Question No. 1 of 10

<table>
<thead>
<tr>
<th>Question</th>
<th>Instruction: (1) Read the problem statement and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.</th>
</tr>
</thead>
</table>
| Question 1. What does the arrow below indicate in a mechanism? | (A) Movement of a pair of electrons  
(B) Movement of an atom  
(C) Movement of a single electron  
(D) Movement of a positive charge  
(E) Movement of a pi bond |

| Feedback | A. Incorrect!  
A double headed arrow indicates the movement of a pair of electrons. Go back and review the terminology of mechanisms.  
B. Incorrect!  
Arrows show the movement of electrons not atoms. Go back and review the terminology of mechanisms.  
C. Correct!  
A single headed arrow indicates the movement of one electron.  
D. Incorrect!  
Positive charges never move. Only electrons move. Go back and review the terminology of mechanisms.  
E. Incorrect!  
A double headed arrow could show the movement of the two electrons from a pi bond but not a single headed arrow. Go back and review the terminology of mechanisms. |

| Solution | (1) Recall the type of arrows used in drawing mechanisms.  
There are double headed arrows and single headed arrows. Double headed arrows indicate that an electron pair is moving. A single headed arrow indicates one electron is moving. Arrows do not show the movement of atoms or the movement of a positive charge.  
(2) Read each statement and choose the correct answer.  
Therefore, the correct answer is (C). |
### Question No. 2 of 10

**Instruction:**
(1) Read the problem statement and answer choices carefully
(2) Work the problems on paper as needed
(3) Pick the answer
(4) Go back to review the core concept tutorial as needed.

**Question 2.** Which statement below regarding substitution reactions is **incorrect**?

<table>
<thead>
<tr>
<th>Option</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>Sn1 reactions occur via a concerted mechanism while Sn2 reactions occur stepwise via a carbocation intermediate.</td>
</tr>
<tr>
<td>(B)</td>
<td>Sn1 reactions have first order kinetics while Sn2 reactions have second order kinetics.</td>
</tr>
<tr>
<td>(C)</td>
<td>Protic solvents work best for Sn1 reactions while aprotic solvents work best for Sn2 reactions.</td>
</tr>
<tr>
<td>(D)</td>
<td>Sn1 reactions occur with both inversion and retention of chiral centers while Sn2 reactions occur with complete inversion of such centers.</td>
</tr>
<tr>
<td>(E)</td>
<td>In a Sn1 reaction, tertiary halides form a carbocation faster than a primary halide.</td>
</tr>
</tbody>
</table>

**Feedback**

A. Correct!  
Sn1 reactions occur stepwise via a carbocation intermediate while Sn2 reactions occur via a concerted mechanism.

B. Incorrect!  
Sn1 reactions exhibit first order kinetics. Only one molecule, the alkyl halide, is involved in the rate limiting step. Sn2 reactions exhibit second order kinetics. Two molecules, the nucleophile and the alkyl halide, are involved in the rate limiting step. Go back and review the theory and mechanisms of these reactions.

C. Incorrect!  
Protic solvents help stabilize the carbocation intermediates formed in Sn1 reactions. Sn2 reactions do not have carbocation intermediates so aprotic solvents work best for those types of reactions. Go back and review the theory and mechanisms of these reactions.

D. Incorrect!  
Because the carbocation is trigonal planar, a nucleophile can approach from either side of it unhindered. This leads to both enantiomers being formed during a Sn1 reaction (inversion and retention). Sn2 reactions lead to complete inversion because the nucleophile approaches only from the side opposite of the leaving group.

E. Incorrect!  
Sn1 reactions occur through a carbocation intermediate. The more substituted the positively charged carbon is, the more stable the carbocation. Tertiary halides will form a carbocation faster than primary halides because their carbocations are more stable.

**Solution**

(1) Recall the theory and mechanisms of substitution reactions.

Sn1 reactions occur stepwise via a carbocation intermediate while Sn2 reactions occur via a concerted mechanism. With carbocations, the more substituted the positively charged carbon is, the more stable the carbocation. Therefore, tertiary halides will form carbocations faster than primary halides because their carbocations are more stable.

