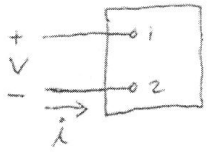
ENGR 204 Spring 2011 **Test 1** **Name:** Key

You can use Orcad Pspice to check problems 1 – 5 only. But for #6 you must use the program.

1) For the circuit shown, i(t) = 2t amps and v(t) = $3t^2$ volts. A) Find the power at 1.0 s and say whether the device is supplying or absorbing power. B) Find the total energy the device supplies or absorbs from t = 0 to t = 1.0 s.



A) $P = -vi$

$= -(3t^2)(2t) = -6t^3$

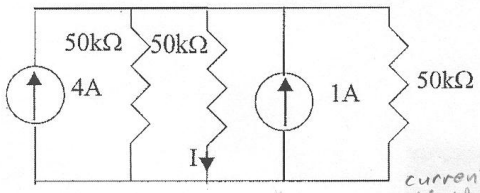
at $t = 1s$ $P = -6\ W$ so the device is supplying power

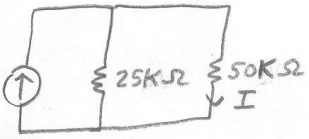
B) $W = \int_0^1 P\,dt = \int_0^1 -6t^3\,dt = -\frac{6t^4}{4}\Big]_0^1 = -1.5\ J$

so it supplies energy

2) a)Find the current I

Everything is in parallel

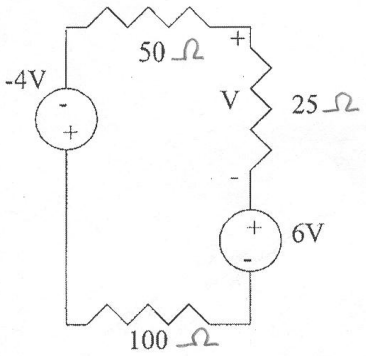


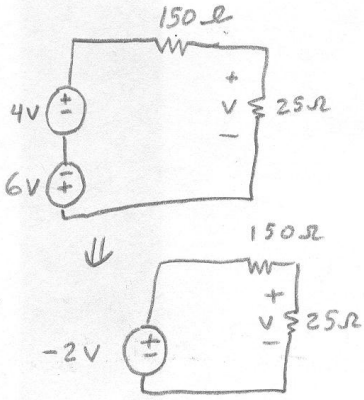
$\Rightarrow$ 

current divider $\Rightarrow$ $I = 5A\left(\frac{25\,K\Omega}{25k\Omega + 50K\Omega}\right)$

$= \boxed{1.67\,A}$

b) Find the voltage V



$\Rightarrow$ 

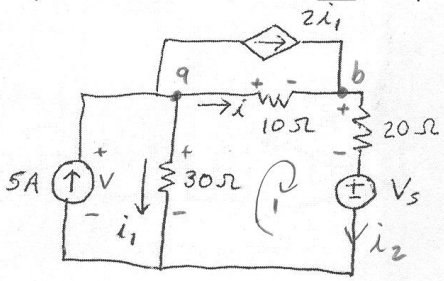
voltage divider:

$V = -2v\left(\frac{25\Omega}{150\Omega + 25\Omega}\right)$

$= -.286\,v$

$= \boxed{-286\,mV}$

3) If i = 1 A, find i_1 and V_s and do a power check. (There is room on the next page.)



KCL at a: $5A = 2i_1 + i_1 + 1A$

or $4A = 3i_1$

so $\boxed{i_1 = \frac{4}{3}A = 1.33\,A}$

KCL at b:

$1A + 2(1.33\,A) = i_2$

so $i_2 = 3.66\,A$

KVL loop! $\circlearrowright$: $-1.33A(30\Omega) + 1A(10\Omega) + 3.66A(20\Omega) + V_s = 0$

so $\boxed{V_s = -43.3\,v}$

Power check:

$P_{5A} = -(5A)V = -(5A)(1.33A)(30\Omega) = -199.5\,W$ (since it is in parallel with the 30Ω)

$P_{30\Omega} = i_1^2(30\Omega) = 53.067\,W$

$P_{10\Omega} = i^2(10\Omega) = 10\,W$

$P_{20\Omega} = i_2^2(20\Omega) = (3.66A)^2(20\Omega) = 267.912\,W$

$P_{V_s} = (3.66A)(-43.3v) = -158.48\,W$

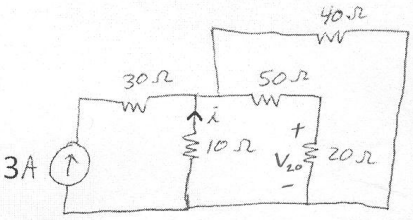
$P_{\diamond} = 2(1.33A)(10v) = 26.6\,W$

