or O_2 to form an oxide. Write the formula of the oxide.

.....

vi) Write the balanced chemical equation for the reaction of *X* when heated with $NaNO_3$ and dilute NaOH.

.....

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.....

vii) Write the formula of the chemical species that the ion of X having the most stable oxidation state forms in an aqueous medium. Predict what you would expect to observe when a small amount of solid Na_2CO_3 is added to an aqueous solution of this ion.

.....

.....

viii) Give one use of element *X*.

.....

.....

b) Test tubes labelled A to E contain solutions of $Mg(NO_3)_2$, Na_2CO_3, KCl, $ZnSO_4$ and $Pb(NO_3)_2$ (not in order) $BaCl_2$ and dilute NH_4OH solutions are added separately to portions of each solution. The observations are given in the table below.

solution	$BaCl_2$ solution	dilute NH_4OH solution
A	a white precipitate soluble in hot water	a white precipitate
B	a white precipitate insoluble in dil. HCl	a white precipitate soluble in excess NH_4OH.
C	a white precipitate soluble in dil. HCl	a clear solution.
D	a clear solution.	a clear solution.
E	a clear solution.	a gelatinous white precipitate

i) Identify soltuiosn *A* to *E*.

A = ...

B = ...

C = ...

D = ...

E = ...

ii) Write balanced chemical equations for the following reactions.

I. All the reactions forming precipitates (indicate the precipitates with an arrow (↓) in the equations)

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II. All the reactions involving dissolution of precipitates

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(41) **2015 AL**

a) ***X*** is a *p*–block element in the periodic Table with an atomic number less than 20. On burning *X* in air, the colourless gas X_1 is formed. X_1 has a pungent smell. X_1 is readily soluble in water. When a solution of $BaCl_2$ is added to this solution, a white precipitate X_2 is formed X_2 dissolves in dil' HCl to give a weak acid X_3 as one of the products. X_1 decolorizes an acidified solution of potassium permanganate. A gas X_4 is formed when X_1 is oxidized. X_4 is used in the industrial manufacture of the strong acid X_5.

i) Identify *X* and draw is structure in the crystalline state.

X: .....

Structure of X

ii) Write the ground state electronic configuration of *X* .....

iii) What are the common positive oxidation states of *X* .....

iv) Write the chemical formulae of the following compounds.

X_1 : .....

X_2 : .....

X_3 : .....

X_4 : .....

X_5 : .....

v) Sketch the most stable structures of X_1 and X_4 Indicate approximate baond angles in each sketch

X_1 X_4

vi) Write the balanced chemical equation for the reaction of X_1 with acidified potassium permanganate.

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b) Test tubes labeled A to E contain the following solids (not in order): $Mg(NO_3)_2$, $(NH_4)_2CO_3$, $(HN_4)_2SO_4$, NH_4NO_3 and $NaHCO_3$

A description of the products formed each of these solids is heated is given in the table below.

Soild	Description
A	**1.** A basic white powder; **2.** Water vapour **3.** A colourless, odourless gas that turns lime water creamy.
B	Three products which are in the gaseous state.
C	**1.** A strong acid; **2.** A colourless gas that gives a brown precipitate / colouration with Nessler's reagent
D	**1.** A white oxide which reacts with water to from a weakly basic solution; **2.** A colourless, diatomic gas at room temperature; **3.** red – brown gas
E	**1.** Water vapour; **2.** A colourless, tasteless, non – toxic triatomic gas with a linear structure.

i) Identify soild ***A*** to ***E***

A: ..... **B:** .....

C: ..... **D:** .....

E: .....

ii) **Write balanced** chemical; **eqations for the reactions that take place on heating each of the** solids A to **E.**

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(42) **2016AL**

a) ***X*** and ***Y*** are *s*–block elements of the periodic Table. They react with water to form hydroxides. The hydroxide of *X* is more basic than that of *Y*. The hydroxide of *X* is used in the manufacture of baby soap. The hydroxide of *Y* is commonly used to identify the gas *Z* that is one of the main gases responsible for global warming.

i) Identify *X* and *Y*.

X ☐ Y ☐

ii) Write the electronic configurations of *X* and *Y*.

X = ...

Y = ...

iii) Write the colour of the flame given by salts of *X* and *Y* in the flame test.

X = ...

Y = ...

iv) Indicate the relative magnitudes of the following in respect of *X* and *Y*.

