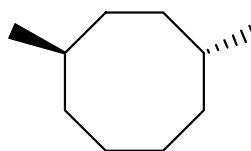
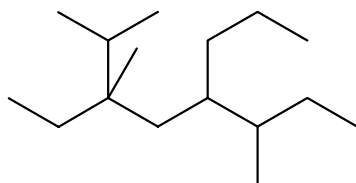


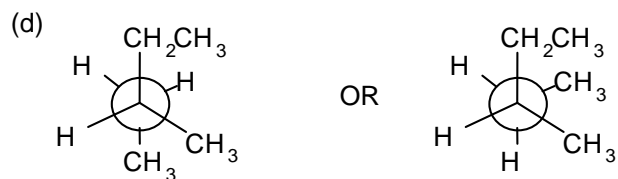
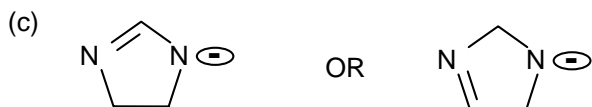
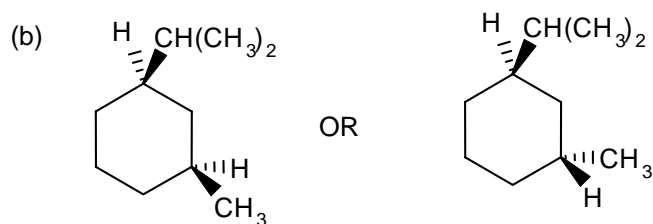
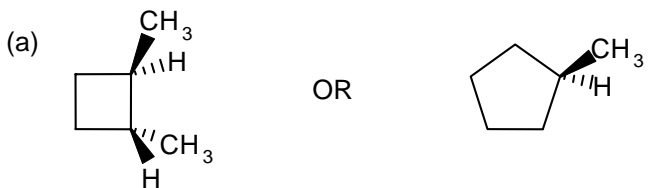
YOUR NAME \_\_\_\_\_

150 points total. Please answer directly onto the exam paper. You may use molecular models.

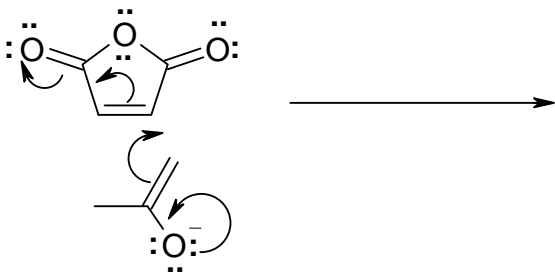
1. (14 points) Give a systematic name for both of the following compounds, including cis/trans where appropriate:



2. (30 points) Which is the more stable structure in each the following pairs?

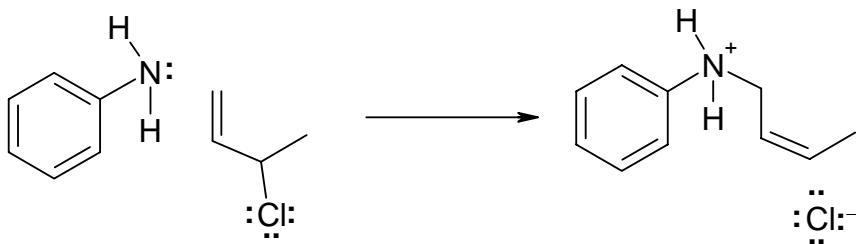


3. (15 points) (a) What is the product of the following reaction?



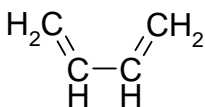
(b) Indicate (on the above diagram) which reactant is acting as the nucleophile, and which is acting as the electrophile.

4. (15 points) (a) Use curved arrows to indicate the electron flow in the following reaction:



(b) Indicate (on the above diagram) which reactant is acting as the nucleophile, and which is acting as the electrophile.

5. (10 points) Draw the pi bonding MOs for 1,3-butadiene (shown below):



6. (30 points) (a) Draw an energy curve, and draw the six main conformations of butane. Show how these conformations correspond to the maxima and minima.

(a) What MO orbitals are present in the carbon2-carbon3 bond in butane?

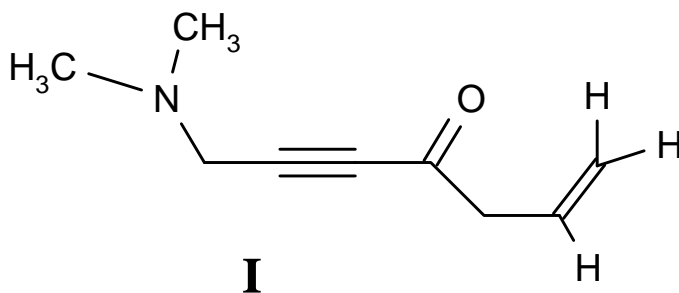
(b) What MO orbitals are present in the carbon2-carbon3 bond in 2-butene ( $\text{CH}_3\text{CH}=\text{CHCH}_3$ )?

(c) Considering your answers to (b) and (c), explain briefly why there is free rotation\* about the C2-C3 single bond in butane but not in the C2-C3 double bond in 2-butene.

---

\* On Earth at 25 °C.

7. (20 points) All parts of this question relate to the structure **I** shown below.



(a) Indicate the hybridization of each atom (except hydrogens) in **I**.

(b) Draw a structure for the conjugate acid of **I**, at the amine position.

(c) List all functional groups present in **I**.

8. (16 points) Draw all major resonance forms for the following compound, and indicate which is the most important contributor.

