**General Chemistry for ISE students: Final examination WS 2010**

(minimum point number: 50 maximum grade at 100 points maximum point number: 115)

1 Which statements on the properties of an electron are correct, which are false? *

a) An electron has no mass
b) An electron never has any influence on magnetism
c) In some experiments, an electron behaves like an electromagnetic wave
d) In some experiments, an electron behaves like a particle
e) Electrons always move in circles (15 points)

2 Try to compare Rutherford's atomic model with Bohr's atomic model as closely as possible. Where are the similarities, where are the differences? Name an experimental observation which can be explained by Bohr's model but not by Rutherford's model. (15 points)

3 Compare alkali-metals (group $I_a$) with earth-alkali metals (group $II_a$). Try to list as many similarities and differences as possible. (15 points)

4 Suppose that an unknown chemical compound exhibits the following properties: a) it is crystalline but shows no electric conductivity in the solid state, b) it melts at 300°C and decomposes at 400°C, c) the compound is s oluble in water, the solution shows no electrical conductivity. What kind of chemical bond would you expect in the given compound? Try to describe this type of bond in detail.
(15 points)

5 If a piece of magnesium (Mg) is dipped into a solution that contains $Cu^{2+}$-ions, the magnesium surface is slowly covered by metallic copper (Cu). What type chemical reaction is occurring? Try to formulate the reaction equation and name the roles of the reaction partners according to the given type of reaction. (15 points)

6 Which statements regarding the action of a catalyst in a chemical reaction are true, which are false?

a) a catalyst is a reaction partner and disappears during the reaction
b) a catalyst increases the activation energy
c) a catalyst decreases the activation energy
d) a catalyst accelerates the reaction
e) a catalyst increases the reaction enthalpy (15 points)

~~7 What is the difference between a smectic and a cholesteric liquid crystal? Which of both has optical properties making it suitable for liquid crystalline displays? Describe the essential characteristics in the molecular structure of a thermotropic liquid crystal. (15 points)~~

~~8 Suppose you need a very large surface between two materials A and B. What kind of structure would you propose? How could you produce such a structure? How could you stabilize it? (10 points)~~

* One or several answers may be correct. Please indicate appropriately by repeating a), b), c), … followed by the statements "right" or "wrong" on your answer sheet.

**General Chemistry for ISE students: Final examination WS 2011**

(minimum point number: 50 maximum grade at 100 points maximum point number: 120)

5 Describe the experiment which finally led to Bohr's atomic model in detail. Which conclusion did Niels Bohr draw from the observations? What was new in comparison with Rutherford's atomic model? . (15 points)

6 Potassium (K) is an element of the first group of the periodic system of elements. Which of the following statements can be concluded just from knowing its position in the periodic system? (15 points)

a) Potassium has a single valence
b) Potassium is heavier than sodium (Na)
c) Potassium has a high melting point
d) Potassium forms ionic bonds with chlorine
e) Potassium is a semi-conductor.

7 The elements chlorine (Cl) and bromine (Br) are direct neighbors in the periodic system. Some properties of these elements are quite similar, some are quite different. Name all similarities and differences which can be postulated from their position of these two elements in the periodic system. (15 points)

8 Which statement(s) on metallic bonds are correct, which are false?* (15 points)

a) Metallic bonds never exist between atoms of different elements.
b) Metallic bonds cannot be destroyed by high temperatures
c) Metallic bonds do never occur with an element of the group VIIIa
d) Metallic bonds do never occur with an element of the group VIIb
e) Metallic bonds never connect more than two atoms

5 Describe the idea of an electron gas in a metallic lattice. What consequences regarding material properties are connected to this special condition of electrons? (15 points)

6 Which statements regarding an acid-base reaction are correct, which are false? (15 points)

a) No bonds are formed or destroyed during acid-base reactions
b) The acidity depends on the position of the reaction partners in the voltage series
c) An acid-base reaction is always connected to a redox reaction
d) Acid-base reactions are always emit heat
e) Acid-base reactions are always slow reactions

7 Which statements regarding the thermodynamics of a chemical reaction are correct, which are false? (15 points)

a) Reactions which emit heat are always reactions with a strong driving force
b) The driving force of a reaction is always connected to a decrease of G
c) A reaction which does not emit heat can be driven by formation of internal disorder
d) A catalyst changes the driving force of the reaction
e) The reaction enthalpy has no influence on the driving force

8 Which properties of polymers are direct consequences of the presence of covalent bonds and the absence of metallic or ionic bonds in their molecular structure? (15 points)

* One or several answers may be correct. Please indicate appropriately by repeating a), b), c), … followed by the statements "right" or "wrong" on your answer sheet.