It has been found that Sn1 reactions have first order kinetics while Sn2 reactions have second order kinetics. In Sn1 reactions, only one molecule, the alkyl halide, is involved in the rate limiting step. In Sn2 reactions, two molecules, the nucleophile and the alkyl halide, are involved in the rate limiting step.

Solvent also plays an important part in substitution reactions. Protic solvents, which have an acidic proton and the ability to form hydrogen bonds, work best in Sn1 reactions because they stabilize the carbocation intermediate. Polar, aprotic solvents do not contain acidic hydrogens and can not be a hydrogen bond donor. These types of solvents work best in Sn2 reactions.

In terms of stereochemistry, Sn1 reactions give both enantiomers (through inversion and retention) while Sn2 reactions give complete inversion.

(2) Read each statement carefully and determine which is incorrect.

The first statement is incorrect because Sn1 reactions are not concerted and proceed through a carbocation intermediate. Sn2 reactions are concerted.

Therefore, the correct answer is (A).
### Question 3 of 10

**Instruction:**
1. Read the problem statement and answer choices carefully
2. Work the problems on paper as needed
3. Pick the answer
4. Go back to review the core concept tutorial as needed.

Question 3. Which statement below regarding elimination reactions is **incorrect**?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Weak bases favor an E1 mechanism while strong bases favor an E2 mechanism.</td>
<td>A. Incorrect! Weak bases do favor an E1 mechanism and strong bases will favor an E2 mechanism. Go back and review the theory and mechanism of elimination reactions.</td>
</tr>
<tr>
<td>(B) Protic solvents are best for E2 reactions while aprotic solvents are best for E1 reactions.</td>
<td>B. Correct! As with Sn1 reactions, protic solvents are best for E1 reactions while, like Sn2 reactions, polar aprotic solvents are best for E2 reactions.</td>
</tr>
<tr>
<td>(C) Tertiary alkyl halides are more reactive than primary alkyl halides in both E1 and E2 reactions.</td>
<td>C. Incorrect! In both E1 and E2 reactions, tertiary halides are more reactive than primary alkyl halides. Go back and review the theory and mechanism of elimination reactions.</td>
</tr>
<tr>
<td>(D) While rearrangements are possible with an E1 mechanism, they are not possible in an E2 mechanism.</td>
<td>D. Incorrect! Because E1 reactions proceed through a carbocation intermediate, rearrangements can occur in the mechanism. E2 reactions are concerted so there is no chance for rearrangements to occur. Go back and review the theory and mechanism of elimination reactions.</td>
</tr>
<tr>
<td>(E) E1 reactions have first order kinetics while E2 reactions have second order kinetics.</td>
<td>E. Incorrect! E1 reactions, like Sn1 reactions, have first order kinetics while E2 reactions, like Sn2 reactions, have second order kinetics.</td>
</tr>
</tbody>
</table>

**Solution**

1. Recall the theory and mechanism of elimination reactions.

   E1 reactions occur stepwise via a carbocation intermediate while E2 reactions occur via a concerted mechanism. Because of this difference in the mechanisms, rearrangements are possible for E1 reactions but not E2 reactions. Another difference in the mechanisms of these reactions is that E1 reactions have first order kinetics while E2 have second order kinetics. Solvent also plays an important part in elimination reactions. Protic solvents, which have an acidic proton and the ability to form hydrogen bonds, work best in E1 reactions because they stabilize the carbocation intermediate. Polar, aprotic solvents do not contain acidic hydrogens and can not be a hydrogen bond donor. These types of solvents work best in E2 reactions. Weak bases will favor an E1 mechanism and strong bases favor E2. In terms of alkyl halides, tertiary halides are most reactive in both instances.

2. Read each statement and choose the one that is incorrect.

   Based on our knowledge of elimination reactions, we know that the second statement is incorrect. Protic solvents are best for E1 reactions not E2. Polar aprotic solvents are best for E2 reactions.

