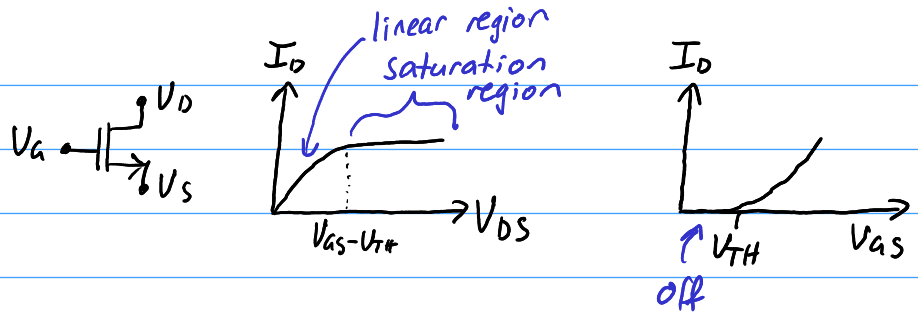
6.20



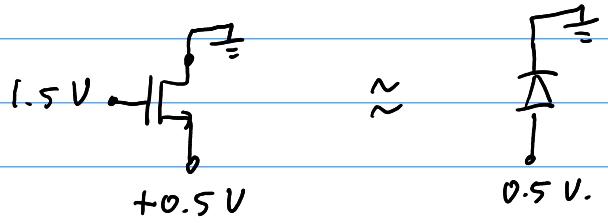
(a) Transistor is off because $V_{GS} = 0$.

(b) $V_{GS} = 1\ V \therefore V_{GS} - V_{TH} = 0.6\ V$.

$V_{DS} = 1.5\ V$. $V_{DS} > V_{GS} - V_{TH}$. $\therefore$ Saturation region.

(c) $V_{DS} = 0 \therefore I_D = 0 \therefore$ Off.

(d) Assuming the substrate is shorted to source (as normal) then the body diode is weakly forward biased.



This is not enough for significant conduction.

$\therefore$ Neglect body diode effects

$\therefore$ Transistor is symmetric w.r.t. source & drain.

Low $|V_{DS}| \therefore$ Linear region.

Note: avoid negative V_{DS} in general! $\ddot\smile$

(e) Low $V_{DS} \therefore$ Linear.

(f) All voltages 0 $\therefore$ Off.

(g) $V_{GS} = 0.5\ V. \therefore V_{GS} - V_{TH} = 0.1\ V$.

$V_{DS} = 0.5\ V \therefore V_{DS} > V_{GS} - V_{TH} \therefore$ Saturation.

(h) Similar to (g) $\therefore$ Saturation

(i) $V_{GS} = 0.5\ V \therefore V_{GS} - V_{TH} = 0.1\ V$.

$V_{DS} = 1\ V \therefore V_{DS} > V_{GS} - V_{TH} \therefore$ Saturation