# Total Synthesis of (-)-Morphine

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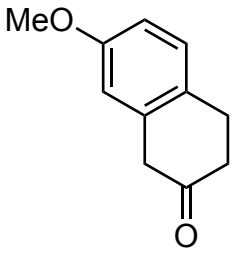
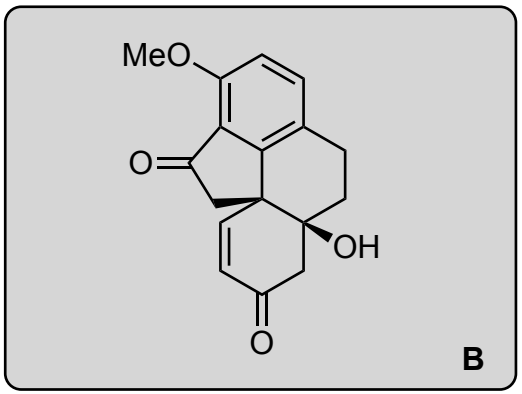
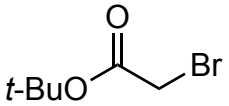


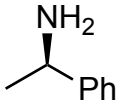

1-6

1) pyrrolidine, reflux *then* **1**, *t*-BuOH *then* AcOH buffer
2) **2**, reflux *then* methyl vinyl ketone *then* AcOH buffer
3) TfOH
4) PhSeCl, MeCN/$H_2O$ (5:1)
5) *m*CPBA, $NaHCO_3$
6) $Cs_2CO_3$, 60 °C



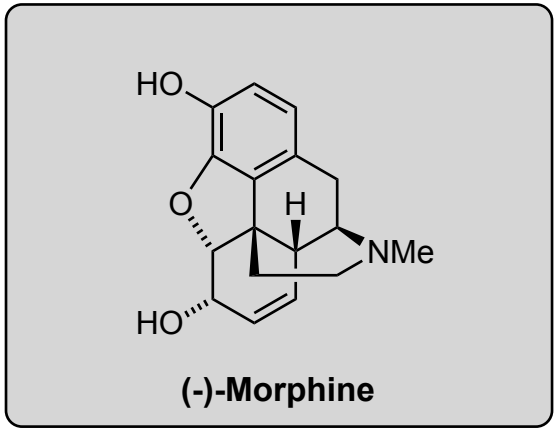




**1**

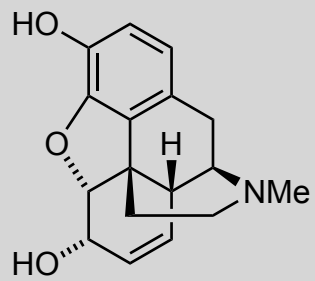



**2**

3) Name of reaction?
Metal-free Friedel-Crafts
6) Name or reactions? *hint*: same reaction but different directions
retro-aldol then aldol

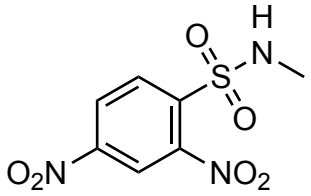


7-18



**(-)-Morphine**

7) *m*CPBA, $NaHCO_3$
8) $K_2CO_3$, MeOH then $TMSCHN_2$
9) $NaBH_4$
10) $TsOH•H_2O$
11) $LiAlH_4$
12) **3**, DEAD, $Ph_3P$
13) $O_2$, $h\nu$ (405 nm), tetraphenylporphine *then* $Et_3N$
14) Martin's sulfurane
15) PhSH, $iPr_2NEt$
16) 4M HCl in dioxane
17) $NaBH_4$
18) $BBr_3$



**3**

7) Name of the reaction?
Baeyer-Villiger reaction
12) Name or reaction
Mitsunobu reaction
13) *hint*: $Et_3N$ promotes O-O bond cleavage.

15) *hint*: protecting group cleavage

17) name of natural product?
Codeine