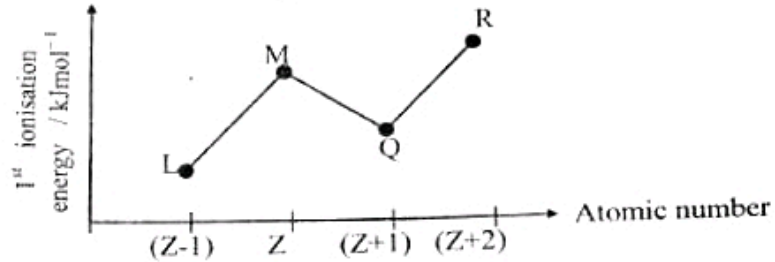
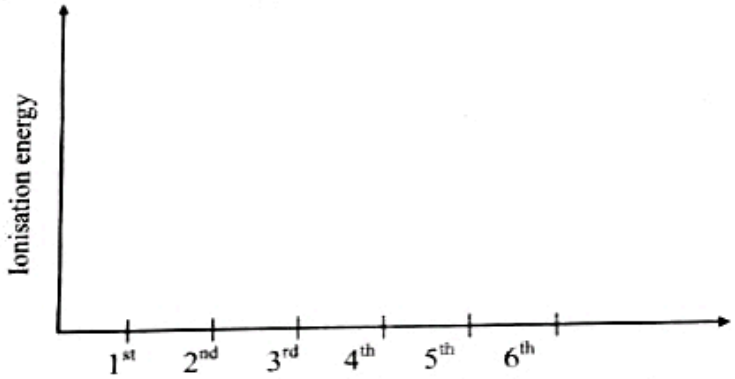
Unit 1

(1) **1980 A/L (optional 1)**

L, *M*, *Q* and *R* are four consecutive elements which belong to the period which starts from sodium and ends with Argon. The respective atomic numbers are (Z – 1), Z, (Z + 1) and (Z + 2). The trend of first ionization energies of these elements are given below. The oxide of *L* is weakly acidic



a) i) Draw a sketch to show the trend of first six ionization energies. Show clearly the largest ionization energy increasement in your diagram. (Drawn the axis as given below).



ii) What is the most applicable formula for the hydride *M*? .

.....

iii) By selecting one or more of the following details, state the nature of the element with the atomic number (Z + 4).

a strong oxidant	a mild oxidant
a strong reductant	a mild reductant
a noble gas	a metal
a non metal	a transition element

b) i) Write the electronic configuration of the element *X* with atomic number 24, according to the general method $1s^2\ 2s^2$ .....

.....

ii) What is the valency of *X*, at its highest oxidation state? .....

iii) The oxide derived from the highest oxidation state of X is reacted with concentrated hydrochloric acid. The oxidation number of X is reduced to 3, in this reaction. Write the balanced chemical equation for this reaction.

.....

(2) **1981 A/L**

a) Followings are the ionisation energies of the elements, L, G, and Q in kJ mol^{-1}

$$L(g) \xrightarrow{897} L^{+}(g) \xrightarrow{1754} L^{2+}(g) \xrightarrow{14820} L^{3+}(g) \xrightarrow{20960} L^{4+}(g)$$

$$G(g) \xrightarrow{799} G^{+}(g) \xrightarrow{2422} G^{2+}(g) \xrightarrow{3651} G^{3+}(g) \xrightarrow{24970} G^{4+}(g)$$

$$Q(g) \xrightarrow{578} Q^{+}(g) \xrightarrow{1817} Q^{2+}(g) \xrightarrow{2741} Q^{3+}(g) \xrightarrow{10813} Q^{4+}(g)$$

i) What are elements belongs to the same group from the elements given above? Give reasons for your answer briefly.

.....

.....

ii) To which group of the periodic table do other elements belong?

.....

iii) State the trend of the atomic radii of the elements L, G, and Q by giving reasons. L, G and Q by giving reasons.

.....

.....

.....