Therefore, the correct answer is (B).
<table>
<thead>
<tr>
<th>Question</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 4. Below is a step from the mechanism of the addition of HX over an alkene without the arrows draw in. Which choice below correctly describes how the arrows should be drawn in?</td>
<td>(1) Recall the rules of drawing arrows in a mechanism. There are double headed arrows and single headed arrows. Double headed arrows indicate that an electron pair is moving. A single headed arrow indicates one electron is moving. Arrows do not show the movement of atoms or the movement of a positive charge. Arrows are always drawn from the nucleophile to the electrophile. (2) Identify the nucleophile and electrophile in the reaction above. The pi electrons of the double bond act as the nucleophile while the hydrogen of HBr is the electrophile. Thinking about what should occur in this reaction prior to reading the statements will help you identify the correct answer. (3) Read each statement and determine which is correct. Since this is not a radical reaction, we can eliminate statement (D) because it describes using single headed arrows. We are looking for the statement that describes drawing an arrow from the pi bond of the alkene to the hydrogen of HBr. Another arrow should be used to show the HBr bond breaking and the electrons going to the bromine. Statement (B) correct describes how the arrows should be drawn in the first step of the mechanism. Therefore, the correct answer is (B). TIP: It might help to draw out the arrows as described in each statement to help you determine the correct answer.</td>
</tr>
<tr>
<td>(A) A double headed arrow drawn from the least substituted carbon of the alkene to the hydrogen of HBr; a double headed arrow drawn from the H-Br bond to the bromine.</td>
<td>A. Incorrect! What part of the alkene is doing the actual attacking of the HBr? The carbon or the pi electrons of the double bond? Arrows should never be used to show atom movements. They are intended to show electron movements only. Go back and review the rules for drawing arrows in mechanisms.</td>
</tr>
<tr>
<td>(B) A double headed arrow drawn from the pi bond of the alkene to the hydrogen of HBr; a double headed arrow drawn from the H-Br bond to the bromine.</td>
<td>B. Correct! The pi electrons are acting as the nucleophile in this mechanism so a double headed arrow should be drawn from the bond to the electrophile under attack (the hydrogen here). The hydrogen-bromine bond will break with the electrons going to bromine so a double headed arrow needs to be drawn from the bond to the bromine.</td>
</tr>
<tr>
<td>(C) A double headed arrow drawn from the most substituted carbon of the alkene to the hydrogen of HBr; a double headed arrow drawn from the H-Br bond to the bromine.</td>
<td>C. Incorrect! What part of the alkene is doing the actual attacking of the HBr? The carbon or the pi electrons of the double bond? Arrows should never be used to show atom movements. They are intended to show electron movements only. Go back and review the rules for drawing arrows in mechanisms.</td>
</tr>
<tr>
<td>(D) A single headed arrow drawn from the least substituted carbon of the alkene to the hydrogen of HBr; a double headed arrow drawn from the H-Br bond to the bromine.</td>
<td>D. Incorrect! Remember that a single headed arrow indicates the movement of just one electron. This type of arrow is usually seen in radical mechanisms. Is this a radical mechanism? Go back and review the rules for drawing arrows in mechanisms.</td>
</tr>
<tr>
<td>(E) A double headed arrow drawn from the least substituted carbon of the alkene to the bromine of the HBr; a double headed arrow drawn from the H-Br bond to the hydrogen.</td>
<td>E. Incorrect! What part of the alkene is doing the actual attacking of the HBr? The carbon or the pi electrons of the double bond? Arrows should never be used to show atom movements. They are intended to show electron movements only. Also, what species act as the nucleophile and as the electrophile? Go back and review the rules for drawing arrows in mechanisms.</td>
</tr>
</tbody>
</table>
### Question No. 5 of 10

**Instruction:**
1. Read the problem statement and answer choices carefully.
2. Work the problems on paper as needed.
3. Pick the answer.
4. Go back to review the core concept tutorial as needed.

<table>
<thead>
<tr>
<th>Question</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(B) II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(C) III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(D) IV</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>(E) V</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

**Question 5.** Which carbocation intermediate below will undergo a rearrangement and form the most stable carbocation compared to the others?

- **A. Correct!** This secondary carbocation will rearrange to form a tertiary benzylic carbocation. Compared to the rearranged carbocations created by the other choices, this is the most stable one.
- **B. Incorrect!** This secondary carbocation will rearrange to form a tertiary carbocation. Compared to the rearranged carbocations created by the other choices, this is not the most stable one.
- **C. Incorrect!** This secondary carbocation will rearrange to form a tertiary carbocation. Compared to the rearranged carbocations created by the other choices, this is not the most stable one.
- **D. Incorrect!** This primary carbocation will rearrange to form a secondary carbocation. Compared to the rearranged carbocations created by the other choices, this is not the most stable one.
- **E. Incorrect!** This primary carbocation is not capable of rearranging to a more stable carbocation. Look at the other choices and see which might give the most stable rearranged carbocation.

