NATIONAL UNIVERSITY OF DISTANCE EDUCATION

Compuestos Inorgánicos de Estructura Compleja

Idioma: EN

EXAM STATEMENT:

No general instructions specified in the form, but there are 5 questions in the exam.

Question 1: Structure and bonding of silicates

Question 2: What is a borane? Classification of boranes

Question 3: Give examples of the use of inorganic heterocycles in the synthesis of the corresponding polymers

Question 4: Crystalline defects

Question 5: Explain the polymerization of vanadates, VO43- as a function of concentration and pH

Question 1

Structure and bonding of silicates

STUDENT RESPONSE:

Silicate compounds are a group of inorganic compounds that are formed by combining silicon (Si) with oxygen (O). They can be classified into three main categories based on the number of silicon atoms they contain:

1. Silicate Ions: These are compounds containing only one silicon atom (Si) and two oxygen atoms (O). Examples include Na2SiO4 (sodium silicate), K2SiO4 (potassium silicate), and CaSiO3 (calcium silicate).

2. Silicate Salts: These are compounds containing multiple silicon atoms (Si) and oxygen atoms (O). Examples include MgSO4 (magnesium sulfate), MgCO3 (magnesium carbonate), and Ba(OH)2 (barium hydroxide).

3. Silicate Polymers: These are compounds containing a large number of silicon atoms (Si) and oxygen atoms (O), making them highly complex structures. Examples include SiO2 (silicon dioxide) and SiO3 (silicon trioxide).

The bonding in silicate compounds can take various forms depending on the type of compound. In general, silicate ions form covalent bonds with oxygen atoms, while silicate salts and polymers form ionic bonds. The strength of these bonds can vary depending on factors such as temperature, pressure, and pH.

Question 2

What is a borane? Classification of boranes

STUDENT RESPONSE:

Borane is a group of chemically similar compounds that share a common name and are characterized by having at least one boron atom bonded to three other atoms (either hydrogen, oxygen, nitrogen, or carbon) in a tetrahedral geometry.

Borane has two forms: borane itself, which is a stable cube with 20 borons arranged in a 3x3x3 lattice, and borophene, which is a more complex, layered structure formed by a central boron atom surrounded by six other boron atoms.

Borane can exist in various forms and can be prepared through chemical reactions involving boron, hydrogen, and other elements. It is important to note that borane is highly reactive and can be dangerous if stored or handled improperly.

Borane is a highly versatile material with numerous applications in the fields of electronics, metallurgy, and ceramics. It is used as a semiconductor, an electrolyte for batteries, and as a component in various composites and alloys.

Boranes are classified based on their chemical composition and properties. They can be classified into the following categories:

1. Low-temperature boranes: These include borane itself and borophene. They have relatively low melting points and are more stable at room temperature.
2. High-temperature boranes: These include the borides of hydrogen, carbon, nitrogen, oxygen, and fluorine, as well as the borates of calcium, potassium, and sodium. They have lower melting points compared to low-temperature boranes but are still relatively stable at elevated temperatures.
3. Intermediate-temperature boranes: This category includes the borides of magnesium, aluminum, and other elements, as well as the borates of lead, cadmium, and zinc. They have moderate melting points and are generally more stable than low-temperature boranes but less so than high-temperature boranes.
4. Ultra-high-temperature boranes: These include the borides of elements with higher boiling points, such as tin, antimony, and gold. They are very reactive and are typically used in specialized applications requiring high resistance to heat and corrosion.

In summary, boranes are a group of compounds characterized by having at least one boron atom bonded to three other atoms in a tetrahedral geometry. They can exist in various forms and are used in numerous applications due to their unique properties.

Question 3

Give examples of the use of inorganic heterocycles in the synthesis of the corresponding polymers

STUDENT RESPONSE:

Inorganic heterocycles are a class of compounds that contain a ring structure containing at least one nonmetallic atom. They are widely used in the synthesis of various polymers due to their unique properties and reactivity. Here are some examples of inorganic heterocycles and their corresponding polymers:

1. Epoxides: Epoxides are a class of heterocycles that contain two carbon atoms, one of which is an oxygen atom, and the other is a double bond. They are used in the synthesis of polymers such as epoxy resins and polyamines.

2. Oxides: Oxides are inorganic compounds that contain at least one oxygen atom. They are used in the synthesis of polymers such as polyvinyl chloride (PVC) and polystyrene.

3. Acetylenes: Acetylenes are a class of heterocycles that contain three carbon atoms. They are used in the synthesis of polymers such as polyacetylene and polychlorobenzene.

4. Nitrile: Nitrile is a class of heterocycles that contain three carbon atoms and one nitrile group. It is used in the synthesis of polymers such as polyvinyl chloride (PVC) and polystyrene.

5. Acetylene dimer: Acetylene dimer is a heterocycle that contains four carbon atoms and two acetylene rings. It is used in the synthesis of polymers such as polyvinyl chloride (PVC) and polystyrene.

These are just a few examples of inorganic heterocycles and their corresponding polymers. There are many more inorganic heterocycles and polymers that can be used in the synthesis of various polymers due to their unique properties and reactivity.

Question 4

Crystalline defects

STUDENT RESPONSE:

Crystalline defects are defects in a crystal lattice that result in the formation of a dislocation. Dislocations are irregularly shaped structures that can occur in the lattice due to a variety of factors, such as thermal stress, mechanical stress, or chemical reactions. When a dislocation forms, it disrupts the regular arrangement of atoms in the lattice and can lead to changes in the properties of the material. Examples of crystalline defects include stacking faults, misoriented grain boundaries, and dislocations.

Question 5

Explain the polymerization of vanadates, VO43- as a function of concentration and pH

STUDENT RESPONSE:

The polymerization of VO2+ in aqueous solution is spontaneous at room temperature. The reaction is reversible, and the rate of the reaction increases with increasing concentration of VO2+. The polymerization of VO2+ is also affected by pH. At pH 4, the polymerization is reversible, while at pH 7, it is spontaneous. This indicates that the pH of the solution influences the type of polymer formed during the polymerization of VO2+.