Circuit Simulation for the given problem using Circuit lab [Maximum power transfer]

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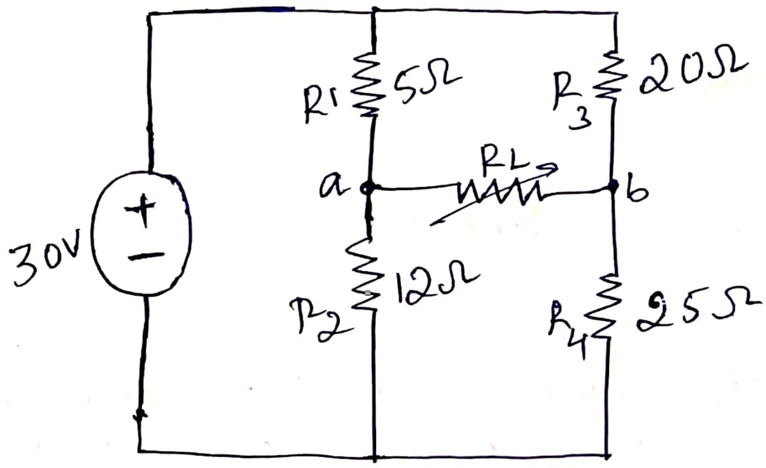
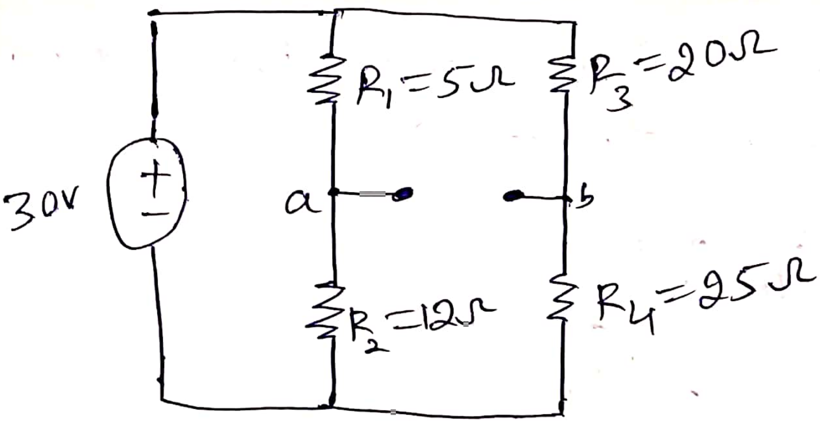


Disconnect the load resistance from the load terminals a and b. To represent the given circuit as Thevenin's equivalent, we are to determine the Thevenin's voltage V_{TH} and Thevenins equivalent resistance R_{TH}



The Thevenin's voltage or voltage across the terminals ab is $V_{ab}=V_a-V_b$

$$V_a = V \times R_2/(R1+R2)$$
$$= 30\times 12/(5+12)$$
$$V_a = 21.17\ V$$

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$$V_b = V \times R_4 / (R_3 + R_4)$$
$$= 30 \times 25 / (20 + 25)$$
$$= 16.66V$$

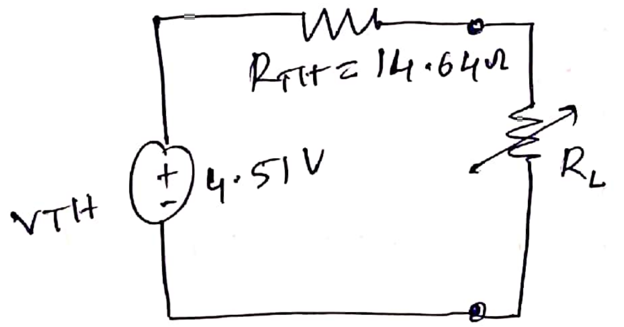
$\therefore$ $V_{TH} = V_{ab} = V_a - V_b = \underline{4.51V}$

To calculate the Thevenins equivalent resistance R_{TH} by replacing sources with their internal resistance (here assume that the voltage source has zero internal resistance so it becomes a short circuited)

$$R_{TH} = R_{ab} = (R_1 R_2 / (R_1 + R_2)) + (R_3 R_4 / (R_3 + R_4))$$

$$R_{TH} = \underline{14.64\ \Omega}$$

By reconnecting the load resistance, the thevenins equivalent circuit can be obtained as,



