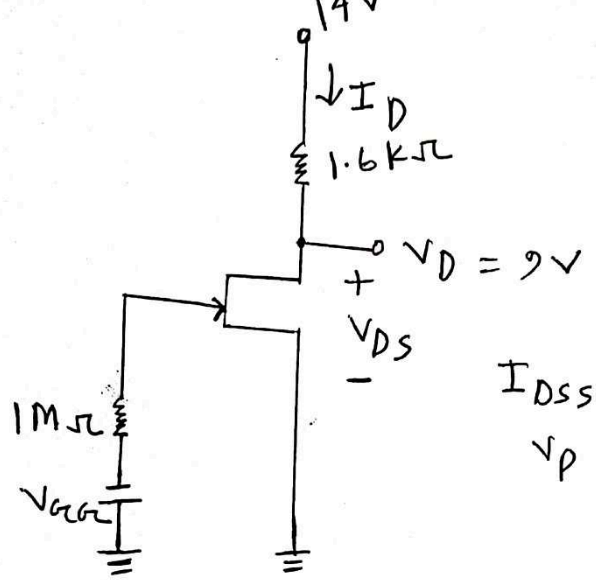
Name: Arpita Datta. Section: B

1 ID: 19-41608-3 1



$I_{DSS} = 8$ mA

$V_P = -4V$

$$I_D = \cancel{V_{DD} - V_D}\ \frac{V_{DD} - V_D}{R_D}$$

$$= \frac{14 - 9}{1.6 \times 10^3} = 3.125 \text{ mA} \quad \text{(Ans)}$$

$$V_{DS} = V_D - V_S = 9 - 0 = 9\text{ V} \quad \text{(Ans)}$$

We know,

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

$$3.125 \times 10^{-3} = 8 \times 10^{-3}\left(1 - \frac{V_{GS}}{-4}\right)^2$$

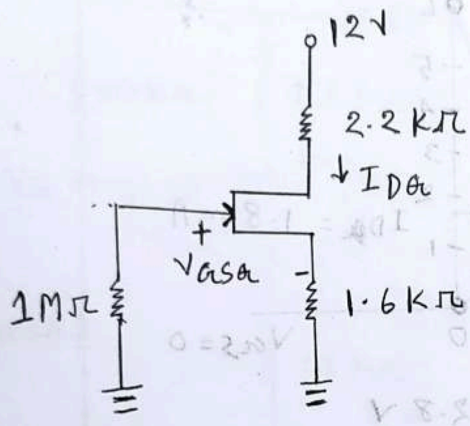
$$\Rightarrow 0.003125 = 0.008\left(\frac{-4 + V_{GS}}{-4}\right)^2$$

$$\Rightarrow 0.003125 = 0.128\,(-4 + V_{GS})^2$$

$$V_{GS} = -1.5V$$

$\therefore V_{GG} = -V_{GS} = -(-1.5) = 1.5\ V$ (Ans)

2



$I_{DSS} = 6\ mA$

$V_P = -6V$

V_{GS}	I_D
0 V	6 mA
$0.3 V_P = 0.3 \times -6 = -1.8V$	$\frac{I_{DSS}}{2} = \frac{6}{2} = 3\ mA$
$.5 V_P = .5 \times -6 = -3V$	$\frac{I_{DSS}}{4} = \frac{6}{4} = 1.5\ mA$
$-6V$	0 mA

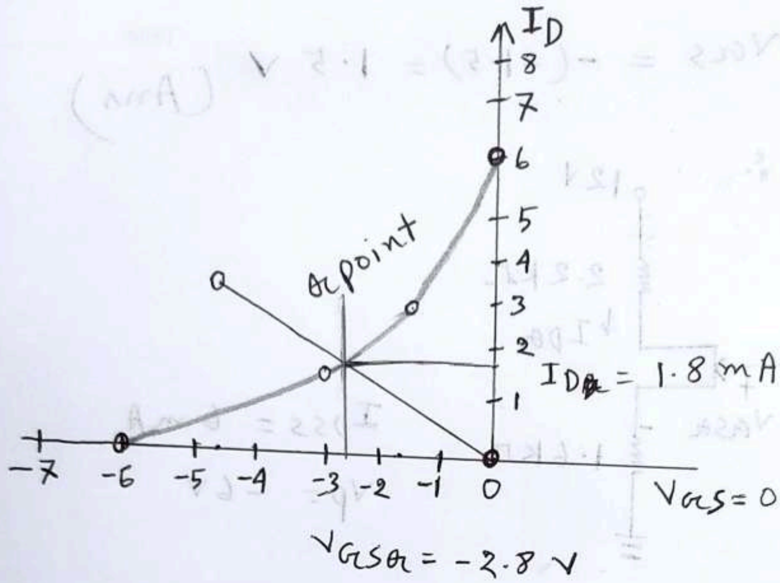
Load Line: $V_{GS} = -I_D R_S$

$I_D = 0\ mA$

$V_{GS} = 0\ V$

$I_D = \frac{I_{DSS}}{2} = \frac{6\ mA}{2} = 3\ mA$

$V_{GS} = -3 \times 1.6 = -4.8\ V$



$V_{GSQ} = -2.8\,V$,

$I_D = 1.8\,mA$ (Ans)

