This is an open-book, open notes exam. No electronic devices are allowed.
1. (5 points each) These reactions would not proceed as indicated. Please draw the correct product of each reaction.

a. \[
\text{Br} - \text{CH}_3\text{CO}_2\text{CH}_3 \xrightarrow{\text{LiAlH}_4} \text{OH}
\]

b. \[
\text{Br} - \text{CN} \xrightarrow{\text{LDA}; \text{Cl}} \text{CN}
\]

c. \[
\text{OCH}_3 \xrightarrow{\text{CuCN}} \text{CN}
\]

d. \[
\text{NO}_2 \xrightarrow{\text{Br}_2 \text{FeBr}_3} \text{Br}
\]

2. (20 points) Circle the correct product, and explain why.

\[
\text{alkene geometry retained}
\]

\[
\text{more stable carbocation}
\]

\[
\text{carbonyl endo}
\]
3. (20 points) Outline a synthetic route to A. You may use any starting materials that contribute three or fewer carbons to the final product.

![Synthetic route to A](image)

4. (20 points) Deduce the structure of C, and outline an arrow-pushing mechanism for its formation. For the mechanism, assume that the active reagent is I⁺.

![Deduction of C and mechanism](image)

**13C NMR**
- 159.5, s
- 137.5, d
- 136.5, s
- 129.5, d
- 111.6, d
- 87.4, s
- 64.3, t
- 57.6, q

**1H NMR**
- 2.3, bd, 1H (exchanges)
- 3.78, s, 3H
- 4.50, s, 2H
- 6.52, d, J = 7.8 Hz, 1H
- 7.45, m, 2H
5. (20 points) Draw an arrow-pushing mechanism for the conversion of D to E. Correct labelling is worth three points, and correct bb/bf an additional three points.

\[ \text{Et}_3\text{N}: \]

\[ \text{Br}^\text{c-d} \]

\[ \text{CO}_2\text{Et} \]

\[ \text{Et}_3\text{N} \]

\[ \text{a-b} \]

\[ \text{c-S} \]

\[ \text{c-H} \]

\[ \text{H-N} \]