**Solution**

1. **Identify the classification of each carbocation listed.**

   Recall that carbocations are classified by the number of carbons attached to the positively charged carbon. Primary carbocations have one carbon attached to the positively charge carbon, secondary carbocations have two attached, etc. Look at each cation above and classify it. I is a secondary carbocation. II is a secondary carbocation. III is a secondary carbocation. IV is a primary carbocation. V is a primary carbocation.

2. **Determine what kind of rearrangement is possible in each choice and what kind of carbocation would be generated by any rearrangement.**

   - I can undergo a 1,2-hydride shift to form a tertiary benzylic carbocation.
   - II can undergo a 1,2-hydride shift to form a tertiary carbocation.
   - III can undergo a 1,2-methyl shift to form a tertiary carbocation.
   - IV can undergo a 1,2-hydride shift to form a secondary carbocation.
   - V can not undergo any rearrangements that would lead to a more stable carbocation.

   ![Diagrams showing rearrangements](image)

   The tertiary benzylic carbocation formed by I is the most stable of the five.

   Therefore, the correct answer is (A).

   **TIP:** Draw each initial carbocation. Include all hydrogens, etc. Figure out if a 1,2-hydride or methyl shift occurs and then draw the carbocation that would result. Classify each one.
**Question No. 6 of 10**

**Instruction:** (1) Read the problem statement and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.

**Question 6.** What is the product of the following reaction?

![Diagram of the reaction]

(A) I  
(B) II  
(C) III  
(D) IV  
(E) V

**Feedback**

A. Incorrect!  
A ketone would not be obtained as the final product under these conditions. Go back and review what LDA is and how it reacts.

B. Correct!  
The LDA deprotonates the α-hydrogen of the aldehyde. The resulting enolate attacks the alkyl bromide so the final product is the alkylated aldehyde.

C. Incorrect!  
An alcohol would not be obtained as the final product under these conditions. Go back and review what occurs in the alkylation of carbonyl compounds with LDA.

D. Incorrect!  
An alcohol would not be obtained as the final product under these conditions. Go back and review what occurs in the alkylation of carbonyl compounds with LDA.

E. Incorrect!  
An ester would not be obtained as a product under these conditions. Go back and review what occurs in the alkylation of carbonyl compounds with LDA.

**Solution**

(1) Recall the reactions covered in this tutorial.

The tutorial covered substitution reactions, elimination reactions, carbocation rearrangements, addition reactions, nucleophilic addition reactions, electrophilic aromatic addition reactions, acid-base reactions, radical reactions, and anionic reactions.

(2) Determine what kind of reaction is taking place.

To determine what kind of reaction is taking place, you will first need to identify the reactants being used in the reaction. The starting material is an aldehyde. The other reactants are lithium diisopropyl amide (a strong bulky base) and a primary alkyl halide. You may have already recognized this reaction as the α-alkylation of a carbonyl compound. If you did not, go back and review the reactions in this tutorial.

In this type of reaction, one of the acidic α-hydrogens is deprotonated with the strong, bulky base called lithium diisopropyl amide (LDA for short). (Note that deprotonated amines are called amides so do not confuse these strongly basic amines with the functional group called amides.) The deprotonation forms a species called an enolate which is nucleophilic. The enolate attacks an electrophile which is an alkyl bromide in this case. The final product is a newly α-alkylated carbonyl compound.

(3) Predict the product(s).

Based on what we know about the reaction, we can predict that the product should be an alkylated aldehyde.

Therefore, the correct answer is (B).
Question No. 7 of 10

**Instruction:**
(1) Read the problem statement and answer choices carefully
(2) Work the problems on paper as needed
(3) Pick the answer
(4) Go back to review the core concept tutorial as needed.

**Question**
What kind of bond formation is shown below?

![Bond Formation](image)

- (A) Homolytic
- (B) Heterolytic
- (C) Homogenic
- (D) Heterogenic
- (E) None of the above.