**General Chemistry for ISE students: Final examination WS 2012**

(minimum point number: 50 maximum grade at 100 points maximum point number: 120)

9 Which statements on the properties of an electron are correct, which are false? *

f) An electron has a mass
g) An electron is as heavy as a neutron
h) A moving electron can be scattered like an electromagnetic wave
i) The pathway of a single accelerated electron is exactly reproducible
j) In an atom, all electrons are in the same physical state (15 points)

10 Try to compare Bohr's atomic model with Rutherford's atomic model in as many details as possible. Which are the similarities? Which new aspects are being accounted for by Bohr? Which experimental evidence supports Bohr's idea?
. (15 points)

11 The elements lithium (Li) and sodium (Na) are direct neighbors in the periodic system. Some properties of these elements are quite similar, some are different. Name all similarities and differences which can be postulated from their position of these two elements in the periodic system. (15 points)

12 Which statement(s) on compounds with metallic bonds are correct, which are false?* (15 points)

f) Compounds with metallic bonds do not melt
g) Compounds with metallic bonds do not evaporate
h) Compounds with metallic bonds always conduct electricity
i) Compounds with metallic bonds always dissolve in water
j) Compounds with metallic bonds always reflect light
k) Compounds with metallic bonds are always solid at room temperature

5 Describe the chemical bond between a hydrogen and a carbon atom. Try to use a) the valence bond model, b) the orbital model and explain the difference between these two perspectives.
(15 points)

6 Which statements regarding an acid-base reaction are correct, which are false? (15 points)

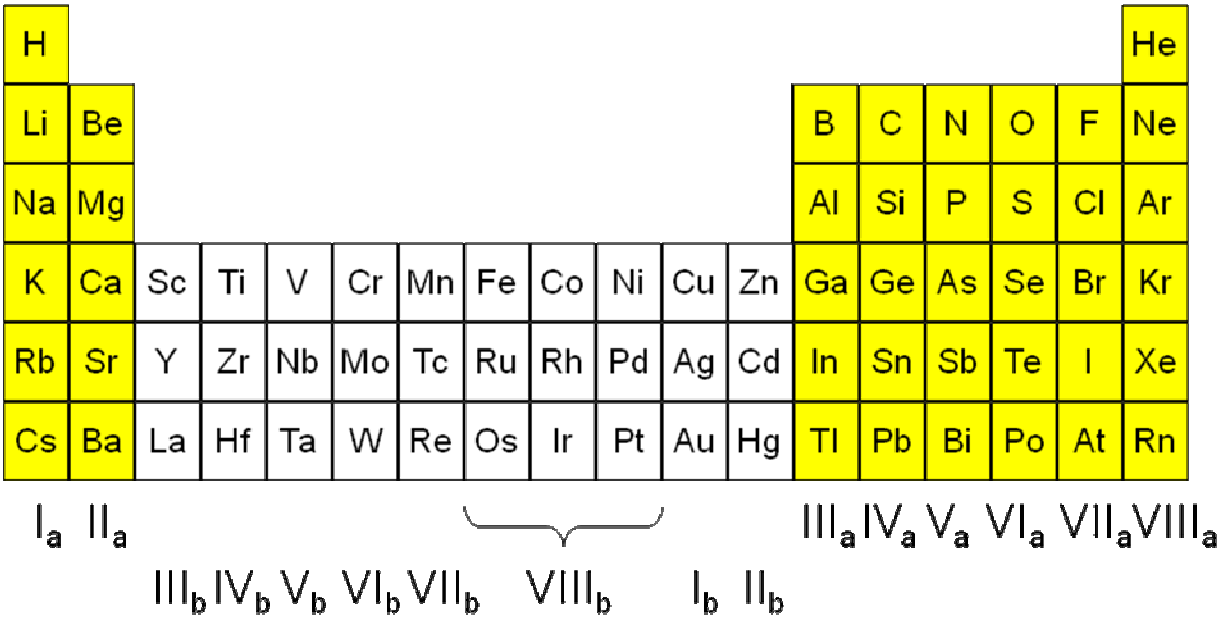
a) An acid-base reaction is always connected to a reorganization of chemical bonds
b) An acid-base reaction involves the transfer of protons
c) An acid-base reaction always involves the generation of heat
d) Acid-base reactions never occur in water
e) Acid-base reactions may affect the pH value of a solution
(15 points)

7 Why does the temperature affect the velocity of a chemical reaction? Which law describes the dependence of the reaction rate v on the temperature T? How does the activation energy $E_a$ affect this dependence?
(15 points)

8 Describe the state of a chemical equilibrium. Give an example for a chemical equilibrium. Which law is being fulfilled in this state?
(15 points)

* One or several answers may be correct. Please indicate appropriately by repeating a), b), c), … followed by the statements "right" or "wrong" on your answer sheet.

# periodic table of elements (groups $I_a$ to $VIII_a$ and groups $I_b$ to $VIII_b$)




+ lanthanides and actinides

Final exam in general chemistry March 7th 2013

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