$V_{DS} = V_{DD} - I_D(R_S + R_D)$

$= 12 - 1.8 \times 10^{-3}(1.6 + 2.2)10^3$

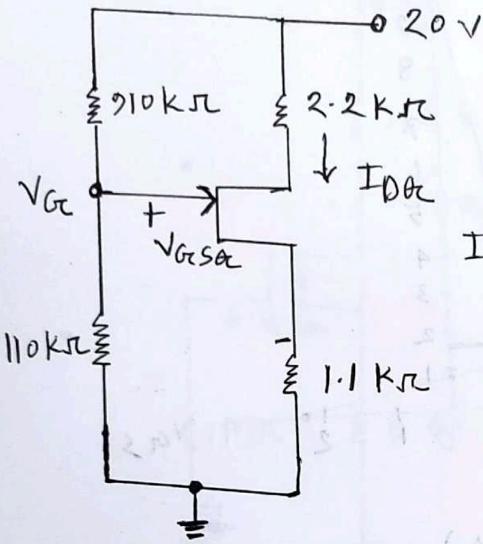
$= 5.16\,V$ (Ans)

$V_S = I_D R_S = 1.8 \times 1.6 = 2.88\,V$ (Ans)

$V_D = V_{DS} + V_S = 5.16 + 2.88 = 8.04\,V$

(Ans)

3



$I_{DSS} = -10\ mA$

$V_P = -3.5\ V$

By using voltage divider rule, $V_G = \dfrac{R_2 V_{DD}}{R_1 + R_2}$

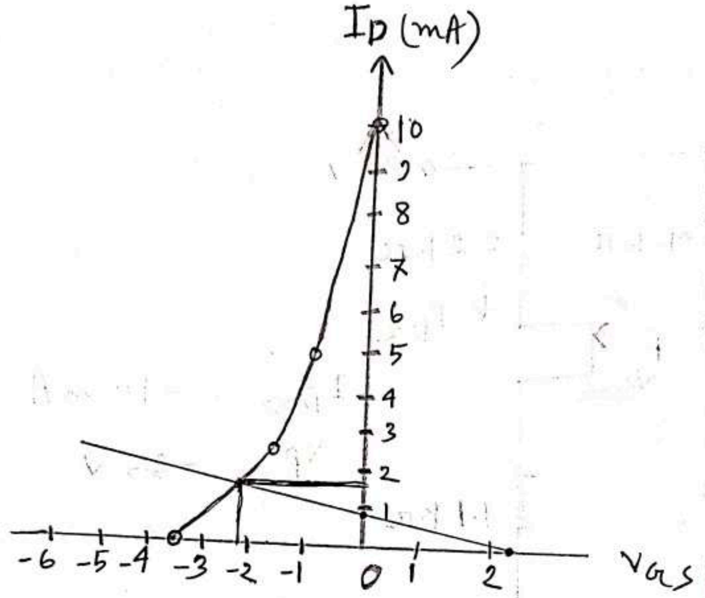
$$V_G = \frac{110\times10^3 \times 20}{110\times10^3 \times 910\times10^3} = 2.16\ V \text{ (Ans)}$$

V_{GS}	I_D
0 V	10 mA
$0.3V_P = -1.05$	$\frac{I_{DSS}}{2} = \frac{10}{2} = 5$
$0.5V_P = -1.75$	$\frac{I_{DSS}}{4} = \frac{10}{4} = 2.5$
$-3.5\ V$	0

We know, $V_{GS} = -I_D R_S$

when, $I_D = 0$, $V_{GS} = V_G = 2.16\ V$

when, $V_{GS} = 0$, $I_D = \dfrac{V_{GS}}{R_S} = \dfrac{2.16}{1.1} = 1.963\ mA$



$V_{GSQ} = -2.1V$ (Ans)

$I_{DQ} = 1.5 mA$ (Ans)

