1. Provide a mechanism

![Mechanism Diagram]

2. Provide a structure for A and a mechanism for the conversion to B

![Mechanism Diagram]

3. Circle the product, and explain using your knowledge of molecular orbitals of the following transformation

![Reaction Diagram]

4. Biochemically, vitamin D is made from dehydrocholesterol by sequential electrocyclic ring opening and a 1,7-sigmatropic shift as shown below.

![Reaction Diagram]

a. Is step 1 photochemical or thermal? Explain in detail using molecular orbital arguments.
b. We discussed in class that 1,5 sigmatropic hydride shifts are allowed, but that 1,3 hydride shifts are not allowed. Step 2 is a 1,7 sigmatropic hydride shift. Explain why this step is allowed (this is a challenging question)