.....

b) Write the relevant nuclear reactions for the nucleic changes take place in the following processes.

i) Formation of two similar nuclei when an atom of hydrogen and $^{7}_{3}Li$ are fused.

.....

ii) Emission of a β (beta) particle from $^{24}_{11}Na$.

.....

iii) Emission of an alpha particle (α) from $^{17}_{8}O$

.....

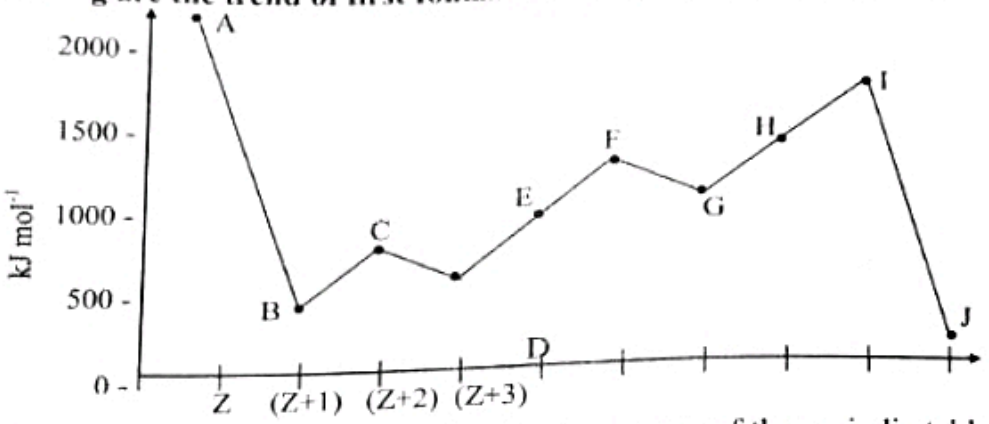
(3) **1981 A/L**

c) Write the electronic configuration of the ion Y^{2+} formed by the element Y in the form of $1s^2\ 2s^2$ ..... (Y = Ni)

.....

(4) **1982 A/L**

a) *A*, *B*, *C*, *D*, *E*, *F*, *G*, *H*, *I* and *J* are ten consecutive element found in the periodic table with atomic numbers, Z, (Z + 1), (Z+2), (Z+3), ... (Z+9) respectively.
Following are the trend of first Ionization energies of the elements *A* to *J*.



i) When this ten elements are classified in the groups of the periodic table, some groups can obtain more than one element. Identify these elements, and mention to which groups these element (*A* to *J*) would belong.

.....

.....

.....

.....

.....

ii) What is the element with the highest second ionization energy? Give reasons for your answer.

.....

.....

.....

iii) Explain the following statement.

1) The first ionization energy of *D* is higher than the first ionization energy of *C*

.....

.....

.....

2) The first ionization energy of A is larger than the first ionisation energy of *I*

.....

.....

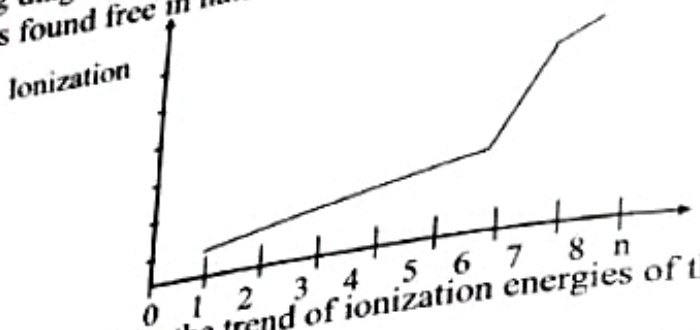
.....

iv) Which element of the above ten elements has the highest electro positivity?

.....

(5) **1984 A/L**

Following diagram shows the first eight successive ionization energies of the element X which is found free in nature.



a) i) Give reasons for the trend of ionization energies of the element X

.....

.....

.....

ii) Deduce the group of the periodic table which X belongs.

