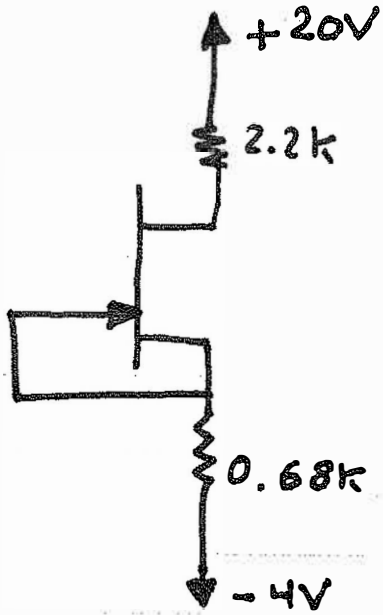
7.10



$I_{DSS} = 4.5\,mA$
$V_P = -5V$

$$I_{DS} = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$V_{GS} = 0$

$\therefore \quad I_{DS} = I_{DSS} = 4.5\,mA$

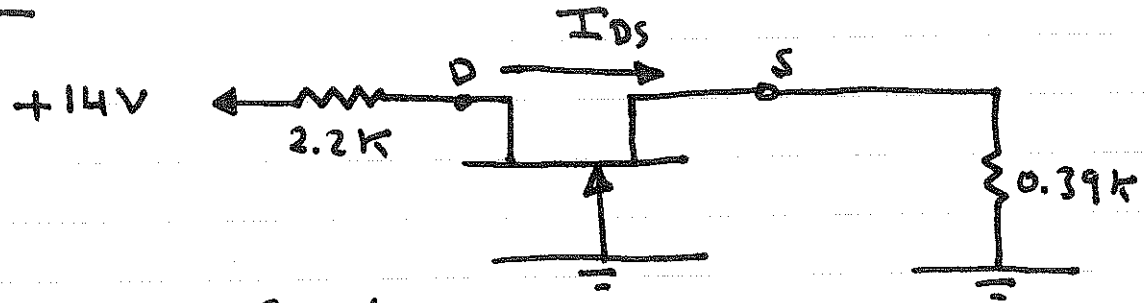
$20 = 2.2K\,I_{DS} + V_{DS} + 0.68K\,I_{DS} - 4$

$\therefore \quad V_{DS} = 11.04\,V$

$V_D = 20 - 2.2K\,I_{DS} = 10.1\,V$

$V_S = 0.68K\,I_{DS} - 4 = -0.94V$

7.11



$I_{DSS} = 6mA$

$V_p = -6V$

$$I_{DS} = I_{DSS}\left(1 - \frac{V_{GS}}{V_p}\right)^2 \quad \text{— (1)}$$

$V_{GS} = V_G - V_S$

$V_G = 0$; $V_S = 0.39K\, I_{DS}$

$\therefore V_{GS} = -0.39K\, I_{DS}$ ——— (2)

$$\therefore I_{DS} = 6\times10^{-3}\left(1 - \frac{-0.39K\, I_{DS}}{-6}\right)^2$$

