7,5

1. 2,5
2. 2,5
3. 2,5
4. 0

S T Q Q S S D
L M M J V S D

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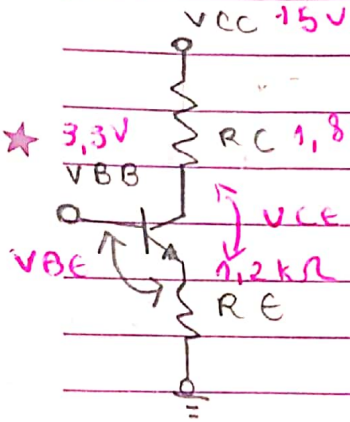
1) $V_{CC} = 15V$ $V_{BB} = 3,3V$ $R_C = 1,8K\Omega$
$R_E = 1,2K\Omega$ $\beta = 100$
$I_C = ?$ $V_{CE} = ?$ $V_C = ?$ e $V_E = ?$

$V_{BE} = 0,7$



malha entrada

$-V_{BB} + V_{BE} + R_E I_C = 0$

$I_C = \frac{V_{BB} - V_{BE}}{R_E}$

$I_C = \frac{3,3 - 0,7}{1200} = 2,167\ mA$

malha saída

$-V_{CC} + R_C . I_C + V_{CE} + R_E . I_C = 0$

$-15 + 1800 I_C + V_{CE} + 1200 I_C = 0$

$V_{CE} = 15 - 3000 I_C$

$V_{CE} = 8,499\ V$

$V_E = R_E . I_E$

como $I_B = 0$ então $I_E = I_C$, logo

$V_E = I_C . R_E$

$V_E = 2,167\ mA . 1200 = 2,6004\ V$

$V_{CE} = V_C - V_E$, $V_C = V_{CE} + V_E$ logo:

$V_C = 8,499 + 2,6004 = 11,0994\ V$

Gráfico

$V_{CE\,corte} = V_{CC} = 15V$

$I_{C\,sat} = \frac{V_{CC}}{R_C + R_E} = \frac{15}{3000} = 5\ mA$

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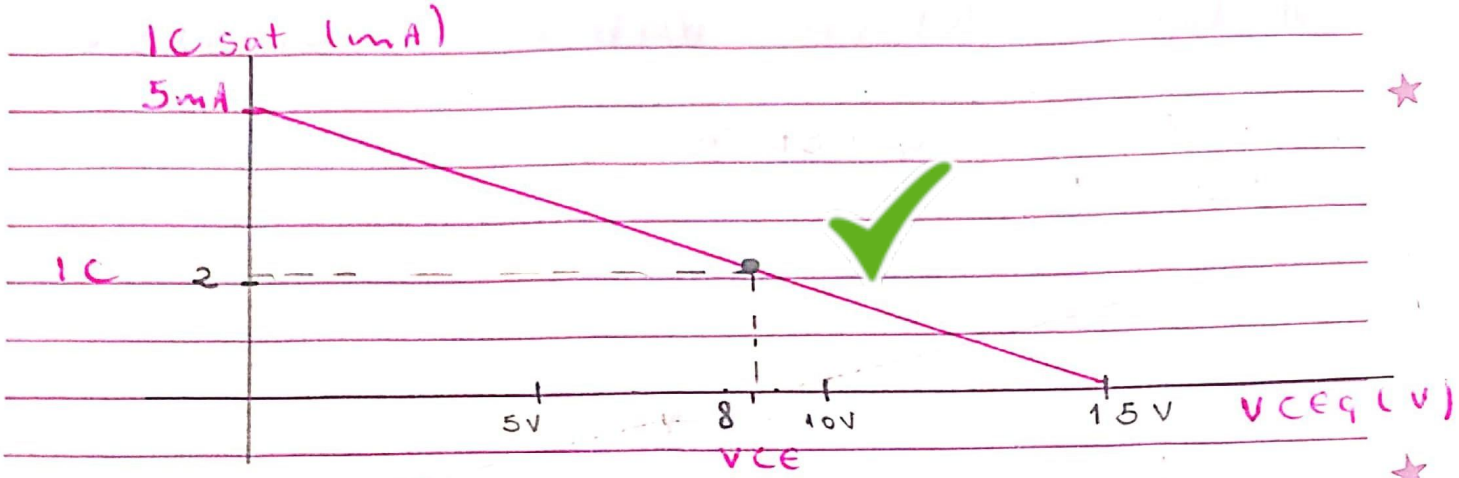


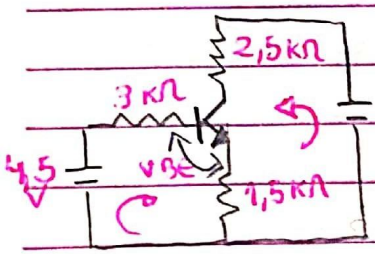
2)

