This is an open-book, open notes exam. Please show your work in detail.

1. (20 points) Draw the structures of B and C, and give IUPAC names for A, B, and C. You do not have to show mechanisms, but you do need to show stereochemistry clearly.

   A
   (1S, 3S)-3-methylcyclohexanol

   B
   C
   (1R, 3S)-1-bromo-3-methylcyclohexane

   1-((1R, 3S)-3-methylcyclohexyl)ethanone

2. (20 points) Indicate the expected major product. Explain your reasoning in detail.
3. (20 points) Outline the synthesis steps to convert D into E. In addition to D, you may use any piece that contributes three or fewer carbons to the final product.

\[ \text{TsCl, pyridine} \]

\[ \text{MgCl} \]

\[ \text{MCPBA} \]

\[ \text{CH}_3\text{MgBr} \]

4. (20 points) Deduce the structure of F, and draw an arrow-pushing mechanism for the transformation.

**1^3C NMR**
- 14.6, q
- 53.0, d
- 127.5, d
- 128.3, d (2)
- 129.0, d (2)
- 137.8, s
- 200.8, d

**1^H NMR**
- 1.42, d, J = 7.3 Hz, 3H
- 3.63, dq, J = 4.2, 7.3 Hz, 1H
- 7.22, dd, J = 8.1, 2.4 Hz, 2H
- 7.31, dd, J = 8.1, 8.2 Hz, 2H
- 7.38, td, J = 8.2, 2.4 Hz, 1 H
- 9.65, d, J = 4.2 Hz, 1H
5. (20 points) Draw a detailed arrow-pushing mechanism for the following transformation. 5/20 points for correctly showing the mapping of the starting material onto the product.