Solving for I_{DS}, we get

$I_{DS} = 3.55\,mA$

$V_{GS} = -1.384\,V$

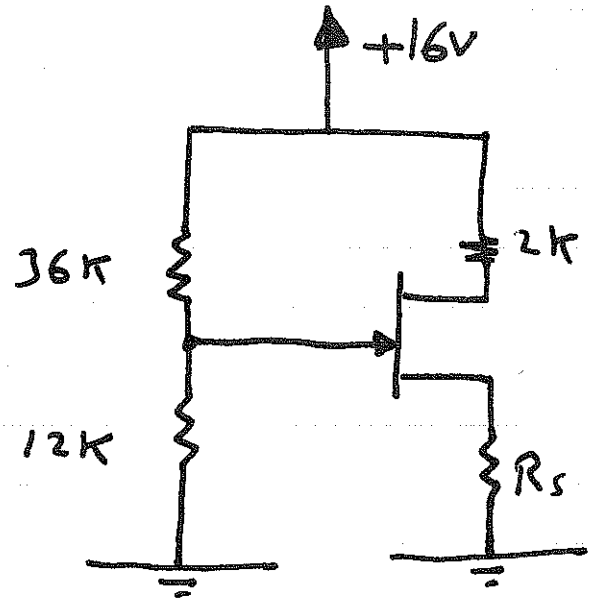
$V_S = 1.384\,V$

$V_{DS} = 14 - I_{DS}(2.2K + 0.39K)$

$V_{DS} = 4.8V$

$|V_{DS}| > |V_p| - |V_{GS}| = 4.616V$ ✓

7.15



$I_{DSS} = 12mA$

$V_P = -8V$

$V_D = 10V$

$$I_{DS} = \frac{16 - V_D}{2K} = 3mA$$

$$I_{DS} = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2 = 3mA$$

$$\therefore V_{GS} = V_P\left(1 - \sqrt{\frac{I_{DS}}{I_{DSS}}}\right) = -4V$$

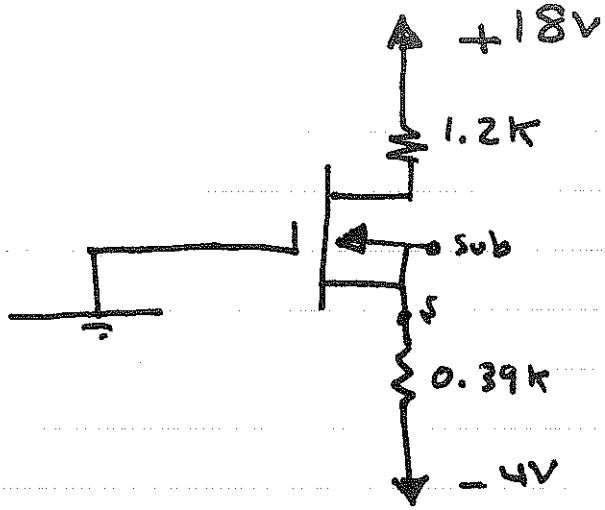
$$V_G = \frac{12K}{12K + 36K} \cdot 16 = 4V$$

