

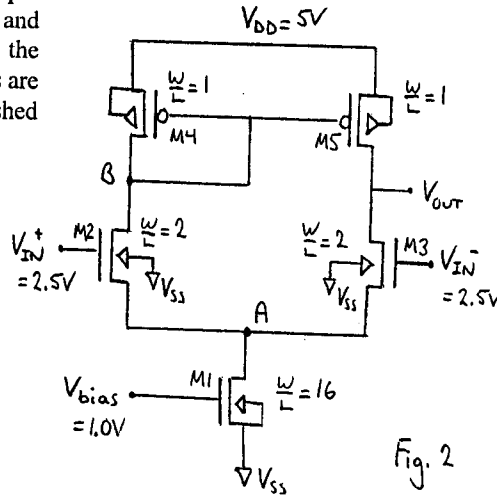
Name: _____

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5. To compensate for the fact that the electron mobility in a MOSFET channel is approximately twice that of the hole mobility, the W/L ratio for the p-channel transistors in the layout of Fig. 1 has been made twice as large as the W/L ratio for n-channel transistors. State two advantages in circuit performance which result from this proportionality between W/L ratios. No calculations are necessary. 5 marks

6. Fig. 2 shows the circuit diagram for a simple differential input stage of a CMOS op-amp. $V_{DD} = 5\text{ V}$, $V_{in}^+ = V_{in}^- = 2.5\text{ V}$ and $V_{bias} = 1.0\text{ V}$. Assume $\mu_n = 2\mu_p$ in the channel and ignore the body effect. Take $V_{Tn} = -V_{Tp} = 0.7\text{ V}$. Assume all transistors are in saturation, but justify this assumption when you have finished your calculations.

- a) Compute the voltage at node A. 8 marks



- b) Compute the voltage at node B. 8 marks

- c) What is V_{out} ? Justify your answer. 2 marks

- d) Qualitatively, how would allowing for the body effect change your answer to (a) and (b)? Explain. 3 marks