$V_D = V_{DD} - I_D R_D = 20 - (1.5 \times 10^{-3} \times 2.2 \times 10^3)$

$= 20 - 3.3 = 16.7 V$ (Ans)

$V_S = I_D R_S = 1.5 \times 10^{-3} \times 1.1 \times 10^3$

$= 1.65 V$ (Ans)

$V_{DSQ} = V_D - V_S = 16.7 - 1.65$

$= 15.05 V$ (Ans)

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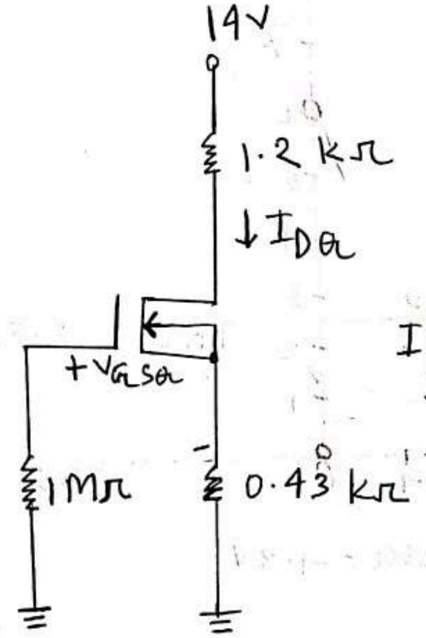


$I_{DSS} = 6\ mA$
$V_P = -4V$

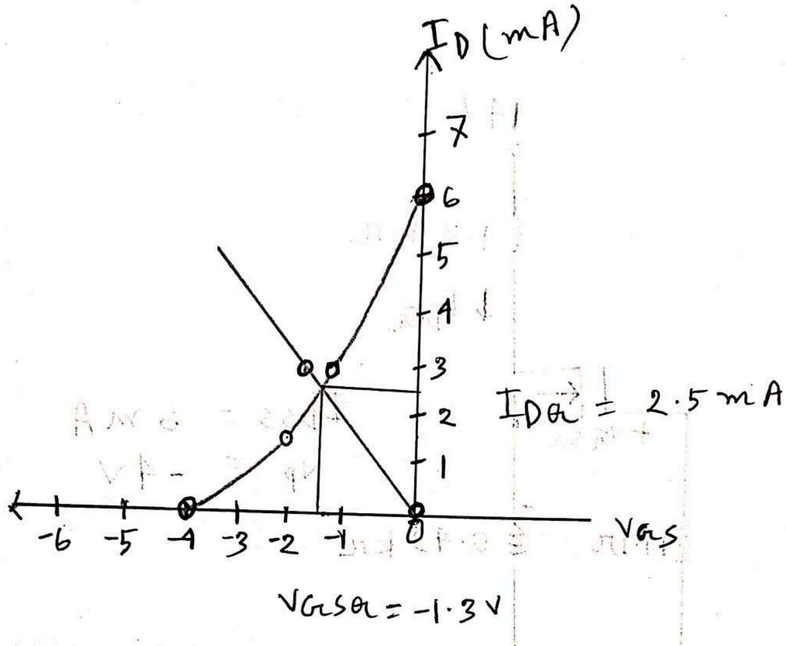
V_{GS}	I_D
0 V	6 mA
$0.3V_P = -1.2V$	$\frac{I_{DSS}}{2} = \frac{6}{2} = 3mA$
$0.5V_P = 2V$	$\frac{I_{DSS}}{4} = \frac{6}{4} = 1.5mA$
$-4V$	0 mA

Load Line : $V_{GS} = -I_D R_S$

$I_D = 0\ mA,\ V_{GS} = 0V$

$I_D = \frac{I_{DSS}}{2} = \frac{6}{2} = 3mA$

$V_{GS} = -3 \times 0.43 = -1.29V$



$V_{GSQ} = -1.3\text{ V}$ (Ans)

$I_{DQ} = 2.5\text{ mA}$ (Ans)

$$V_D = V_{DD} - I_D R_D$$
$$= 14 - (2.5\times10^{-3} \times 1.2\times10^{3})$$
$$= 11\text{ V} \quad \text{(Ans)}$$

$$V_S = I_D R_S = 2.5\times10^{-3} \times 0.43\times10^{3}$$
$$= 1.075\text{ V} \quad \text{(Ans)}$$