**Feedback**

- **A. Incorrect!**
  Homolytic refers to a type of bond breakage, not formation. Go back and review the terminology of reactions in this tutorial.

- **B. Incorrect!**
  Heterolytic refers to a type of bond breakage, not formation. Go back and review the terminology of reactions in this tutorial.

- **C. Incorrect!**
  Homogenic refers to a type of bond formation where each atom donates an electron to the bond. Go back and review the terminology of reactions in this tutorial.

- **D. Correct!**
  Heterogenic bond formation occurs when one reactant, in this case the alkoxide ion, donates both electrons for the bond.

- **E. Incorrect!**
  The correct answer may be found in choices above. Go back and review the terminology of reactions in this tutorial.

**Solution**

(1) Recall the definitions pertaining to mechanisms learned in this tutorial.

There are two types of bond formation that were discussed in this tutorial. Heterogenic bond formation describes the process of forming a bond between two atoms where one atom donates both electrons for the bond. Homogenic bond formation describes the process of forming a bond between two atoms where each atom donates an electron to the bond.

(2) Determine which process is taking place in the above example.

In the example above, one can see that a double headed arrow indicating two electrons from the nucleophilic oxygen attacking the electrophilic hydrogen. The oxygen is donating both electrons to form a bond with the hydrogen.

Therefore, the correct answer is (D).
<table>
<thead>
<tr>
<th>Question</th>
<th>Question 8. Choose the phrase that appropriately completes the following sentence.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In a polar reaction:</td>
</tr>
<tr>
<td></td>
<td>(A) An electrophile attacks a nucleophile.</td>
</tr>
<tr>
<td></td>
<td>(B) A nucleophile attacks an electrophile.</td>
</tr>
<tr>
<td></td>
<td>(C) The temperature is kept below 0 °C.</td>
</tr>
<tr>
<td></td>
<td>(D) Radicals are generated.</td>
</tr>
<tr>
<td></td>
<td>(E) An electron poor species attacks an electron rich species.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feedback</th>
<th>A. Incorrect! Electrophiles, which are electron poor species, never attack nucleophiles. Go back and review the terminology of mechanisms.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedback</td>
<td>B. Correct! Nucleophiles, which are electron rich species, attack electrophiles to form bonds in polar reactions.</td>
</tr>
<tr>
<td>Feedback</td>
<td>C. Incorrect! Polar does not refer to the temperature of a reaction. Polar refers to polarity and charges. Go back and review the terminology of mechanisms.</td>
</tr>
<tr>
<td>Feedback</td>
<td>D. Incorrect! Radicals are neutral species with an unpaired electron. Remember, polar refers to polarity and charges. Radicals are not generated in a polar reaction. Go back and review the terminology of mechanisms.</td>
</tr>
<tr>
<td>Feedback</td>
<td>E. Incorrect! An electron poor species is the same as an electrophile. An electron rich species is the same as a nucleophile. Electrophiles do not attack nucleophiles. Go back and review the terminology of mechanisms.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution</th>
<th>(1) Recall the definitions of mechanisms covered in this tutorial.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solution</td>
<td>In a polar reaction, a nucleophile attacks an electrophile. Electrophiles never attack nucleophiles. Remember, electrons flow from the electron rich species to the electron poor species. Arrows show movement of electrons only.</td>
</tr>
<tr>
<td>Solution</td>
<td>Therefore, the correct answer is (B).</td>
</tr>
</tbody>
</table>
Question 9. In an Sn1 reaction, which is the slow step?

(A) Formation of a carbocation intermediate.
(B) Attack of a nucleophile.
(C) There is no slow step as the reaction is concerted, not stepwise.
(D) Attack of an electrophile.
(E) Removal of a proton from an adjacent carbon by the base.

Feedback

A. Correct!
Formation of the positively charged carbocation intermediate is the slow step in an Sn1 reaction.

B. Incorrect!
Attack of a nucleophile is the fast step in an Sn1 reaction. Go back and review the facts on Sn1 reactions.

C. Incorrect!
Sn1 reactions are stepwise and not concerted like Sn2 reactions. Go back and review the facts on Sn1 reactions.

D. Incorrect!
Remember, electrophiles do not attack anything. They themselves are attacked. Go back and review the facts on Sn1 reactions.