$I_B = ?$ $I_C = ?$ $V_{CE} = ?$ $\beta = 100$

$V_{CC} = 18V$ $R_1 = 12K\Omega$ $R_2 = 4K\Omega$

$R_C = 2,5\ K\Omega$ $R_E = 1,5K\Omega$

$$V_{th} = \frac{R_2 \cdot V_{CC}}{R_1 + R_2} = 4,5V \qquad R_{th} = \frac{R_1 \cdot R_2}{R_1 + R_2} = 3K\Omega$$



malha entrada

$-4,5 + 3K I_B + 0,7 + 1,5 I_E = 0$

$I_E = 101 I_B$

$1515001 I_B =$

$1545001 I_B = 3,8 \qquad I_B = 2,4595 \times 10^{-5}$

$I_B = 24,59\ \mu A$

$I_C = 100 I_B = 2,459 \times 10^{-3} = 2,4595 mA$

malha saída

$-1 V_{CE} = V_{CC} - I_C (R_C + R_E)$

$= 18 - 2,4595 \times 10^{-3} (4K) =$

$= 8,162\ V$

Dados gráfico

$V_{CE\ corte} = V_{CC} = 18V$

$I_{C\ sat} = \frac{18}{4000} = 4,5 \times 10^{-3} A$

$4,5\ mA$

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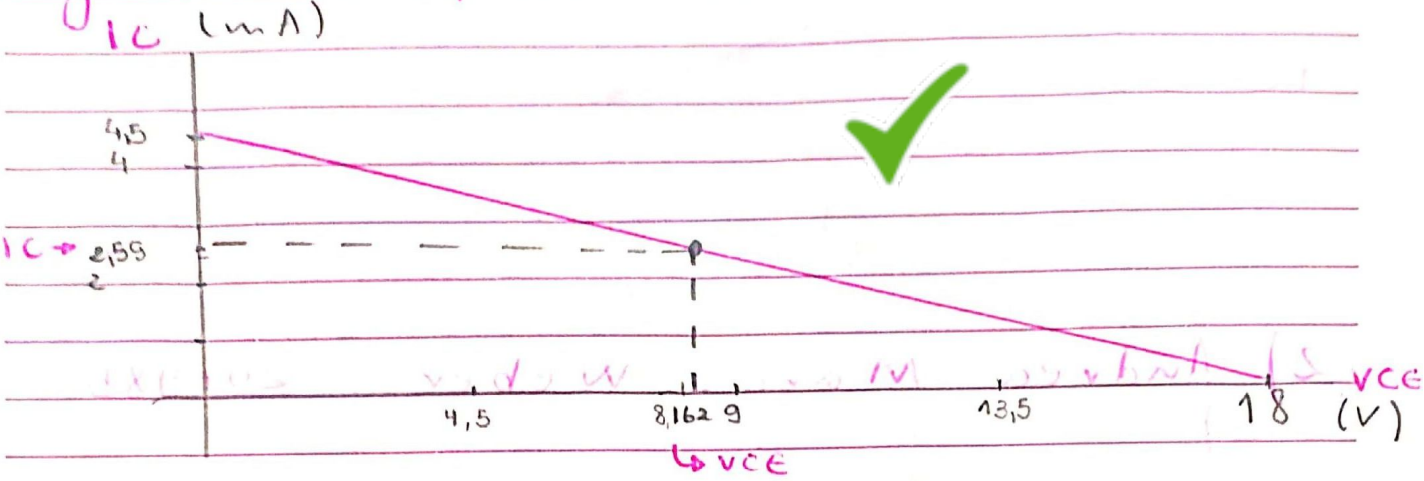
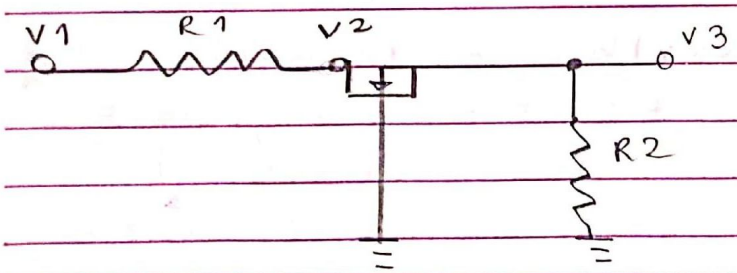
Gráfico questão 2