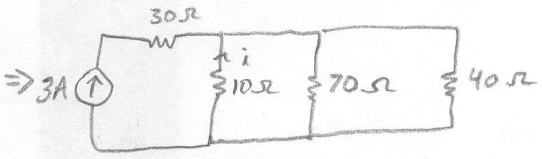
$\Sigma P_{used} = 357.6\,W$

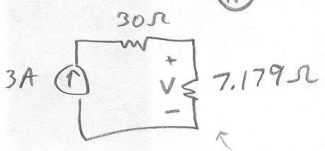
$|\Sigma P_{supplied}| = 357.9\,W$

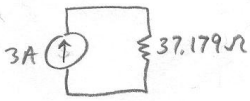
so yes these are ≈ equal

4) Find the equivalent resistance of the circuit shown as seen by the current source and also find the current i and the voltage across the 20 Ω resistor.









so $R_{eq} = 37.179\Omega$

so $V = 3A(7.179\Omega) = 21.537\,v$

this is the volts across the 10Ω resistor since it is in parallel. So,

$i = -\frac{21.537v}{10\Omega} = -2.1537\,A$

$= -2.15\,A$

assuming V_{20} is defined as shown in the original circuit,

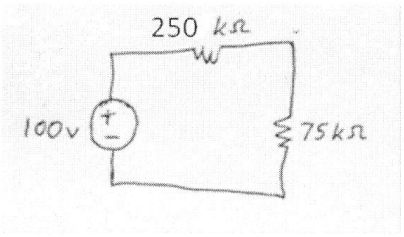
$V_{70} = V = 21.537v$

then voltage divider:

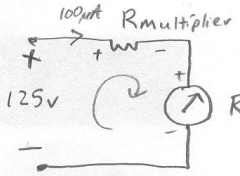
$V_{20} = 21.537v\left(\frac{20\Omega}{20\Omega + 50\Omega}\right)$

$= 6.15\,v$

5) A D'Arsonval movement is rated at 10 mV, 100 μA. It is to be used to make a voltmeter whose full scale reading is 125 volts.
   A) What is the multiplier resistor that must be added in order to make this voltmeter?
   B) What is the total resistance of this voltmeter?
   C) If it is to be used to measure the voltage across the 250 kΩ resistor in the circuit shown, what would this voltmeter read?
   D) What would an ideal voltmeter read for the voltage across the 250 kΩ resistor?



A)

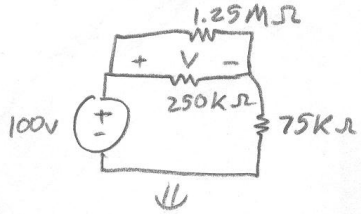


KVL: $-125\,v + 100\mu A\,(R_{multiplier}) + 10\,mV = 0$

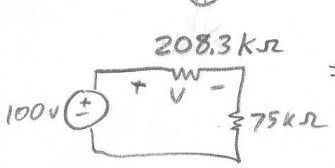
so $R_{multiplier} = 1{,}249{,}900\,\Omega = 1.2499\,M\Omega$

B) $R_{meter} = R_{multiplier} + R_{D'}$
$= 1{,}250{,}000\,\Omega$
$= \boxed{1.25\,M\Omega}$

C)



need to find V.

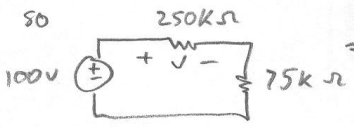


$\Rightarrow$ voltage divider $\Rightarrow$ $V = 100\,v\left(\frac{208.3\,k\Omega}{208.3\,k\Omega + 75\,k\Omega}\right)$

$= \boxed{73.5\,v}$

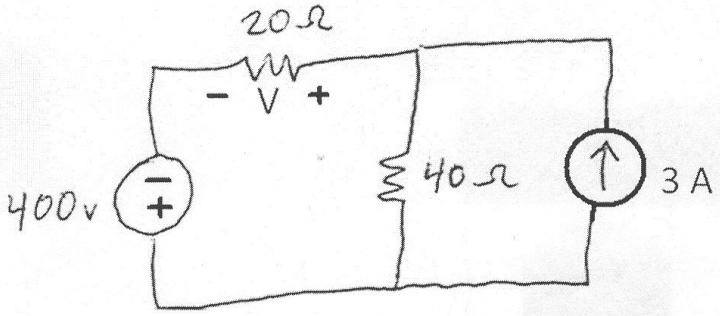
D) Ideal voltmeter has $R = \infty$

so



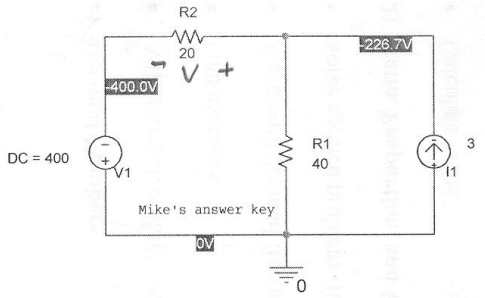
$\Rightarrow V = 100\,v\left(\frac{250\,k\Omega}{250\,k\Omega + 75\,k\Omega}\right) = \boxed{76.9\,v}$

6) Use Orcad Pspice for the circuit below to find the voltage V. Be sure to printout your results and be sure your name is typed on the printout and indicate your answer on your printout or in the space below. If you can't get Pspice to run, at least print out your circuit.



V = 173.3v

see printout.



the question wants V (shown above).

$V = 173.3\ v$

$= (-226.7 - (-400v))$