E. Incorrect!
Removal of a proton from an adjacent carbon by a base actually describes E1 and E2 reactions, not Sn1 reactions. Go back and review the facts on Sn1 reactions.

Solution

(1) Recall the facts of Sn1 reactions that were covered in the tutorial.

Sn1 reactions occur stepwise via a carbocation intermediate while Sn2 reactions occur via a concerted mechanism. With carbocations, the more substituted the positively charged carbon is, the more stable the carbocation. Therefore, tertiary halides will form carbocations faster than primary halides because their carbocations are more stable.

It has been found that Sn1 reactions have first order kinetics while Sn2 reactions have second order kinetics. In Sn1 reactions, only one molecule, the alkyl halide, is involved in the rate limiting step. This fact indicates the slow step of the reaction is the formation of the carbocation intermediate. In Sn2 reactions, two molecules, the nucleophile and the alkyl halide, are involved in the rate limiting step.

Solvent also plays an important part in substitution reactions. Protic solvents, which have an acidic proton and the ability to form hydrogen bonds, work best in Sn1 reactions because they stabilize the carbocation intermediate. Polar, aprotic solvents do not contain acidic hydrogens and can not be a hydrogen bond donor. These types of solvents work best in Sn2 reactions.

In terms of stereochemistry, Sn1 reactions give both enantiomers (through inversion and retention) while Sn2 reactions give complete inversion.

(2) Read the question and possible choices carefully and determine the correct answer.

The slow step for a Sn1 reaction is the formation of the carbocation intermediate.

Therefore, the correct answer is (A).
Question No. 10 of 10

Instruction: (1) Read the problem statement and answer choices carefully (2) Work the problems on paper as needed (3) Pick the answer (4) Go back to review the core concept tutorial as needed.

<table>
<thead>
<tr>
<th>Question</th>
<th>Feedback</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 10. What term best describes the reaction below?</td>
<td>A. Correct! This step illustrates an initiation step in a radical mechanism.</td>
</tr>
<tr>
<td><img src="image" alt="Reaction" /></td>
<td>B. Incorrect! Propagation refers to a step in a radical mechanism where radicals are both formed and consumed. Here, radicals are only formed. Go back and review the basics of radical mechanisms.</td>
</tr>
<tr>
<td>(A) Initiation</td>
<td>C. Incorrect! Termination refers to a step in a radical mechanism where radicals are consumed. Here, radicals are only formed. Go back and review the basics of radical mechanisms.</td>
</tr>
<tr>
<td>(B) Propagation</td>
<td>D. Incorrect! Polar covalent refers to a type of bond between atoms whose electronegativities differ. Go back and review the basics of radical mechanisms.</td>
</tr>
<tr>
<td>(C) Termination</td>
<td>E. Incorrect! Ionic refers to a type of bonding between a metal and nonmetal. Go back and review the basics of radical mechanisms.</td>
</tr>
<tr>
<td>(D) Polar covalent</td>
<td></td>
</tr>
<tr>
<td>(E) Ionic</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Recall the reactions covered in this tutorial.</td>
<td></td>
</tr>
<tr>
<td>The tutorial covered substitution reactions, elimination reactions, carbocation rearrangements, addition reactions, nucleophilic addition reactions, electrophilic aromatic addition reactions, acid-base reactions, radical reactions, and anionic reactions.</td>
<td></td>
</tr>
<tr>
<td>(2) Determine what kind of reaction is taking place.</td>
<td></td>
</tr>
<tr>
<td>To determine what kind of reaction is taking place, you will first need to identify the reactants being used in the reaction. The starting material is bromine. There are no other reactants but heat/light which causes a homolytic bond breakage of the bromine-bromine bond. You may have already recognized this reaction as one of the steps from a radical halogenation reaction. If you did not, go back and review the reactions in this tutorial.</td>
<td></td>
</tr>
<tr>
<td>(3) Recall the different steps in a radical halogenation reaction.</td>
<td></td>
</tr>
<tr>
<td>Radical halogenation reactions occur in three steps. In initiation, radicals are formed. In propagation steps, radicals are both consumed and formed. And finally, in termination steps, radicals are consumed. By looking at the example above, one can see radicals are formed. This is an example of an initiation step. Therefore, the correct answer is (A).</td>
<td></td>
</tr>
</tbody>
</table>