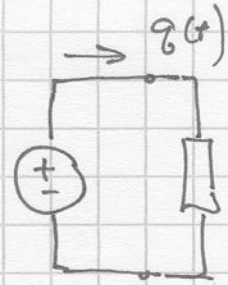
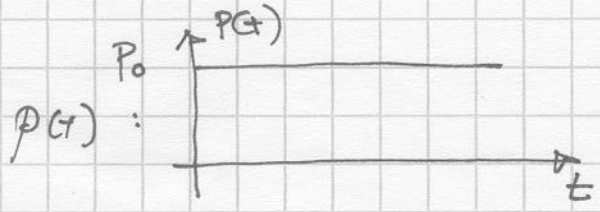
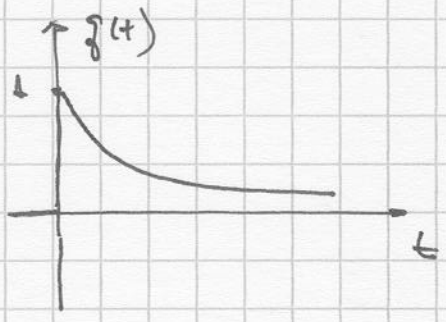
1





$q(t) = e^{-2t}$



$$i = \frac{dq}{dt}$$

b) $i = -2e^{-2t} \qquad t \geq 0$; $u(t) = \frac{P(t)}{i(t)}$; $u(t) = \frac{-P_0}{2} e^{2t}$ $t \geq$

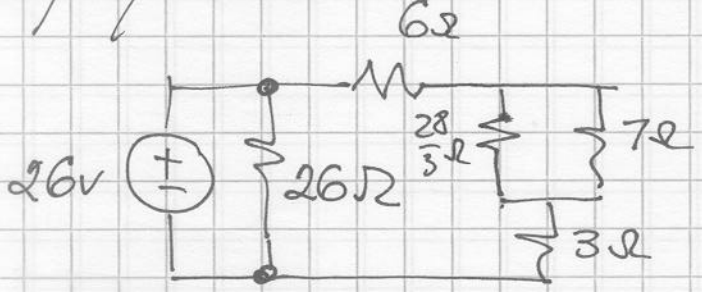
a) $W(t) = \int_{-\infty}^{t} P_0 \cdot dx$; $W(t) = P_0 \cdot t \qquad t \geq 0$

c) $p = v \cdot i$

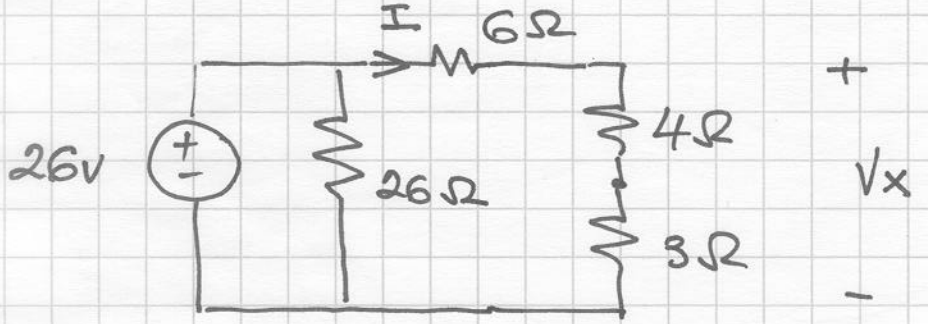
$\frac{dW(t)}{dt} = v \cdot \frac{dq}{dt}$; $v(t) = \frac{dW(t)}{dq(t)}$

(2)

By equivalence:



$$\frac{\frac{28}{3}\times 7}{\frac{28}{3}+7} = \frac{28\times 7}{49} = 4$$



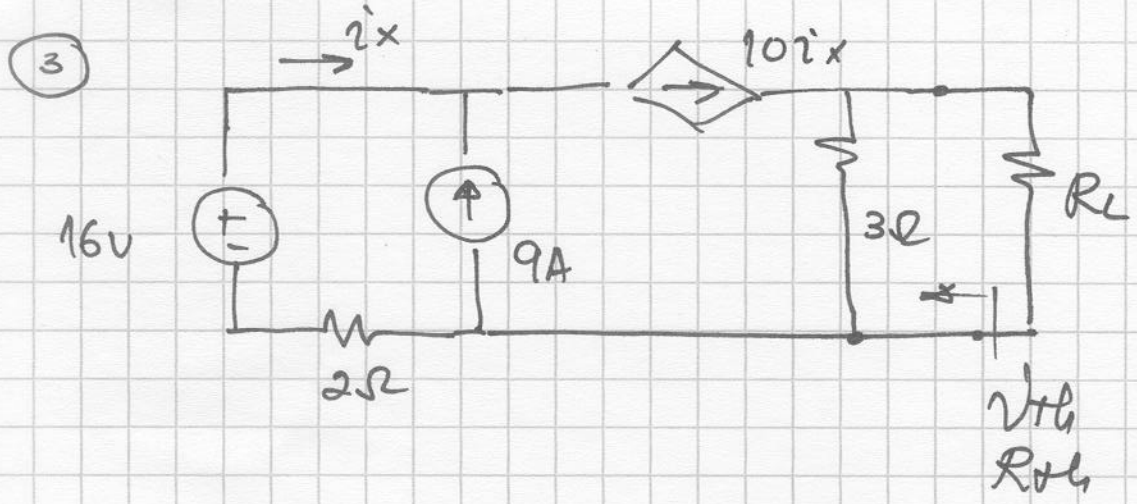
$$I = \frac{26}{6+4+3}$$

$$I = 2A$$

$$V_x = 7 \times 2$$

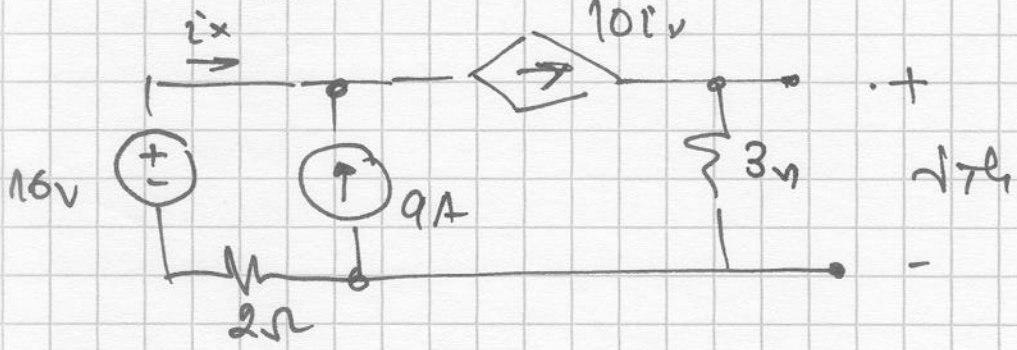
$$V_x = 14V$$

3



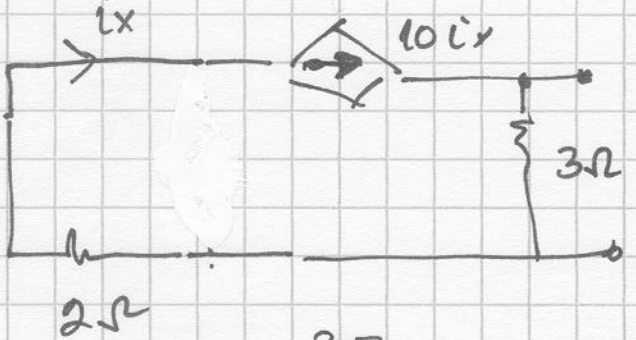
$10\,i_x = 9 + i_x$

$i_x = 1A$



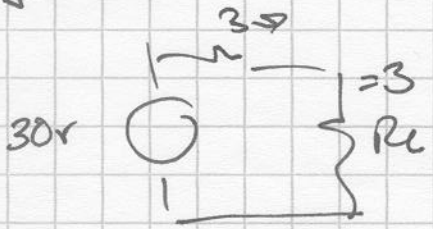
$V_{th} = 10 \cdot i_x \cdot 3$

$V_{th} = 30V$



$i_x = 0$

$R_{th} = 3\Omega$

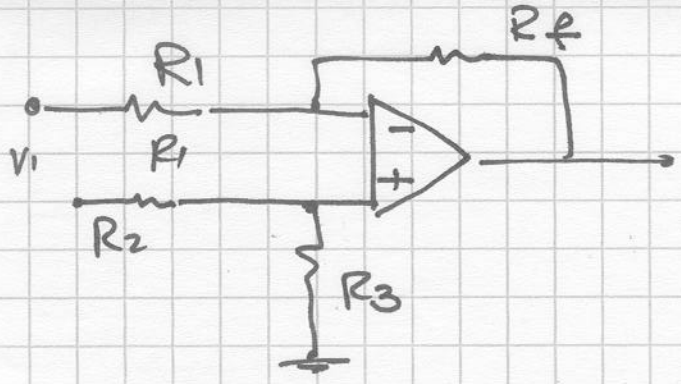


$R_L = 3\Omega$ $\quad I = \frac{30}{6} = 5A$

$V = 15V$

$P = 75W$

(4)



