

## Solutions

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Original authored guidance; equivalent structural formulae are accepted.

**2.1**  $C_6H_{10}$ . One ring removes two hydrogens relative to acyclic hexene  $C_6H_{12}$ , while both already contain a double bond.

**2.2** Hydrogen with nickel catalyst gives ethane. Steam with an acid catalyst gives ethanol. Cold dilute acidified potassium manganate(VII) gives ethane-1,2-diol. Strong hot oxidation is not the specified diol-producing method.

**2.3** Pent-1-ene can be the decolourising liquid, cyclopentane the other. Both have  $C_5H_{10}$ , but one has  $C=C$  and the other a saturated ring; the formula does not reveal connectivity. The test supports unsaturation rather than uniquely proving pent-1-ene.

**3.1** But-1-ene,  $CH_2=CHCH_2CH_3$ . The two original double-bond carbons become adjacent backbone carbons; the attached ethyl group remains a side group.

**3.2** Each double-bond carbon must have two different groups. In 2-methylpropene,  $CH_2=C(CH_3)_2$ , one carbon has two H and the other two methyl groups, so it cannot show E/Z isomerism. In pent-2-ene,  $CH_3CH=CHCH_2CH_3$ , each has H plus a different carbon group, so E and Z forms are possible. Restricted rotation about  $C=C$  allows these forms to remain distinct; different groups somewhere in the molecule is insufficient.

**3.3** Recycling can conserve feedstock but needs collection/sorting and suitable clean material. Incineration can recover energy, but relevant toxic gases must be removed and carbon emissions remain. Biodegradable alternatives may reduce persistence, but breakdown needs suitable conditions, organisms, time and often industrial composting. They do not automatically degrade rapidly in a cold sea or landfill, and must not be treated as permission to litter. Accept other linked scientific tradeoffs.