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15-1 The answer in the book is adequate.

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15-3 The answer in the book is adequate.

15-4 The key here is that if benzene really had alternating single and double bonds, the distance between pairs of carbons would not be the same: those sharing two bonds would be closer to each other. For a benzene with two substituents on adjacent carbon atoms, those carbons could share either two or four electrons and thus there would be two isomers.

15-5 Cyclobutene is strained, even more so than a saturated four-membered ring because of the sp^2 -hybridized carbons in the ring. Opening of the ring releases this strain. In the conversion of cyclobutene to 1,3-butadiene, the bond changes (net, one π bond is broken and one σ bond is made between carbons) would have the reaction endothermic by about 20 kcal/mole. However, the release of the strain energy more than compensates for the bond energy changes, resulting in an exothermic reaction.

15-6 The answer in the book is adequate.

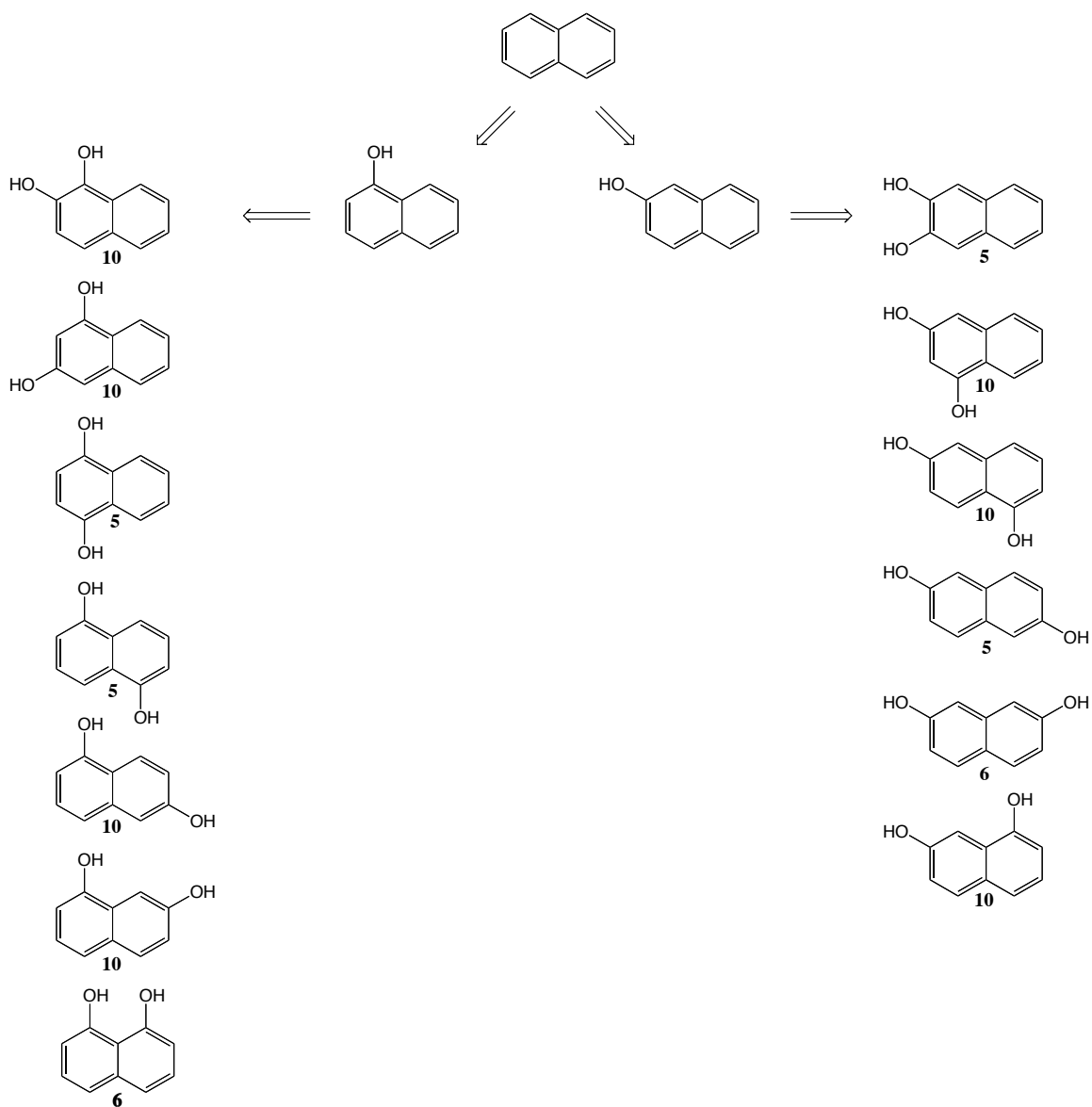
15-7 This exercise is worked out in the book as "Working with Concepts".

15-8 Chill. This is way too difficult an exercise for a sophomore course.

15-9 The answer in the book is adequate.

15-10 This is a much more reasonable spectral problem. From the statement that we have a substituted naphthalene and the formula, we can conclude that there are either two OH groups attached or and OOH group as the formula has two oxygen atoms in addition to the carbons and hydrogens of naphthalene. However, no matter where we placed an OOH group, all of the carbon atoms would be unique and from the observation of only six resonances in the carbon spectrum, we can conclude that there is symmetry in the molecule and that it has two OH groups. We can find the symmetrical candidates either by intuition, or by drawing out ALL possible naphthalenes with two OH groups. Let's take the latter approach.

There are only two unique places to add the first OH group, and having done so, we see that all of the carbons are now unique. We can then derive all of the possible isomers by adding the second OH group in turn to each of the remaining carbons (except for the two bridgehead carbons). In doing so, we will obtain some duplicates (find them yourself) but do not be concerned for at this point we are going to reject most of the structures as they will have too many unique carbon atoms.



Of all of these, only two have six unique carbon atoms. We can differentiate between these two because the proton spectrum has a doublet for two hydrogens with only small coupling (1.4) and thus these two hydrogen atoms can not have a hydrogen on an adjacent carbon.

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15-13 Remember that the position of nuclei must remain unchanged from one resonance structure to another. However, absent Huckel theory, one would need the experimental evidence that cyclooctatetraene is not planar to conclude as the book does.

15-14 The answer in the book is adequate.

15-15 Given the roughly 30 kcal/mole of additional stabilization in benzene, it is a stretch to presume that we could conclude that the bond angle distortion that would result in these 10 π electron systems were planar would be greater than aromatic stabilization. Bad question, bad answer.

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15-20 This exercise is worked out in the book as "Working with Concepts".

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15-23 The answer in the book is adequate. You should heed the book's advice to always draw the hydrogen on the carbon that has added the electrophile.

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15-27 The answer in the book is adequate.

15-28 This exercise is worked out in the book as "Working with Concepts".

15-29 Do not be concerned if you did not come up with the answer to this exercise---it is rather high end for a course at this level.

15-30 Among isomeric compounds with the same functional groups, the higher the molecular symmetry, the higher the melting point.

15-31 This exercise is worked out in the book as "Working with Concepts".

15-32 The answer in the book is adequate.

15-33 The answer in the book is adequate.