$$\therefore V_S = -V_{GS} + V_G = 8V$$

$$V_S = R_S I_{DS}$$

$$\therefore R_S = \frac{V_S}{I_{DS}} = 2.67K$$

7.21



$I_{DSS} = 8\,mA$

$V_p = -8V$

$$I_{DS} = I_{DSS}\left(1 - \frac{V_{GS}}{V_p}\right)^2$$

$V_{GS} = V_G - V_S$

$V_G = 0$; $V_S = 0.39K\, I_{DS} - 4$

$\therefore V_{GS} = 4 - 0.39K\, I_{DS}$

$$I_{DS} = 8\times10^{-3}\left(1 - \frac{4 - 0.39K\, I_{DS}}{-8}\right)^2$$

Solving for I_{DS}, we get

$I_{DS} = 9\,mA$

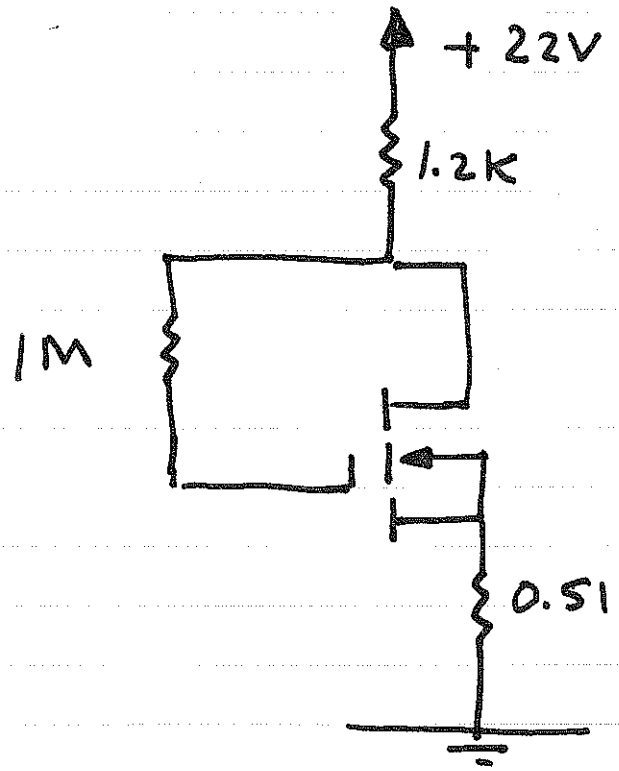
$V_{GS} = 4 - 0.39K\, I_{DS} = 0.488V$

$V_{DS} = 22 - I_{DS}(1.2K + 0.39K) = 7.69$

$V_{DS} \overset{?}{>} V_{GS} - V_p = 8.488$ ×

The DMOSFET is in the ohmic region

7.22



$$K_n = \frac{I_{D(on)}}{[V_{GS(on)} - V_{GS(TH)}]^2} = \frac{5mA}{(7-4)^2}$$

$$\therefore K_n = \frac{5}{9}\ mA/V^2$$

$$I_{DS} = K_n \left(V_{GS} - V_T \right)^2 \qquad \text{—— (1)}$$

$$V_{GS} = V_G - V_S$$

$$V_G = 22 - 1.2K\, I_{DS}$$

$$V_S = 0.51K\, I_{DS}$$

$$\therefore V_{GS} = 22 - 1.71K\, I_{DS} \qquad \text{—— (2)}$$

Sub equation ② into equation ①

and solving for I_{DS}, we get

$I_{DS} = 8.27\,mA$

$V_{GS} = 22 - 1.71K\,I_{DS} = 7.86V$

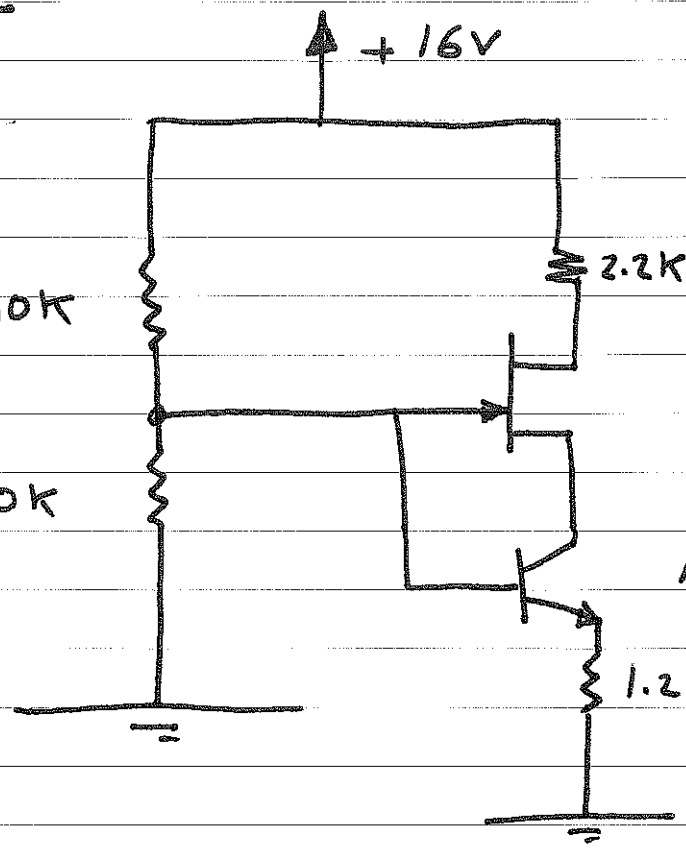
$V_D = 22 - (1.2K)(8.27mA) \cong 12V$

$V_S = R_S I_{DS} = (0.51K)(8.27mA) = 4.22V$

$V_{DS} = V_D - V_S = 7.78\,V$

$|V_{DS}| > |V_{GS} - V_T| = 3.86V$ ✓

7.25



$$R_{TH} = 40K \parallel 10K = 8K$$

$$V_{TH} = \frac{10K}{10K+40K}(16V) = 3.2V$$

$$V_{TH} = R_{TH} I_B + V_{BE} + 1.2K\, I_E$$

$$\therefore I_B = \frac{3.2 - 0.7}{8K + (1.2K)(101)} = 19.35\,\mu A$$

$$I_C = \beta I_B = 1.935\,mA$$

$$I_{DS} = I_C = 1.935\,mA$$

$$I_{DS} = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$$

$$\therefore V_{GS} = V_P\left(1 - \sqrt{\frac{I_{DS}}{I_{DSS}}}\right) = -2.6V$$

$V_C = V_B - V_{GS}$

$V_B = 3.2 - 8K\,I_B \cong 3V$

$\therefore V_C = 5.6V$

$V_E = V_B - V_{BE} \cong 2.3V$