What are the missing reactants or products of the following reactions? Show **stereochemistry** as appropriate.

1. 

\[ \text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{PCC}} \text{excess EtOH} \xrightarrow{\text{dry HCl}} \]

2. 

\[ \text{2-butyne} \xrightarrow{\text{H}_2 \text{ Pd/Pb}} \xrightarrow{\text{KMnO}_4 \text{ cold, dilute}} \]

3. 

\[ \text{H} \xrightarrow{\text{CH}_3 \text{OTs \text{ acetic acid \text{ heat}}}} \xrightarrow{\text{CPh}_3 \text{ alkene}} \]

4. 

\[ \text{NaBH}_4 \xrightarrow{\text{PBr}_3 \text{ base}} \xrightarrow{\text{PhCO}_3\text{H aq. acid}} \]
5. 1,2,3,3,6,6-Hexamethyl-cyclohexene

6. \[ \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow{\text{Cr}_2\text{O}_7^{2-}, \text{SOCl}_2, \text{(CH}_3\text{)}_2\text{CuLi}} \text{heat, acid} \]

7. \[ \text{CH(CH}_3\text{)}_2\text{CH(CH}_3\text{)}_2\text{Br} \xrightarrow{\text{D represents deuterium}} \text{base} \]

8. \[ \text{H}_3\text{C} \xrightarrow{\text{KMnO}_4, \text{HIO}_4} \text{KBrO}_4 \xrightarrow{\text{cold, dil.}} \]

9. \[ \text{Ph-CH}_3 \xrightarrow{\text{Br}_2, \text{NaOEt, excess NaNH}_2} \text{NaCH}_3 \]


10. 

\[ \text{B}_2\text{H}_6 \rightarrow \text{H}_2\text{O}_2, \text{OH}^- \]

11. 

base

\[ \text{cis 2,3 diphenyl-2-butene} \]

12. 

\[ \text{PhCD}_2\text{OH} \xrightarrow{\text{PCC}} \xrightarrow{\text{conc. NaOH}} \text{heat} \]

13. Give the mechanism for the following conversion. Use the curved arrow notation.

14. Give supporting, experimental (obtained in a laboratory) evidence that the conversion of 1-butanol to 1-bromobutane using acid and NaBr does not proceed via a classical carbocation.
Using alcohols having four or fewer carbons and benzene as the source of all carbons in the target molecules, any inorganics, and any solvents provide a simple, efficient synthesis of the following compounds. **NB:** you may use a product from an earlier problem even if you were not able to synthesize the earlier compound.

15. benzoic acid, PhCO₂H

16. 3-phenyl-pentane (efficiency counts)

17. 1,2-diphenyl ethene

18. A chemistry 52 student has to separate the components in an ether solution of two compounds. Upon extraction with 1 M NaOH solution and acidification of the aqueous layer a white precipitate was formed.

If the original ether solution is extracted with 1 M HCl and the aqueous solution is brought to pH 7 a second layer (organic) is formed.

Provide a brief interpretation of the experimental observations and give two compounds which would exemplify the components of the mixture.

19. Provide a balanced chemical reaction for the periodic acid (HIO₄) oxidation of 2,3-butanediol yielding acetaldehyde and iodate ion (IO₃⁻).

20. Shade the p orbitals of the pi system below so as to sketch the molecular orbital which holds the highest energy pi electrons in 1,3-butadiene. If a p orbital does not contribute to the molecular orbital cross it out with a large "x".

![Molecular Orbital Diagram](attachment:image.png)
Chemistry 51  
Exam 2 Answer Sheet  

5 points for each box.  

Name_____________________

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