1-3) A section of the molecular orbital diagram for acetone is shown below.

![Molecular orbital diagram](image)

i) Label the levels as $n$, $\pi$, and $\pi^*$

ii) Draw in box A the electrons after an allowed $n \rightarrow \pi^*$ transition.

iii) Draw in box B the electrons after an allowed $\pi \rightarrow \pi^*$ transition.

4-6) Photochemical excitation of carbonyl compounds is typically via $n \rightarrow \pi^*$ transition, and we often represent the photochemically excited state as the below diradical.

![Photochemical excitation](image)

i) Draw curly arrows to account for this transformation.

ii) List two limitations or drawbacks of using this Lewis structure to represent the excited state.
7-10) Provide a mechanism for the following reaction.
THE NEXT SECTION HAS 4 PROBLEMS (A) – (D) EACH WORTH 5 PTS ANSWER ANY 3 (For a total of 15 pts)
A) Provide a mechanism for the following reaction.
B) Provide a mechanism for the following reaction.
C) Provide a mechanism for the following reaction.
D) Provide a mechanism for the following reaction.
BONUS QUESTION (up to 3 points)

Explain what is happening in this diene isomerization.
1-3) A section of the molecular orbital diagram for acetone is shown below.

\[ \text{Energy} \]
\[ \text{\(1\)} \]
\[ \text{\(\Pi^*\)} \]
\[ \text{\(\Pi\)} \]
\[ \text{\(\text{A} \)} \]
\[ \text{\(\text{B} \)} \]

i) Label the levels as \(n\), \(\pi\), and \(\pi^*\)

ii) Draw in box A the electrons after an allowed \(n \rightarrow \pi^*\) transition.

iii) Draw in box B the electrons after an allowed \(\pi \rightarrow \pi^*\) transition.

4-6) Photochemical excitation of carbonyl compounds is typically via \(n \rightarrow \pi^*\) transition, and we often represent the photochemically excited state as the below diradical.

\[ \text{\(\text{O} \)} \hspace{.5cm} \text{hv} \hspace{.5cm} \text{\(\text{O} \)} \]

i) Draw curly arrows to account for this transformation.

ii) List two limitations or drawbacks of using this Lewis structure to represent the excited state.

(a) It is not accurate, since the Lewis structure implies the \(\Pi\) bonding electrons are moving (whereas it is the \(n\), lone pair electron).

(b) It provides no information about the spin multiplicity (meaning Singlet or Triplet state).
7-10) Provide a mechanism for the following reaction.
A) Provide a mechanism for the following reaction.
B) Provide a mechanism for the following reaction.
C) Provide a mechanism for the following reaction.

\[ \text{[Mechanism diagram with steps and reactants]} \]
D) Provide a mechanism for the following reaction.
**BONUS QUESTION (up to 3 points)**

Explain what is happening in this diene isomerization.

\[
\text{Ph} - \text{C} = \text{Ph} \xrightarrow{hv} \left[ \begin{array}{c} \text{Ph} \\ \text{C} \end{array} \right]^{*} \xrightarrow{} \text{Ph} - \text{C} = \text{Ph} \& \text{Ph} - \text{C} = \text{Ph}
\]

The molecule gets excited, and then it transfers its energy to the diene.

\[
\left[ \text{Ph} - \text{C} = \text{Ph} \right]^{*} + \text{Ph} - \text{C} = \text{Ph} \rightarrow \text{Ph} - \text{C} = \text{Ph} \& \left[ \text{Ph} - \text{C} = \text{Ph} \right]^{*}
\]

The excited diene can be portrayed as a di-radical...

\[
\left[ \text{Ph} - \text{C} = \text{Ph} \right]^{*} \approx \text{Ph} - \text{C} = \text{Ph} \rightarrow \text{Ph} - \text{C} = \text{Ph} \rightarrow \text{Ph} - \text{C} = \text{Ph}
\]

...which can rotate around, until it relaxes back to the diene in a lower energy (more stable "trans") conformation.

This is an example of the molecule acting as a SENSITIZER (indirectly exciting another molecule).