NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF APPLIED CHEMISTRY

SUPPLEMENTARY EXAMINATIONS – JULY 2014

GENERAL CHEMISTRY – SCH 1217

FOR SBB AND ESH

TIME – 3 HOURS

INSTRUCTIONS TO CANDIDATES:

1.   ANSWER **ALL** QUESTIONS FROM SECTION A AND **ANY THREE** FROM SECTION B. SECTION A CARRIES 40 MARKS AND EACH QUESTION IN SECTION B CARRIES 20 MARKS. MARKS ARE ALLOCATED IS INDICATED IN BRACKET [ ]

2.   START ANSWERING EACH QUESTION ON A NEW PAGE. (NOT EACH PART OF A QUESTION)

INFORMATION TO CANDIDATES

1.   YOU ARE REMINDED FOR THE NEED TO USE CLEAR PRESENTATION AND GOOD ENGLISH

TOTAL MARKS = 100

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PRINTED PAGES (ON ONE SIDE ONLY) INCLUDING THE TOP PAGE WITH THE INSTRUCTIONS.

SECTION A:

1)

a) With the aid of a diagram discuss how a catalyst function   [6 marks]

b) Two catalysts, catalyst A and catalyst B, are compared for their catalytic activity for the reaction. When catalyst A is present it takes 10s for A to change from 2 to 0.5 moles and when catalyst B is present it takes 20s for A to decrease from 5 to 2.5 moles at the same temperature and with the same quantities of catalyst.

   Which catalyst is more active for the reaction concerned?   [4 marks]

2)

a) Hydrogen and iodine react according to the equation

   Suppose 1.00 mol$H_{2(g)}$ and 2.00 mol $I_{2(g)}$ are placed in a vessel. How many moles of substances are present in the mixture when it comes to equilibrium at 458 °C. The equilibrium constant at this temperature is 49.7   [10 marks]

3)

a) Draw the orbital diagram for the electron configuration of oxygen, atomic number 8. How many unpaired electrons does an oxygen atom possess?   [3 marks]

b) Write the electron configuration for phosphorus, element 15.   [3 marks]

c) How many unpaired electrons does a phosphorus atom possess?   [2 marks]

d) What is the characteristic valence electron configuration of the group 7A elements, the halogens?   [2 marks]

4)

a) Write balanced equations for:

   a.i) Solid mercury (II) sulphide decomposing into its component elements when heated.

   a.ii)   Aluminium metal combining with oxygen in the air.

   a.iii)   When methanol, $CH_3OH(l)$, is burned in air.

b) Calculate the percentage of nitrogen, by mass, in $Ca(NO_3)_2$.

c) What is the molar mass of glucose, $C_6H_{12}O_6$?   (10 marks)

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SECTION B:

1) The Haber-Bosch process for the production of ammonia is one of the key industrial processes in developed countries.

Temperature (K)

298	-91.8	-198.12
800	-107.4	-225.4
1300	-112.4	-228.0

a) At what temperature(s) is the reaction spontaneous in the forward direction?

b) Calculate the mole fraction of ammonia in the equilibrium mixture at each of the three temperatures. At what temperature is the mole fraction of NH_3 the largest?

[20 marks]

2)

a) Calculate the enthalpy change for the following reactions at the two temperatures (400 K and 1000 K).

values (kJ/mol) at the different two temperatures are as follows

-77	0	-393	-242	-110	0

-89   0   -394   -248   -111   0

[10 marks]

b) Complete the following nuclear equations. Write the mass number, atomic number, and symbol for the remaining particle

(b.i.1.a.i)

(b.i.1.a.ii)

(b.i.1.a.iii)

(b.i.1.a.iv)

(b.i.1.a.v)

[10 marks]

3)

a) Which family of elements is characterized by an ns^2np^2 electron configuration in the outermost occupied shell? Explain your reasoning and give examples of such elements

[4 marks]

b) Write the electron configuration for (**a**) Ca^{2+}, (**b**) Co^{3+}, and (**c**) S^{2-}.   [6 marks]

c) Define Hund's first rule and Pauli's exclusion principle.   [6 marks]

d) Balance these equations by providing the missing coefficients:

[4 marks]

4)

a) Which substance do you expect to have the greatest lattice energy, MgF_2, CaF_2,or ZrO_2?

Explain.   [3 marks]

b) Predict the ion generally formed by:

(i)   Sr,
(ii)   S,
(iii)   Al.   [3 marks]
c)   Predict the charges on the ions formed when magnesium reacts with nitrogen [2 marks]

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d)   In each case, which bond is more polar: **(a)** B—Cl or C—Cl, **(b)** P—F or P— Cl? Indicate   in each case which atom has the partial negative charge.   [6 marks]

e)   Name the 3 main reaction types and give 2 examples of each.   [6 marks]

END OF QUESTION PAPER!!!