MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2012/2013

PRE-UNIVERSITY ENTRANCE EXAMINATION

SCH 00100: CHEMICAL STRUCTURES AND PERIODICITY

Date: 13th August, 2013   *Time: 2.00 – 4.00pm*

INSTRUCTIONS:

♦ Answer ANY FOUR questions.

1. (a) Proton numbers of some elements N, O, P, Q, R and W (not their real chemical symbols) are given as 4, 14, 18, 19 and 9 respectively.

   (i) Present the shell electronic configuration of for each of these

   elements.   (5 mks)

   (ii) Give the noble gas electron arrangement of these elements.   (2.5 mks)

   (iii) Deduce the group (I-VIII) to which each of the elements belong. (5 mks)

   (iv)State the period to which each of the elements belong.   (2.5 mks)

   (b) Give the chemical symbols of the following chemical elements:

   (i)   Sodium

   (ii)   Helium

   (iii)   Potassium

   (iv)   Boron
   (v)   Chlorine

                                                                        (2.5 mks)

2 (a). The elements L and Y (not their real symbols) belong to the same period, however, they have 1 and 7 electrons in their valence shells respectively.

   (i) What is meant by the terms valence and oxidation power of an

   element?   (2 mks)

   (ii) Energy is applied to each of the elemental atom for the two elements to

   lose a single electron. Which of the elements will require more energy to lose its 1st electron?   (2 mks)

   (iii) Deduce the valence for each of the two elements is. Explain your answers.
                                                                        (4 mks)

   (iv) Deduce the probable oxidation state for each of the two elements will be

   in their compounds.   (4 mks)

   (b) An atom U (not real chemical symbol) can gain or lose an electron in its valence shell. Explain the effect on its:

(i) Atomic size after gaining an electron (2 mks)

(ii) Atomic size after losing an electron (2 mks)

(c) You are given the chemical symbols of some elements:

(i) Be

(ii) Ca

(iii) Ar

Give the names of elements represented by the above chemical symbols.
(1.5 mks)

3. (a) Define the following terms:

(i) Atom (1 mk)
(ii) Chemical reaction (1 mk)

(b) An atom is composed of two parts each with fundamental particle(s).

(i) State these two parts of an atom (1 mk)

(ii) Fundamental particles namely protons, electrons and neutrons

reside in an atom. State the part of the atom in which each of

these particles reside in. (2 mks)

(c) Present a simplest model of an atom (atomic number, 5) and clearly

label the various entities of the atom. (2 mks)

(d) State the sign and magnitude of the charge of each of the following
fundamental particles of an atom particles:

(i)   Proton (1 mk)

(ii) Electron (1 mk)

(iii) Neutron (1 mk)

(e) What is meant by the following terms as applied to atoms of elements:

(i)   Atomic number

(ii)   Nucleon number

(iii)   Mass number

(iv)   Isotopes
(v)   Isobars

(5 mks)

(f) Uranium-238 is deposited in a desert during nuclear testing. Will it

undergo radioactive decay more rapidly during summer compared

to winter time? Explain your answer.

(2.5 mks)

4. (a) Determine if the following nuclei (not real chemical symbols) would be
radioactive or not. Explain your answers.

(i) $^{108}_{50}Z$

(ii) $^{115}_{52}L$

(iii) $^{208}_{84}A$

(3 mks)

(b) A radioactive isotope of an element has a half-life of 12 days

(i) What is meant by the term half-life as applied in radioactivity?   (2 mks)

(ii) How many grams of this isotope of an element will remain after

60 days if you begin with 40 g? Show clearly your calculations.   (2 mks)

(c) Nulear fusion and nuclear fission are techniques that have the potential of
supplying the energy needs of the world.

(i) Briefly give the meaning of the terms nuclear fusion and nuclear

fission.

(2 mks)

(ii) Neutrons in a nuclear reactor have to be moderated to avoid

Uncontrolled chain reactions. Which materials are used in

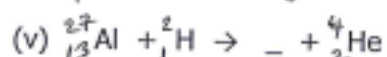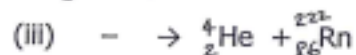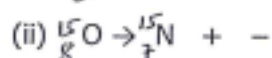moderating the neutrons in nuclear reactors?   (2 mks)

(iii) Mention the shortcomings that are to be surmounted for nuclear
fusion to be enabled on earth today? (2 mks)
(iv) Give any two applications of radioisotopes. (2 mks)

5. (a) State the effect on mass number and atomic number of a reacting

isotope of an element when it undergoes each of the following
transformations separately:

(i)   A beta particle is emitted (2 mks)
(ii)   An alpha particle is emitted (2 mks)
(iii) A gamma ray is emitted (2 mks)
(iv)   A positron is emitted (1.5 mks)

(b) *Some nuclear reactions are represented by the following incomplete*

nuclear equations:

(i) $^{210}_{83}Bi \rightarrow {}^{4}_{2}He + -$ (1 mk)

(ii) $^{15}_{8}O \rightarrow {}^{15}_{7}N + -$

(iii) $- \rightarrow {}^{4}_{2}He + {}^{222}_{86}Rn$

(iv) $^{9}_{4}Be + - \rightarrow {}^{12}_{6}C + {}^{1}_{0}n$

(v) $^{27}_{13}Al + {}^{2}_{1}H \rightarrow - + {}^{4}_{2}He$

I. *The mass* number and atomic number of the missing species. (5 mks)

II. Name the radiation if the missing species happens to be a

radiation. (1 mk)

(c) Carbon -14 is radioactive and emits some radiation. However, carbon-12 is
stable. What difference is there between the two isotopes in terms of:

(i) Chemical reactivity

(ii) Density

Explain your answers (4 mks)