I. Atomic size ☐ > ☐

II. Density ☐ > ☐

III. Melting point ☐ > ☐

IV. First ionization energy ☐ > ☐

v) Identify ***Z***.....

vi) Using balanced chemical equations **only**, indicate how the hydroxide of ***Y*** could be used to identify ***Z***.

Note : Indicate percipitates, if any, using "↓" and colours of precipitates / solutions used in the identification.

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vii) A natural source of ***Y*** in which it is present as a carbonate is used as a raw material in the manufacture of a disinfectant

I. Name the natural source .....

II. Identify the disinfectant .....

III. Write the steps in the manufacturing process of the disinfectant, using balanced chemical equations only.

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b) i) Complete the reactions given below by selecting the appropriate solution from the given list and writing in the box.

List of solutions (not in order)

$Na_2S_2O_3(aq)$, $AgNO_3(aq)$, $K_2SO_4(aq)$, $(NH_4)_2CO_3(aq)$, $BaCl_2(aq)$, $KI(aq)$

Note: A solution should be used **only once**.

I $BaCl_2(aq)$ + [ ] → **A** (Write precipitate that dissolves in dil. HCl to give a clear solution)

II $Pb(NO_3)_2(aq)$ + [ ] → **B** (Yellow precipitate that dissolves in hot water)

III $AgNO_3(aq)$ + [ ] → **C** (White precipitate that turns black on standing)

IV $K_2SO_3(aq)$ + [ ] → **D** (White precipitate that dissovlves in dil. HCl)

V. NaBr(aq) + [ ] → **E** (Pale yellow precipitate that dissolves completely in conc. ammonia)

VI. $Ba(NO_3)_2(aq)$ + [ ] → **F** (White precipitate that does **not** dissolve in dil. HCl)

ii) Write the chemical formulae of the precipitates *A* to *F*

A ..... **B** .....

C ..... **D** .....

E ..... **F** .....

iii) Write balanced chemical equation for the dissolution of precipitates *A*, *D* and *E* in b) i) above.

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2017 A/L

a) *X*, *Y* and *Z* are elements that belong to the same group in the Periodic table. They are in three successive periods respectively on descending the group. *Y* exists as a non-metallic coloured liquid at room temperature.

i) Identify *X*, *Y*, and *Z*. (Give atomic symbols.)

X = ... Y = ... Z = ...

ii) Indicate the relative magnitudes of the following with regard to *X*, *Y* and *Z*.

I) Atomic size [ ] > [ ] > [ ]

II) Electron Affinity [ ] > [ ] > [ ]

III) First Ionization energy [ ] > [ ] > [ ]

iii) You are provided with aqueous solutions of the anions of *X*, *Y*, and *Z*, each in a separate test. Suggest a reagent that could be used to identify these anions.

Reagent: .....

Observation: X : .....
(for the anions)

Y : .....

Z : .....

or

Reagent: .....

Observation: X : .....
(for the anions)

Y : .....

Z: .....

iv) Give balanced chemical equations for the reactions of $X_2(g)$ with the following.

I) $NH_3(g)$ .....

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II) dil.NaOH .....

v) Draw the structure of two oxoacids of *X*.

vi) Name one natural source of *X*.

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vii) I) A monomer that contains *X* forms an addition polymer that is widely used in the manufacture of water pipes. Draw the structure of monomer

II) Write the full name of polymer. .....

b) An aqueous solution Q contains three anions. The following tests were carried out to identify these anions. (Fresh portions of solution Q were used for each test ① to ⑤).

		Test	Observation
①	I	Dilute HCl was added.	A colourless gas was evolved. A clear solution was obtained
	II	The gas evolved was tested with filter paper moistened with lead acetate.	No colour change
②	I	A $BaCl_2$ solution was added	A white precipitate was obtained.
	II	The white precipitate was separated by filtration, and dil. HCl was added to it.	A white precipitate dissolved with the evolution of a gas.
	III	The gas evolved was tested with a filter paper moistened with acidified potassium dichromate.	The colour changed from orange to green.
③		Conc. HNO_3 and an excess of ammonium molybdate solution were added and the mixture was warmed.	A yellow precipitate did not form.
④		Devarda's alloy and NaOH solution were added and the mixture was heated.	A gas that termed Nessler's reagent brown was evolved.
⑤		A $FeCl_3$ solution was added.	A blood red coloured solution was obtained.

i) Identify the **three** anions in solution Q.

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ii) Write the balanced chemical equation for the reaction taking place in test number ② III.

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