(4)

$$V_+ = \frac{R_3}{R_2+R_3} \cdot V_2$$

$$V_- = V_+$$

$$I_1 = \frac{V_1 - V_-}{R_1}$$

$$I_1 = \frac{1}{R_1} \cdot \left(V_1 - \frac{R_3}{R_2+R_3} \cdot V_2 \right)$$

$$V_{out} = - R_f \cdot I_1 + V_-$$

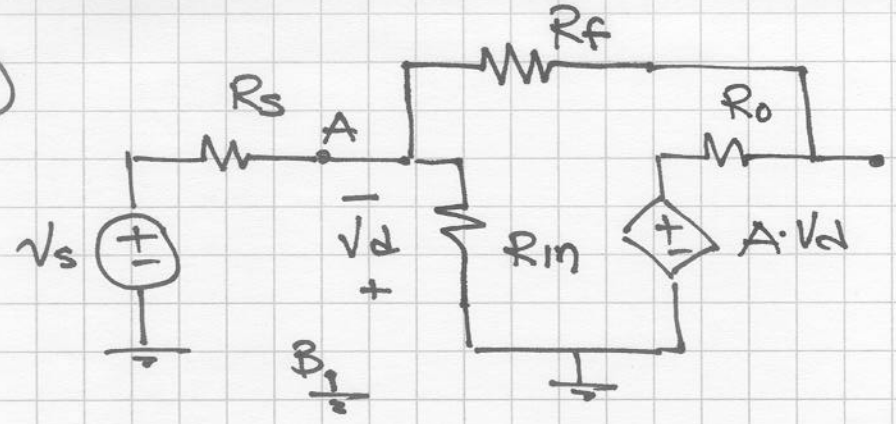
$$V_{out} = - \frac{R_f}{R_1} \cdot \left(V_1 - \frac{R_3}{R_2+R_3} \cdot V_2 \right) + V_+$$

$$V_{out} = - \frac{R_f}{R_1} \cdot V_1 + \left(\frac{R_f}{R_1} + 1 \right) \frac{R_3}{R_2+R_3} \cdot V_2$$

Also: $V_{out} < V_{sat}$

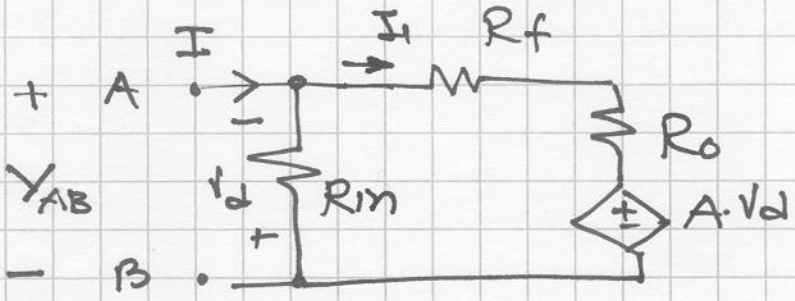
$$\left| - \frac{R_f}{R_1} \cdot V_1 + \left(\frac{R_f}{R_1} + 1 \right) \cdot \frac{R_3}{R_2+R_3} V_2 \right| < V_{sat}$$

(5)



(5)

Thevenin's equivalent:



$R_{th} = ?$

$$R_{th} = \frac{V_{AB}}{I}$$

$$I = \frac{V_{AB}}{R_{in}} + I_1$$

$$V_{AB} - R_f \cdot I_1 - R_o \cdot I_1 - A \cdot V_d = 0$$

$$V_d = -V_{AB}$$

$$(1+A) V_{AB} = (R_o + R_f) I_1$$

$$I_1 = \frac{(1+A)}{R_o + R_f} \cdot V_{AB}$$

Hence: $$I = \frac{V_{AB}}{R_{in}} + \frac{(1+A)}{R_o + R_f} \cdot V_{AB}$$

$$R_{Th} = \frac{V_{AB}}{I}$$

$$R_{Th} = \frac{1}{\frac{1}{R_{in}} + \frac{1+A}{R_o + R_f}}$$

$$R_{Th} = \frac{R_o + R_f}{1 + A + \frac{R_o + R_f}{R_{in}}}$$

$V_{Th} = 0$ (no independent sources Right of AB)

If opamp is ideal:

$R_o \to 0$

$R_{in} \to \infty$

$A \to \infty$

$R_{th} \to 0$ Hence, the circuit behaves as a virtual short circuit.