# Total Synthesis of (-)-Morphine

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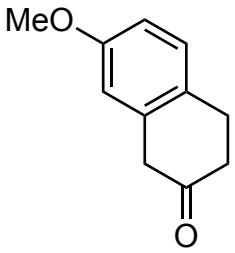
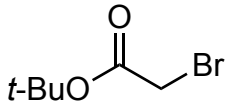


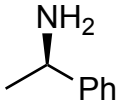

1-6

**B**

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



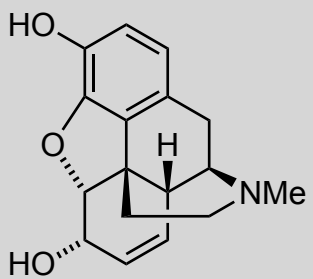

**1**




**2**

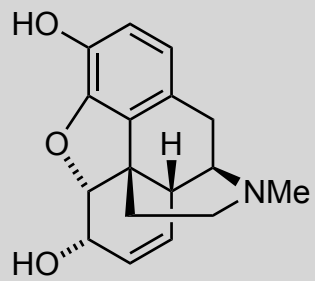
3) Name of reaction?

6) Name or reactions? *hint*: same reaction but different directions




**(-)-Morphine**

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* $Et_3N$

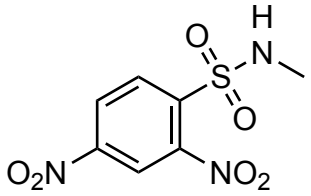
14) Martin's sulfurane

15) PhSH, $iPr_2NEt$

16) 4M HCl in dioxane

17) $NaBH_4$

18) $BBr_3$



**3**

7) Name of the reaction?

12) Name or reaction

13) *hint*: $Et_3N$ promotes O-O bond cleavage.

15) *hint*: protecting group cleavage

17) name of natural product?