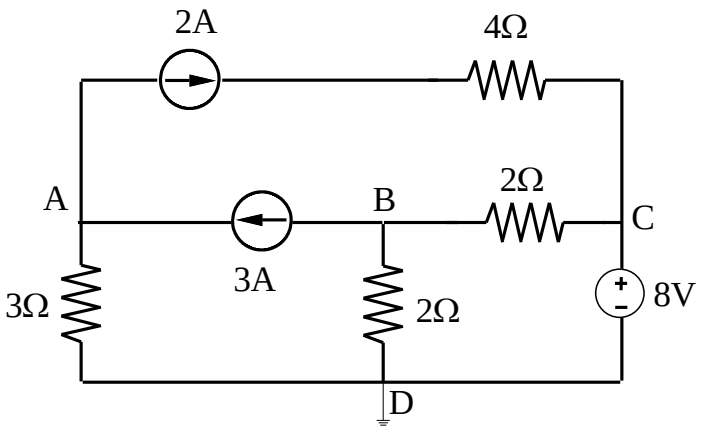
Electrical Power Engineering Fundamentals
DC Exam (18th October 2019)

a) Solve the circuit below using mesh analysis and provide a circuit diagram showing the value and direction of the currents that flow through each branch
b) Calculate the power balance of the circuit
c) Calculate Thevenin's equivalent of the circuit between terminals BD **including all the elements of the circuit in the equivalent**
d) Using the results of part c calculate the resistor that connected between B and D extracts the maximum amount of power from the circuit and calculate the power absorbed by the resistor.



Mesh equations:

Mesh 1: i1 = 2A

Mesh 2: ux+2· (i2-i3)+3·i2=0
Mesh 3: 2·(i3-i1)+8+2·(i3-i2)=0
Ad eq: i1-i2=3

Solving i1= 2A; i2=-1A; i3=-3/2 A; ux=2V

Branch currents:

i_{AC}= 2A
i_{BA}=3A
i_{AD}= 1A
i_{CB}= 7/2 A
i_{DC}=3/2A

b) $P_R=\sum R.i^2$= 44W

p_{8V}= 8· 3/2= 12 W DELIVERED
p_{3A}= 3·2= 6 W DELIVERED
p_{2A}=ux2·2 = 13·2=2 W DELIVERED

To calculate ux2 we apply 2KL to mesh 1:
-ux2+4·2+2·7/2-ux=0
ux2=13V

$p_g=p_{8V}+p_{3A}+p_{2A}$=44W =p_R

c) $u_{th=}u_B-u_D$= 2·1/2 =1V

Passivizing the circuit we find that: R_{th}=2||2 = 1 Ω

Alterative: Place a short-circuit between B and D and calculate isc=1A

Rth=uth/isc= 1 Ω

d) The R that absorbs maximum power is R= R_{th}= 1 Ω

Conecting R to the Thevenin's equivalent:

i=uth/(R+Rth)= 1/2 A

$P=R\cdot i^2$= 1/4 W