.....

(6) **1986 A/L**

b) i) What are the important information that can be obtained by studying atomic spectra? (two facts are sufficient)

.....

.....

.....

.....

ii) Explain the Hydrogen's atomic spectrum qualitatively by using an energy level diagram.

.....

.....

.....

.....

.....

.....

.....

.....

.....

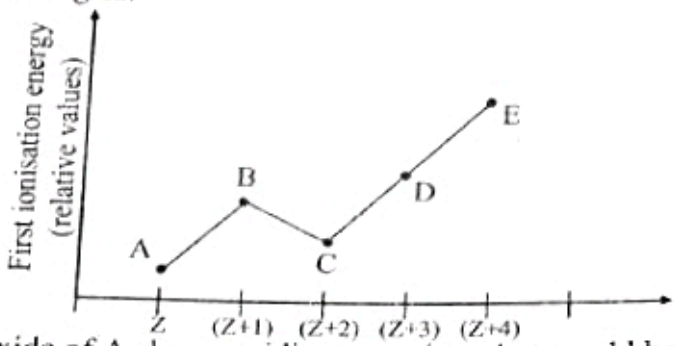
.....

.....

.....

(7) **1987 A/L**

a) *A*, *B*, *C*, *D* and *E* are five non transition elements with atomic numbers Z, (Z + 1), (Z+2), (Z+3) and (Z+4) respectively. Following diagram represents the trend of 1st ionisation energies.



i) If the oxide of A shows acidic properties what would be the molecular formula when *D* combines with hydrogen? Give reasons for your answer.

.....

.....

.....

ii) Which element would show the largest atomic radii? .....

iii) Draw the dot and cross diagram to show the electron arrangement of the compound formed when *A* combines with bromine.
(Consider only the valence electrons of atoms)

(8) **1989 A/L**

a) i) Write down the electronic configuration of the element Arsenic of atomic number 33 in the form of $1s^2\ 2s^2$ ...

.....

ii) The first ionization energy of Arsenic is higher than the first ionization energy of Selenium which has the atomic number of 34. Explain the above observation based on the electronic configuration of these two elements.

.....

.....

.....

.....

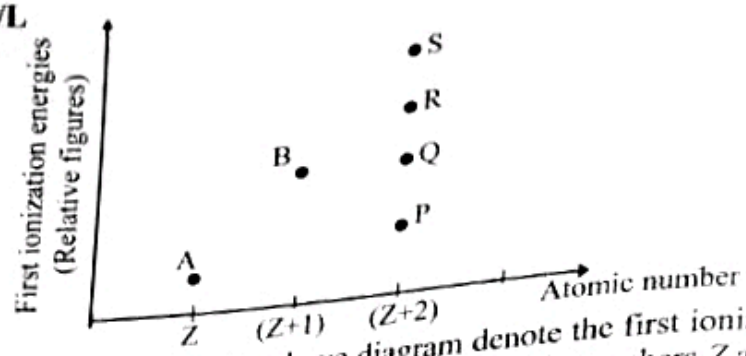
.....

d) Give the experimental data to accept that all the particles of cathode rays obtain from the different elements are equal.

.....

(9) **1990 A/L**

a) i)



The points *A*, *B* in the above diagram denote the first ionization energy values of the non transition elements with the atomic numbers *Z* and (*Z* + 1). Identify the point for the first ionization energy of the non transition element with the atomic number (*Z* + 2) from the given points *P*, *Q*, *R* and *S* and write down in the space. (N.B. Marks will be deducted for false points)

.....

ii) Explain why does the fourth ionization energy of Boron is greater than the fourth ionization energy of Aluminium.

.....

.....

(10) **1991 A/L**

a) Write down the electronic configuration of the element of atomic number 25 in the form of $1s^2\ 2s^2$.....

.....

(11) **1992 A/L**

a) i) Write down the electronic configuration of the element of atomic number 30 in the form $1s^2\ 2s^2$ ...

.....

