1.   Predict the products of the following reactions of 1-methylcyclohexene.
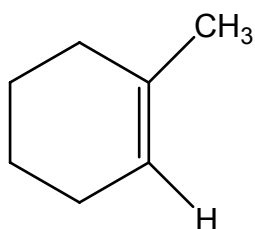
1. Hg(OAc)$_2$

2. NaBH$_4$

Br$_2$/H$_2$O

1. CH$_3$CO$_3$H

2. H$_3$O$^+$

1. O$_3$

2. H$_2$O$_2$

1. B$_2$H$_6$

2. H$_2$O$_2$/NaOH
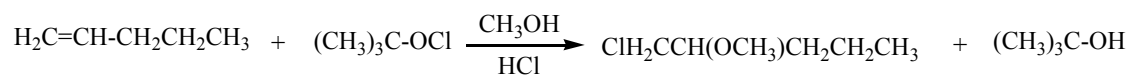
2.	There are two dicarboxylic acids with the formula $HO_2CHC=CHCO_2H$. One dicarboxylic acid is called maleic acid; the other is called fumaric acid. In 1880, Kekulé found that on treatment with cold dilute $KMnO_4$ maleic acid yields *meso*-tartaric acid and fumaric acid yields (±)-tartaric acid. Show how this transformation allows one to write stereochemical formulas for maleic acid and fumaric acid.

3.	Suggest an efficient, multi-step preparation for each of the following compounds from the indicated starting materials. The compounds should be free of major amounts of isomeric side-products.

(a) $\longrightarrow$ $HOOC(CH_2)_4COOH$

(b) $(CH_3)_2CHCH_2CH_3$ $\longrightarrow$ $(CH_3)_2CHCHOHCH_3$

(c) $\longrightarrow$

(d) $\longrightarrow$
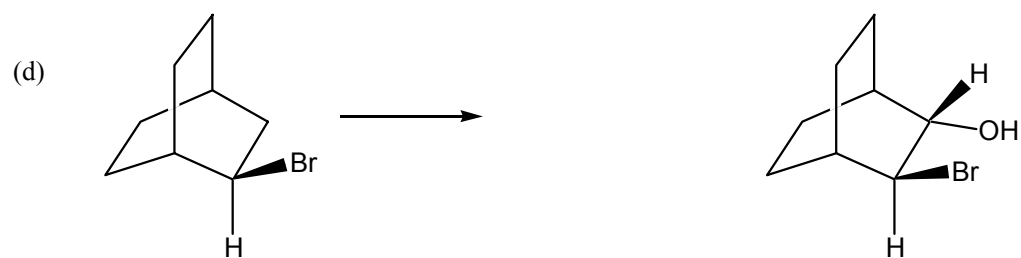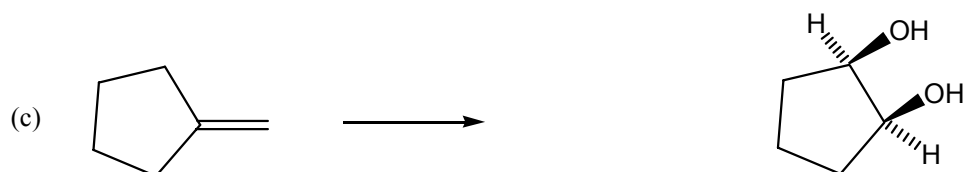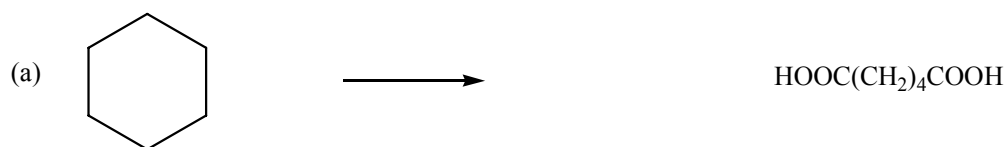
4.   Provide a reasonable mechanism to account for the following observation.

$H_2C=CH-CH_2CH_2CH_3$ + $(CH_3)_3C-OCl$ $\xrightarrow[\text{HCl}]{\text{CH}_3\text{OH}}$ $ClH_2CCH(OCH_3)CH_2CH_2CH_3$ + $(CH_3)_3C-OH$

Note: When halogens are dissolved in water, hypohalous acids (HOX) are formed. Hypohalous acids are weak bases that can be protonated on oxygen to yield the strong electrophiles, XOH_2^+, which react with alkenes to yield halohydrins.

$$X_2 \quad + \quad H_2O \quad \rightleftharpoons \quad HOX \quad + \quad HX$$

$$HOX \quad + \quad HX \quad \rightleftharpoons \quad XOH_2^+ \quad + \quad X^-$$