3) $V_2 = ?$ $V_3 = ?$

$R1 = 2,2\,K\Omega$ $R2 = 1,1\,K\Omega$ $V1 = 15\,V$

$IDSS = 8\,mA$ $VP = -8\,V$



$VGS = -I_D R_S$

$VGS = ?$

$$I_D = IDSS\left(1 - \frac{VGS}{VP}\right)^2$$

$$\rightarrow 0 = 18\times10^{-3}\left(1 - \frac{(\not{1}D\,1,1K)}{\not{-}8}\right)^2 - ID$$

$$0 = 8\times10^{-3}\left(1 - 137,5\,ID\right)^2 - ID$$

$$0 = 8\times10^{-3}\left(1^2 - 275\,ID + 18906,25\,ID^2\right) - ID$$

$$8\times10^{-3} - 2,2\,ID + 1,5125\times10^{2}\,ID^2 - ID = 0$$

usando a calculadora:

$ID1 = 0,00289656$ $ID2 = 0,0182605$

↳ escolhemos essa

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$I_{D1} = 2,89656\ mA$ ✓ $I_{D2} = 1,82605 \times 10^{-2}$

$18,2605\ mA$

Portanto:

$V_{GS} = -I_D R_S =$

$-2,89656 \times 10^{-3} \cdot 1100 = -3,153216V$

Tensões

$V_2 = V_D = V_{DD} - I_{D1} R_1 =$

$15 - (+2,89656 \times 10^{-3} \times 2200) =$

$V_2 = 8,627568\ V$ ✓

$V_3 = V_S = I_{D1} R_2 = 2,89656 \times 10^{-3} \times 1100 =$

$V_3 = 3,186216\ V$ ✓

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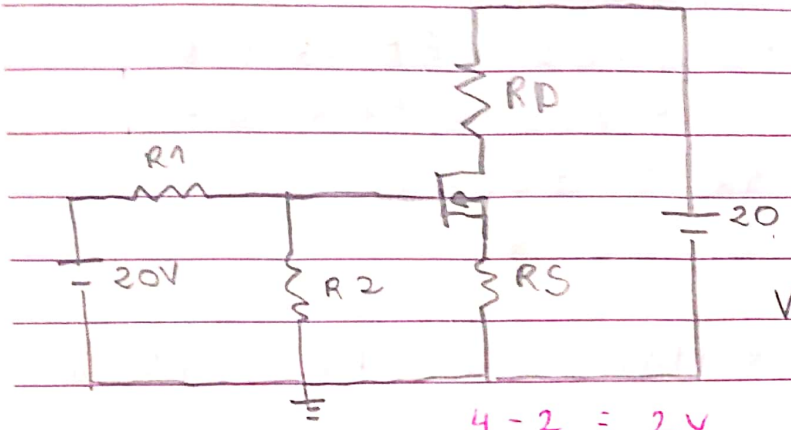
4) $V_{DD} = 20\ V$ $R_D = 2k\Omega$ $R_2 = 2M\Omega$
$R_1 = ?$ $R_S = ?$ $V_{DS} = ?$ $V_D = ?$ e $V_S = ?$



$4 - 2 = 2V$

$V_{th} = \frac{20 \times 2M}{R_1 + 2M}$

$R_{th} = \frac{2M R_1}{R_1 + 2M}$

$V_G - V_{GS} - I_D R_S = 0$

$V_{GS} = V_G - I_D R_S$

$4 = V_G - 1\,mA\, R_S$

malha saída

$-V_{DD} + I_D R_D + V_{DS} + I_D R_S = 0$

$I_D = I_{Don}$

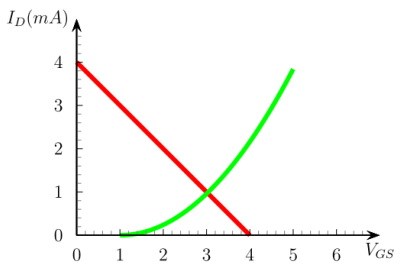
do gráfico temos que

$V_{GS} = 4V$ $V_t = 2V$

$I_{Dsat} = 4\ mA$ $I_{Dq} = 1mA$

$V_{GSq} = 3V$

$V_{G\_Sat} = 2V$



pela família de curvas supomos que $V_{th} \equiv 8\ V$, então:

$8 = \frac{40M}{R_1 + 2M}$ $8R_1 + 16M = 40M$

$R_1 = \frac{24M}{8}$

$R_1 = 3M\Omega$

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L M M J V S D

Andrea

$V_{GS} = V_G - V_S$

$4 = 8 - V_S$ ✗

$V_S = 4\ V$

$4 = V_G - 1mA\ R_S$

$R_S = \frac{4}{1 \times 10^{-3}} = 4K\Omega$ ✗

$V_{DS} = V_D - V_S$

$= 14 - 4 = 10V$ ✗ ✗