1. (a) Bromide is not a strong nucleophile, and would never displace the poor leaving group ethoxide. $S_N1$ is impossible as a primary cation would have to be formed.

(b) Here, protonation of the ether oxygen converts the leaving group from ethoxide, a miserable leaving group to ethanol, a good leaving group, and the reaction succeeds (p. 233).

(c) Ethoxide is not a good enough nucleophile to displace hydroxide. Moreover, there is a MUCH faster reaction possible, removal of a proton to give propoxide ion. Once again, the $S_N1$ reaction is impossible.

(d) Here, the first step, is tosylate formation (p. 233). The good leaving group tosylate is easily displaced by ethoxide to give the new ether. There will, of course, also be some $E2$ reaction to give propene.
2. Just be careful to include the stereochemical demands of the E2 (180°, anti) and SN2 reactions (inversion) in your arrow formalisms.

only axial bromide has an adjacent C—H bond at 180°

axial Br also OK

(b) Three dimensions are utterly essential here. In the trans starting material, there is no C—H bond in the proper position so that a 180° E2 is possible. Only the SN2 is possible.

By contrast, in the cis compound, there are two C—H bonds in the proper ideal position and so there is lots of E2 reaction in competition with the SN2.
3.  
(a) We start with a simple SN2 in which ammonia displaces bromide to give ammonia ion 5. Compound 5, a salt, is then deprotonated by base to give the amine, 6.

![Diagram of SN2 reaction](image)

(b) Part (a) is put in there to get you thinking about ammonia displacing bromide. Let's do that in each of the two molecules shown, 7 and 8. Be careful to do the SN2 with inversion.

![Diagram of SN2 reaction](image)

As in all problems like this one, one of those products is set up for an intramolecular SN2, the other is not. Why? In only the product from 7 is it possible to do an SN2 with inversion.
4. There are surely many other answers, but these seem the simplest to me.

(a) At low temperature, there is no chair-chair interconversion. So the cis compound would show two different methyls (~0.9 in $^1$H NMR spectrum), and the trans compound would show only one. “Counting” carbons with $^{13}$C NMR also works well.

(b) you can’t.

(c) Cyclopropanes have a characteristic very high field absorption, about 0 ppm in the $^1$H NMR spectrum.

(d) 1,4-Cyclohexadiene would show only two different carbons in the $^{13}$C NMR spectrum, whereas 1,3-cyclohexadiene would show three.

(e) The trans compound would have a larger $J$ than the cis compound (p. 675).

(f) Parts of this question are easy, others hard. Methyl group A, for example, is a doublet. That’s easy. Getting the rest of the molecule right depends on seeing that hydrogens B and C are diastereotopic. So, methyl group D will be a doublet of doublets, hydrogen E a doublet of doublets of quartets (16 lines), and each diastereotopic hydrogen (B and C) will be a doublet of doublets of quartets (16 lines).
5. Only those hydrogens lined up with the developing $2p$ orbital on carbon can share the charge (and the LUMO). The ones at an angle do not line up well and do not share the charge.

6. In questions like this one always write a detailed mechanism first:
That deals with the formation of the “expected” product 12.

Next ask yourself, “What must be the immediate precursor to the ‘unexpected’ alcohol?” The answer to that easy question leads to the oxonium ion A and the carbocation B.

Now the question has devolved to “How can I get from the expected carbocation to B?” A hydrogen has to move with its pair of electron (a hydride). If it does, however, the god of thermodynamics will smile because we have generated a tertiary carbocation from a secondary carbocation.

It’s just another acid-base reaction, with the C—H bond acting as Lewis base.