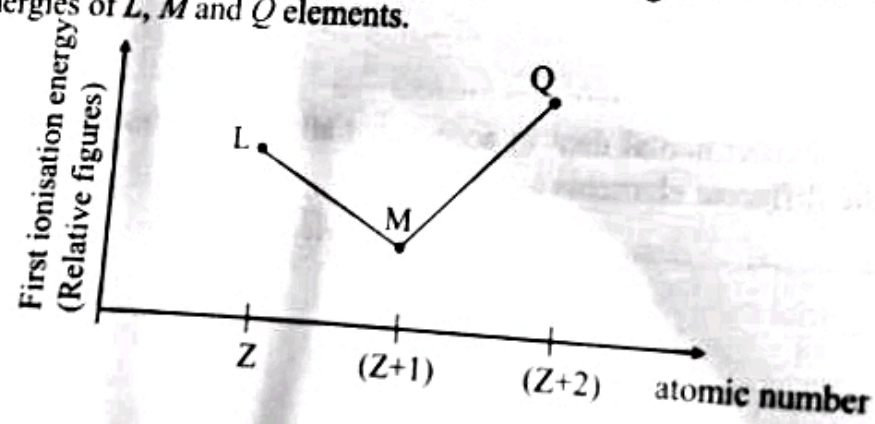
ii) The atomic number of the element *X* is 33. What is the lowest oxidation number you can expect from *X*.

N.B. If there's a sign for the oxidation number it should be clearly stated.

.....

(12) **1993 A/L**

a) *L*, *M*, *Q* and *R* are four non transition elements with the consecutive atomic numbers, *Z*, (Z+1), (Z+2) and (Z+3). Following is the trend of first ionization energies of *L*, *M* and *Q* elements.



Essay

M shows amphoteric properties. Flouride of *M* is an ionic solid.

i) Write the chemical formula of the chloride of *Q*.

.....

ii) Write down the electronic configuration of *R* in general way.

.....

(13) **1998 A/L**

c) i) Indicate specifically, in the usual manner, the arrangement of electrons in the last two sub – energy levels of the element *X* of atomic number 40.

.....

ii) Write the chemical formula of the nitride of *X* derived from its highest oxidation state.

.....

(14) **2000 A/L**

a) Figure 1 : shows the first five electronic energy levels of the *H* atom. (n = 1, 2, 3, 4, 5)

Figure 2 : shows six lines of the emission electronic spectrum of the *H* atom.

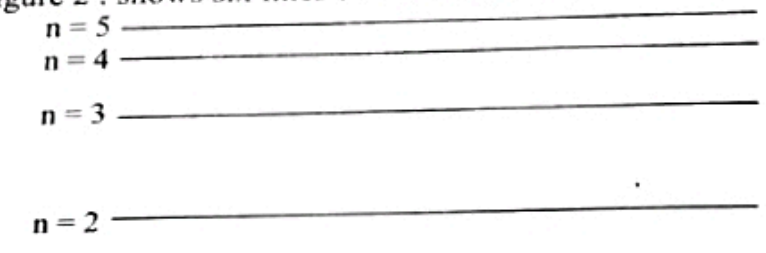


Figure 1

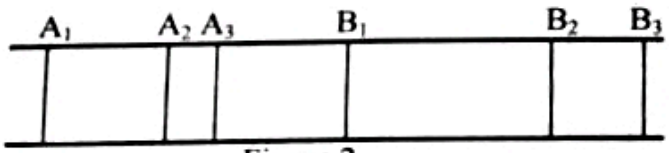


Figure 2

A_1, A_2 and A_3 are the first three lines belonging to the same series in this emission spectrum.

