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| Selected & Constructed Response Items C3.3c |
| Explain why it is necessary for a molecule to absorb energy to break a chemical bond. |
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Selected/Constructed Response Items for Introduction to Bonding

**C3.3c:** Explain why it is necessary for a molecule to absorb energy to break a chemical bond.

1. A piece of iron is broken in two by flexing it back and forth until it weakens and falls apart the reason it falls apart is
   1. bonds are being broken and it takes energy to break bonds.
   2. the iron is being moved and it takes energy to move an object with mass.
   3. bonds are being formed and it takes energy to form bonds.
   4. the iron is reacting with oxygen in the environment and this is an endothermic reaction.

Use the following enthalpy diagram for the decomposition of hydrogen peroxide to answer the following two questions.

I H2(g) + O2(g) ΔH0 = -98.3kJ under standard conditions.

n

c

r 187.6kJ

e

a -285.9kJ H2O2 (*l*) ➝ H2O + ½O2 + Energy

s

I H2O0(*l*)

n

g

H2O(*l*) + ½O2(g)

H

Progress of Reaction

1. The transition from hydrogen peroxide (H2O2) to hydrogen and oxygen gas results in a system that has a
   1. higher potential energy and is therefore more stable.
   2. lower potential energy and is therefore more stable.
   3. higher potential energy and is therefore less stable.
   4. lower potential energy and is therefore less stable.
2. The products of this reaction result in a system that has a
   1. higher potential energy and is therefore more stable.
   2. lower potential energy and is therefore more stable.
   3. higher potential energy and is therefore less stable.
   4. lower potential energy and is therefore less stable.
3. As two atoms of hydrogen move toward each other there is an attraction between the unlike charges of the two atoms, and a repulsion between like charges of the two atoms. Eventually the attraction just balances the repulsion, at this distance
   1. moving the atoms closer together will cause a decline in the potential energy of the system.
   2. moving the atoms farther apart will cause a decline in the potential energy of the system.
   3. moving the atoms closer together or further apart has no affect on the systems potential energy.
   4. the system is at its lowest potential energy, and any change in atom position will require energy.
4. For the following reaction construct the Lewis structure for the reactant and the electron configurations for the products, and use these to explain why the reaction is endothermic.

H2O(g) → 2H(g) + O(g)

Teacher Companion Notes to Selected Constructed Response Items

for Introduction to Bonding

**High School Chemistry**

**C3.3c:** (note: this content expectation if redundant with C2.1a, so the same response items are used except the last one.)

**Question 1:**

**Difficulty:** Low, all students should be able to answer this question correctly.

**Correct answer:** **a**, a direct regurgitation of the content expectation. Also it should be relatively intuitive that bonds are breaking and that energy is being exerted to do this.

Distracter b misidentifies what the question is about.

Distracter c fails to recognize that bonds are breaking, not forming.

Distracter d misidentifies the process taking place.

**Question 2:**

**Difficulty:** Average, a well prepared student should be able to answer this question.

**Correct answer:** **c**, the student has to read the enthalpy diagram correctly, and recognize that the intermediate is at a higher energy state, then relate this to the stability of this condition.

Distracter a recognizes the higher energy state, but fails to relate this to a less stable condition.

Distracter b misreads the graph or does not recognize the intermediate.

Distracter d misreads graph and does not understand potential energy stability relationship.

**Question 3**:

**Difficulty:** Average, a well prepared student should be able to answer this question.

**Correct answer:** **b**, the student has read the enthalpy diagram correctly, and recognizes the product is at a lower energy state, then relates this to the stability of this condition.

Distracter a misreads the graph, and misunderstands the dynamic between potential energy and stability.

Distracter c misreads graph or does not recognize product.

Distracter d does not recognize dynamic between potential energy and stability.

**Question 4:**

**Difficulty:** Average, a well prepared student should be able to answer this question.

**Correct answer:** **d** the student recognizes the dynamic that allows the stability for the creation of a covalent bond.

Distracter a misunderstands that it will take energy to move the atoms closer together.

Distracter b misunderstands that it will take energy to move the atoms further apart.

Distracter c completely misunderstands the dynamic of bond formation.

**Question 5:**

**Difficulty:** High, this question may challenge the above average student.

**Note:** This question draws on background information in the course. This material should be reviewed as another way of understanding the content expectation in this unit.

**Correct answer:** The Lewis structure of the water will have noble gas electron configurations for each of the atoms in the molecule. The electron configurations for the products will be on a form other than a noble gas, indicating an unstable condition. It will take energy to transition from the more to a less stable condition.