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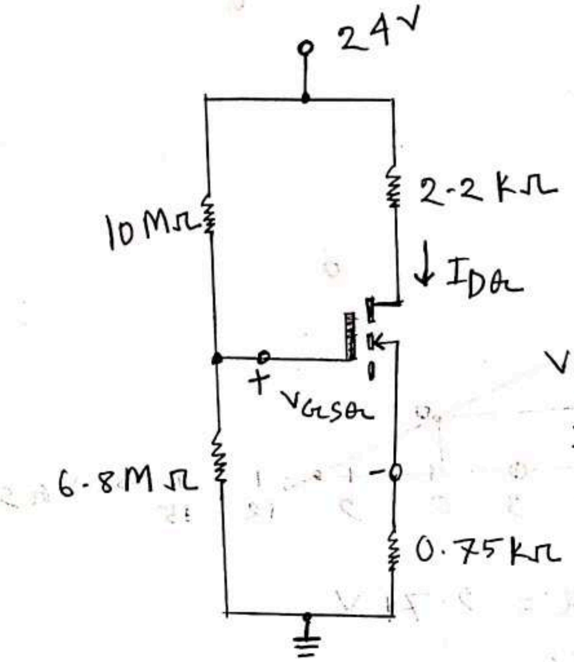


$V_{GS(Th)} = 3V$

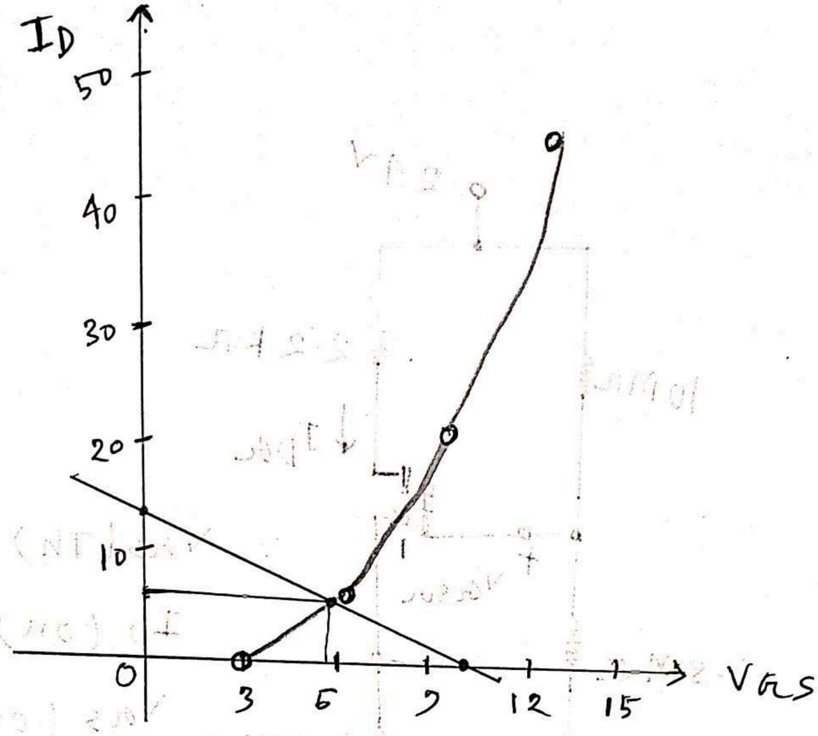
$I_{D(on)} = 5 mA$

$V_{GS(on)} = 6V$

$$V_G = \frac{R_2 \times V_{DD}}{R_1 + R_2} = \frac{6.8 \times 10^6 \times 24}{10 \times 10^6 + 6.8 \times 10^6} = 9.71 V$$

$$K = \frac{I_{D(on)}}{(V_{GS(on)} - V_{GS(Th)})^2} = \frac{5}{(6-3)^2} = \cancel{9.71V}\ 5.56 \times 10^{-4}$$

V_{GS}	I_D
3 V	$5.56 \times 10^{-4} (3-3)^2 = 0$ mA
6 V	$5.56 \times 10^{-4} (6-3)^2 = 5$ mA
9 V	$5.56 \times 10^{-4} (9-3)^2 = 20.01$ mA
12 V	$5.56 \times 10^{-4} (12-3)^2 = 45.04$ mA



we calculated, $V_G = 9.71\ V$

$$I_D = \frac{V_G}{R_S} = \frac{9.71}{0.75} = 12.95\ mA$$

$I_{DQ} = 6\ mA$, (Ans)

$V_{GSQ} = 5.9V$ (Ans)

$V_D = V_{DD} - I_D R_D = 24 - (6 \times 10^{-3} \times 2.2 \times 10^{3})$

$= 10.8V$ (Ans)

$V_S = I_D R_S = (6 \times 10^{-3} \times 0.75 \times 10^{3})$

$= 4.5\ V$

(Ans)