B_1, B_2 and B_3 are the first three lines of the subsequent series in the same emission spectrum.

i) **Draw six arrows between the energy levels in figure 1 to show the electronic transitions corresponding to the six spectral lines in figure 2.**

ii) **Clearly label in figure 1 these arrows appropriately as A_1, A_2, A_3, B_1, B_2 and B_3.**

iii) **Strike off the inappropriate word, within the bracket, in the following sentence.**

The frequencies of the spectral lines (increase / decrease) from A_1 to B_3

(15) **2001 A/L**

c) *A*, *B* and *C* are experimental observations. Given against each of them are some explanations provided by students for these observations. Of these explanations given for each observation, one or more may be correct.

Evaluate these explanations by

i) Marking in the appropriate box a ☑ if, in your opinion,

ii) Marking in the appropriate box a ☒ if, in your opinion, the explanation is invalid.

keep the appropriate box empty as ☐ if your are unable to evaluate the validity of the explanation.

N.B. For every correct answer, 0.3 marks each will be awarded.
If a box is kept empty, no marks will be awarded or deducted.
However, the minimum marks for this part c) will be zero (0)

	Experimental observation.	**Students' Explanation**
A	When a beam of α particles falls on a thin gold plate, most of the α particles pass undeflected through the plate.	☐ The gold plate contains spaces which are large compared with the size of α particles. ☐ The gold plate is non continuous. ☐ The path of α particles is always linear.
B	A paddle wheel placed in the path of cathode rays rotates.	☐ Cathode rays are negatively charged. ☐ Cathode rays have particle – like properties. ☐ Material of the paddle wheel is continuous.
C	The electronic emission spectrum of hydrogen consists of several series of lines, in each series, the separation between the lines decreases as the frequency increases.	☐ There are definite energy levels for the electrons in the H – atom. ☐ The energy corresponding to each line in the spectrum is equal to the energy of an electronic level of hydrogen. ☐ The energy of the electron decreases with increasing radius of the atomic shell. The energy difference between successive levels decreases as the energy of the electronic levels increases.

(16) **2003 A/L**

d) Strike off the inappropriate words given within brackets in the passage given below.

NB: 0.3 marks will be awarded for every correct answer;
0.1 marks will be deducted for every incorrect answer;

The chemical elements in the periodic table are arranged according to the **(mass number / atomic number)**. The majority of these elements are **(metals / non metals)**
(All / Most) of the s – block elements are metals.
The majority of the p – block elements are **(metals / non metals)** **(Most / All)** of the 3d elements are metals. Atoms with the **(same / different)** atomic number and the **(same / different)** mass number are called isotopes.
Nuclei of all atoms have **(protons / neutrons / protons and neutrons)**

(17) **2005 A/L**

c) *A*, *B*, *C* and *D* are four non-transition elements whose atomic numbers are *Z*, *Z* + 1, *Z* + 2 and *Z* + 3 respectively. Of these elements, *C* has the highest first ionization energy. Identify the group in the periodic table to which *C* belongs, if

i) The atomic radius of *D* is smaller than that of *C*.

.....

ii) The atomic radius of *D* is larger than that of *C*.

.....

(18) **2007 A/L**

a) i) Write the complete electronic configuration of the element *X* with the atomic number 33