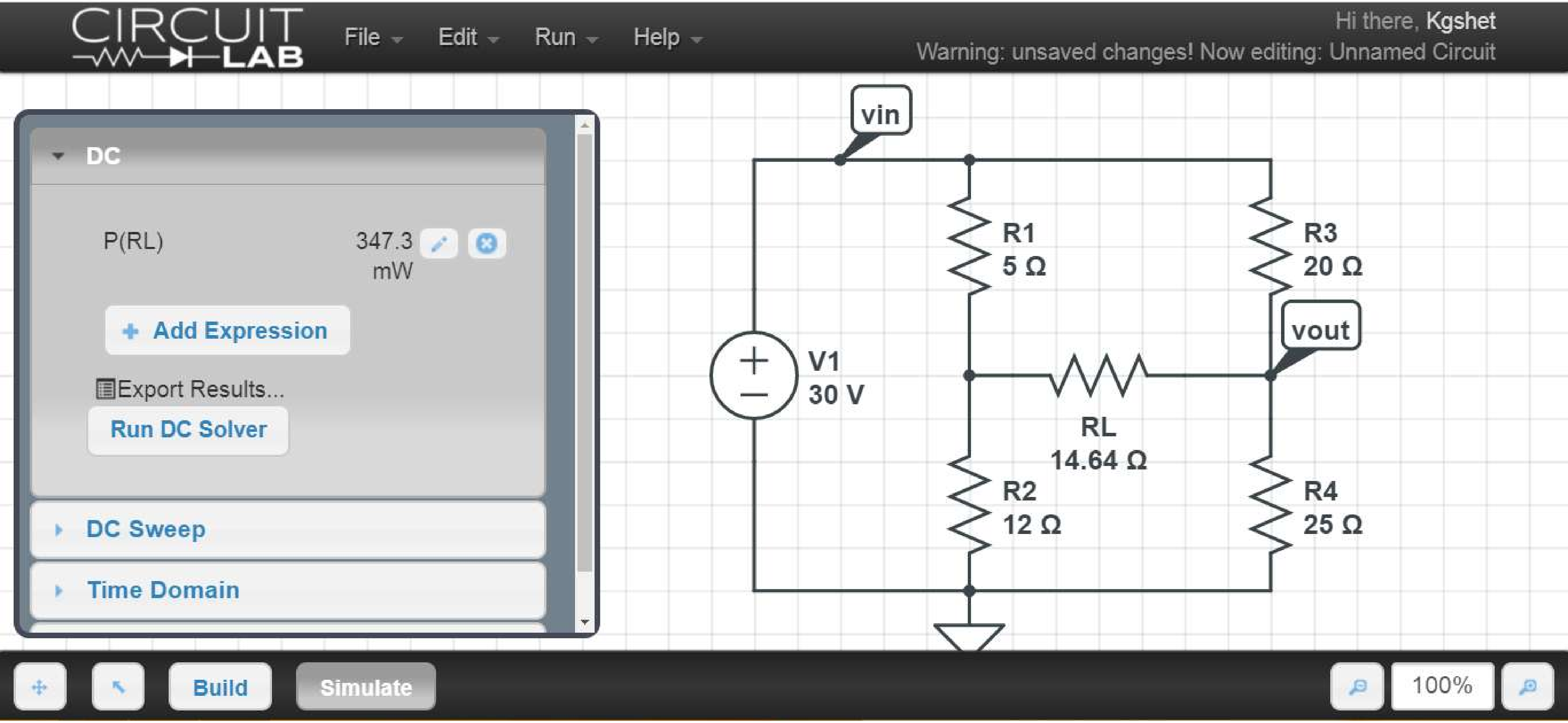
For the maximum power transfer theorem, RL value must equal to the R_{TH} to deliver maximum power to the load.

$\therefore$ $R_L = R_{TH} = 14.64\Omega$.

And the maximum power transferred to load R_L is.

$$P_{max} = V_{TH}^2 / 4R_{TH}$$

$$P_{max} = (4.51)^2 / 4 \times 14.64 \Rightarrow \underline{347.3\ \text{m Watt}}$$


CIRCUIT LAB
File
Edit
Run
Help
Hi there, Kgshet
Warning: unsaved changes! Now editing: Unnamed Circuit
DC
P(RL)
347.3 mW
Add Expression
Export Results...
Run DC Solver
DC Sweep
Time Domain
vin
R1
5 Ω
R3
20 Ω
vout
V1
30 V
RL
14.64 Ω
R2
12 Ω
R4
25 Ω
Build
Simulate
100%


CIRCUIT LAB
File
Edit
Run
Help
Sign in or create an account
Warning: unsaved changes! CircuitLab / Welcome to CircuitLab
Export Plot Images | Export Plot CSV | Hid
DC Sweep
30.00V, 347.3mW
P(RL)
400.0mW
350.0mW
300.0mW
250.0mW
200.0mW
150.0mW
100.0mW
50.00mW
0.000W
-50.00mW
W
-4.000V
-2.000V
0.000V
2.000V
4.000V
6.000V
8.000V
10.00V
12.00V
14.00V
16.00V
18.00V
20.00V
22.00V
24.00V
26.00V
28.00V
30.00V
32.00V
34.00V
V.V