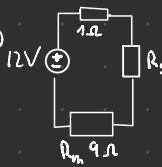
① a) 

$\omega = k \cdot i \quad i = \frac{V}{R} \rightarrow \omega = k \cdot \frac{V}{R}$

$V = \frac{\omega R}{k} = \frac{10 \cdot 9}{20} = \underline{\underline{4{,}5\ V}}$

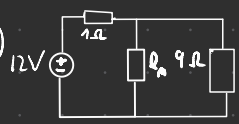
b) 

$\omega = k \cdot \frac{V}{R} = 20 \cdot \frac{12}{10} = \underline{\underline{24\ rpm}}$

c) 

$R_{tot} = \frac{kV}{\omega} = \frac{20 \cdot 12}{12} = 20$

$R_s = R_{tot} - R_m - R_i = 20\Omega - 9\Omega - 1\Omega = \underline{\underline{10\Omega}}$

d) 

$i = \frac{\omega}{k} = \frac{12}{20} = 0{,}6\ A$

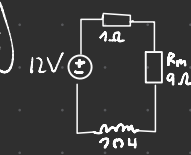
$V = i \cdot R = 0{,}6A \cdot 9\Omega = 5{,}4\ V$

$V_1 = 12V - 5{,}4V = 6{,}6V$

$I_1 = \frac{6{,}6V}{1\Omega} = 6{,}6A \qquad I_{R_p} = 6{,}6A - 0{,}6A = 6A$

$R_p = \frac{5{,}4V}{6{,}6A} = \underline{\underline{0{,}9\Omega}}$

e) Vi ser at strømmen gjennom Lauras løsning er høyere og gir dermed kortere levetid

f) 

$I = \frac{12V}{10\Omega} = 1{,}2A \qquad i = \frac{\omega}{k} = \frac{20}{20} = 1$

$\tau = \frac{L}{R} = \frac{20H}{10\Omega} = 2$

$i(t) = 1{,}2 - 1{,}2\,e^{\frac{t}{\tau}}$

$t = -\ln\left(\frac{0{,}2}{1{,}2}\right) \cdot 2 = \underline{\underline{3{,}58s}}$

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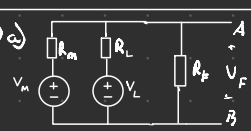
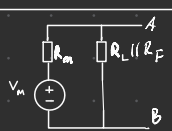
② a) 



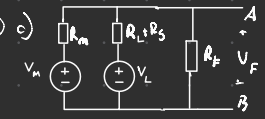
$V_{totR} = I \cdot R = \frac{V_m \cdot R_L \| R_F}{R_m + R_L \| R_F} = \frac{V_m \cdot \frac{R_L \cdot R_F}{R_L + R_F}}{R_m + \frac{R_L \cdot R_F}{R_L + R_F}} = \frac{V_m \cdot R_L \cdot R_F}{R_m R_L + R_m \cdot R_F + R_L \cdot R_F}$

$V_{tot_L} = \frac{V_L \cdot R_m \cdot R_F}{R_m R_L + R_m \cdot R_F + R_L \cdot R_F}$

$V_{tot} = \frac{V_m \cdot R_L \cdot R_F}{R_m R_L + R_m \cdot R_F + R_L \cdot R_F} + \frac{V_L \cdot R_m \cdot R_F}{R_m R_L + R_m \cdot R_F + R_L \cdot R_F}$

$V_{tot} = \frac{R_F}{R_m R_L + R_m \cdot R_F + R_L \cdot R_F}\left(R_m V_L + R_L V_m\right)$

② c)



$$\frac{V_L \cdot R_m \cdot R_F}{R_m R_S + R_m R_L + R_m \cdot R_P + R_L \cdot R_F + R_F \cdot R_S} = \frac{1}{2} \frac{V_L \cdot R_m \cdot R_1}{R_m R_L + R_m \cdot R_P + R_L R_F}$$

$$R_m R_S + R_m R_L + R_m \cdot R_P + R_L \cdot R_F + R_F \cdot R_S = 2\left(R_m R_L + R_m \cdot R_P + R_L \cdot R_F\right)$$

$$R_S \left(R_m + R_F\right) = R_m R_L + R_m \cdot R_P + R_L \cdot R_F$$

$$R_S = \frac{R_m R_L + R_m \cdot R_P + R_L \cdot R_F}{(R_m + R_F)} = R_L + \frac{R_m R_F}{R_F + R_m}$$

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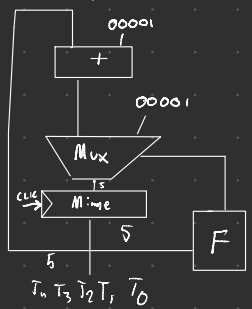
③ a) Han trenger ikke styresignaler nr å lage 24 signaler. Må ha min $2^3 = 8$, han trenger 24 trenger $\underline{2^5}$

b)



$$24 = 16 + 8 = 2^4 + 2^3 = 01100$$

T_4	T_3	T_2	T_1	T_0	A_1	A_3	A_{24}
0	0	0	0	0	0	0	0
0	0	0	0	1	1	0	0
0	0	0	1	0	1	0	0
0	0	0	1	1	1	1	0
0	0	1	0	0	1	1	0
0	0	1	0	1	1	1	0
0	0	1	1	0	1	1	0
0	0	1	1	1	1	1	0
0	1	0	0	0	1	1	0
0	1	0	0	1	1	1	0
0	1	0	1	0	1	1	0
0	1	0	1	1	1	1	0
0	1	1	0	0	1	1	0
0	1	1	0	1	1	1	0
0	1	1	1	0	1	1	0
0	1	1	1	1	1	1	0
1	0	0	0	0	1	1	0
1	0	0	0	1	1	1	0
1	0	0	1	0	1	1	0
1	0	0	1	1	1	1	0
1	0	1	0	0	1	1	0
1	0	1	0	1	1	1	0
1	0	1	1	0	1	1	0
1	0	1	1	1	1	1	0
1	1	0	0	0	1	1	0
1	1	0	0	1	1	1	0
1	1	0	1	0	1	1	0
1	1	0	1	1	1	1	0
1	1	1	0	0	1	1	0
1	1	1	0	1	1	1	0
1	1	1	1	0	1	1	0
1	1	1	1	1	1	1	1

$$A_1 = T_4 + T_3 + T_2 + T_1 + T_0$$

$$A_3 = T_4 + T_2 + T_2 + T_1 T_0$$

$$A_{24} = T_4 \cdot T_3$$