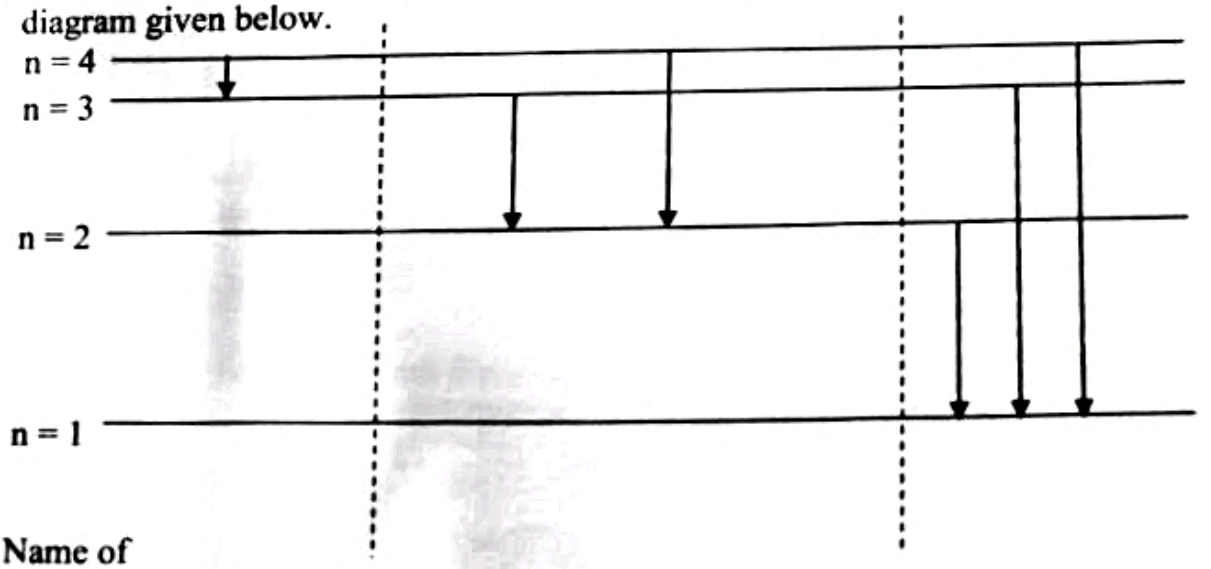
.....

ii) What are the most common oxidation states of the element *X*? .....

iii) Give the chemical formulae of the stable oxides of *X*.

.....

b) The first electronic energy levels of the hydrogen atom are represented in the diagram given below.



Name of the region ....

Indicate with arrows all electronic transitions that could occur between the above energy levels and which are responsible for emission lines in (A) the infra – red region (B) the visible region and (C) the ultra – violet region.
Write the **names of the series** to which each set of lines belongs, in the space provided in the diagram.

d) ***A***, ***B***, ***C*** and *D* are consecutive non – transition elements in the periodic table with atomic number increasing from ***A*** to ***D***. Atomic number of ***D*** is less than 30.
The first ionization energies of these elements are in the order $D << A < B < C$.
Arrange these elements in the increasing order of electro negatively.

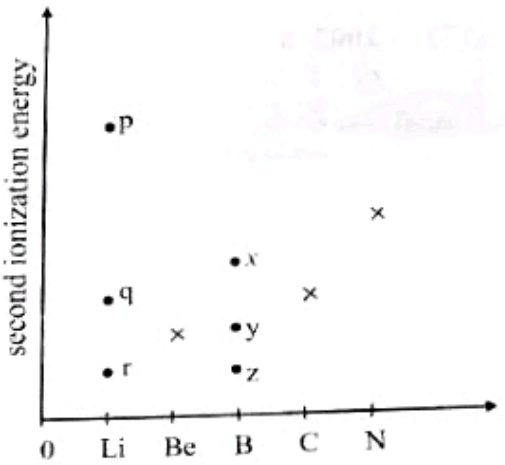
..... < .....< .....< .....

(19) 2008 A/L

c) The points corresponding of the second ionization energy of Be, *C* and *N* are shown by *x* in the figure given below.

i) Select the most appropriate point corresponding to the second ionization energy of Li out of the points *p*, *q* and *r* and mark it with a circle. (O)

ii) Select the most appropriate point corresponding to the second ionization energy of *B* out of the points *x*, *y* and *z* and mark it with a square (□)



(20) 2009 A/L

d) The first ionization energies of five consecutive elements in the periodic table with atomic numbers Z, Z + 1, Z + 2, Z + 3 and Z + 4 are given below. *Z* is less than 16 and one of these elements is a metal. The ionization energy values are not given in any particular order.
Ionization energies : 495, 1313, 1681, 2081, 1402 kJ mol^{-1}

Write in the table given below, the relevant ionization energy value for each element.

Atomic number	Z	Z + 1	Z + 2	Z + 3	Z + 4
Ionization energy/ kJ mol^{-1}					