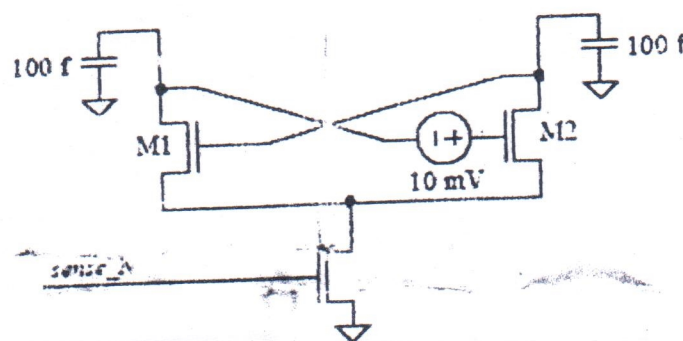Figure 1

4)

Figure 2

This question deals with mismatch between the devices constituting a simple latch sense amplifier. In figure 2, the mismatch between transistors M1 and M2 has been modeled as a voltage offset of 10mV. The devices are considered to be identical after incorporating the offset. The two bitline model capacitances are the same (100fF).

   a) Assuming that the output nodes are equalized at 500mV, after which the enabling signal sense_N is asserted, sketch the waveform of the voltages at the two output nodes with reference to sense_N. (3)

   b) Find the precharge voltages for which the circuit will be maintained at metastability. Use Spice Level 1 MOS transistor models and simple RC discharge models. Key model parameters are

        Vthn=280mv and Vdsat=50mv

   Mention any assumptions and/or approximations you made. (7)