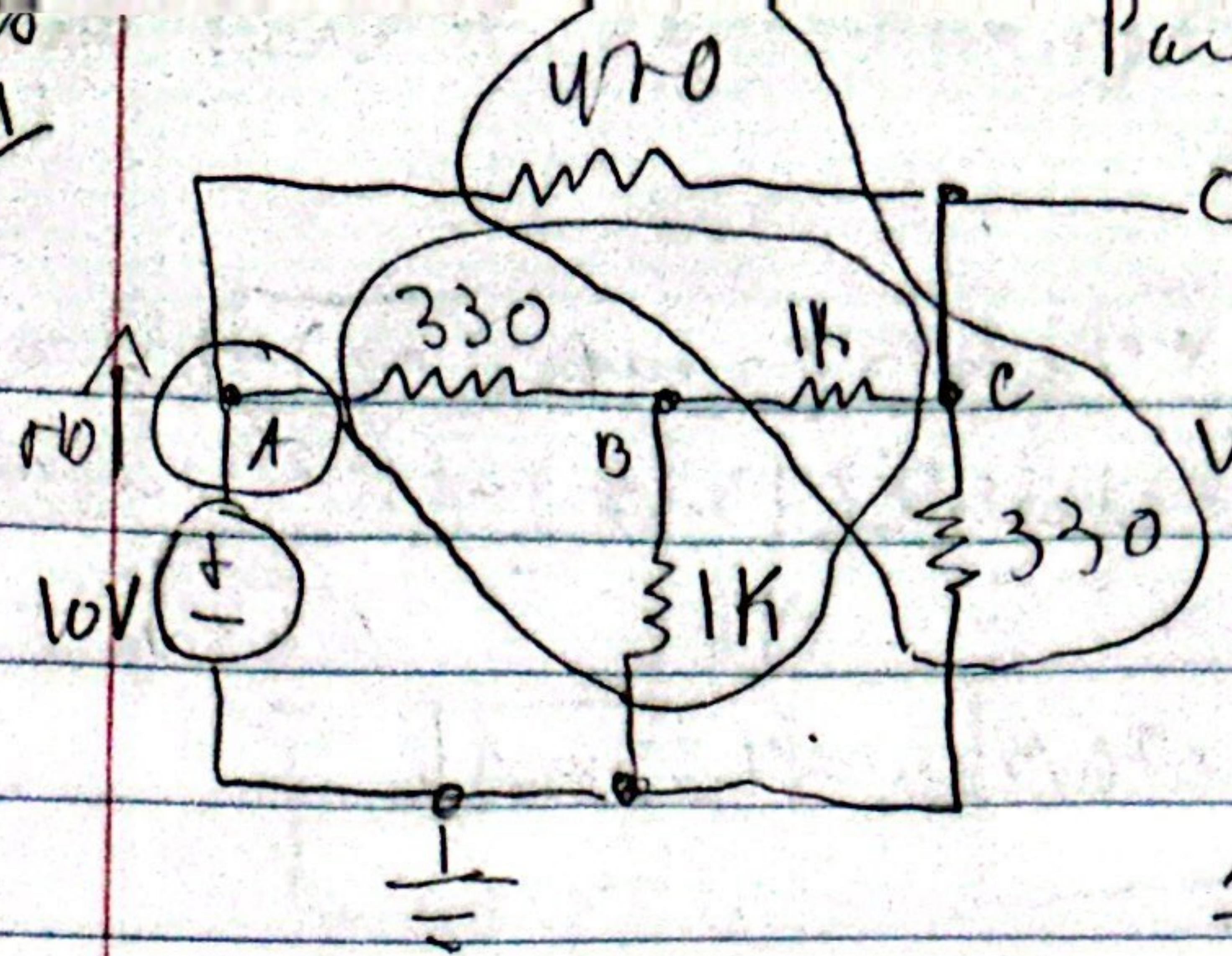
circuit
part 1

# Part 3 circuit analysis




node A: top of the 10V source
fixed at $V_A = 10V$
node B: middle junction (330 & 1kΩ)
node C: right junction (470, 1kΩ, 330)

Resistors:
A - B: 330Ω
B - C: 1kΩ
A - C: 470Ω
B - ground: 1kΩ
C - ground 330Ω

1) node voltage analysis $V_B = 6.92$ $V_C = 4.58$

KCL at node B:

$V_A = +10$
ground = 0V

$$\frac{V_B - V_A}{330} + \frac{V_B - V_C}{1000} + \frac{V_B - 0}{1000}$$

$$\frac{V_B - 10}{330} + \frac{V_B - V_C}{1000} + \frac{V_B - 0}{1000} \quad (\times 1000)$$

$$\frac{1000}{330}(V_B - 10) + (V_B - V_C) + V_B = 0$$

$$(3.0303 + 2)V_B - V_C = 30.30303$$

$$\boxed{5.030303 V_B - V_C = 30.30303}$$

2) KCL at node C:

$$\frac{V_C - V_A}{470} + \frac{V_C - V_B}{1000} + \frac{V_C - 0}{330} = 0$$

$$(\times 1000) \quad \frac{V_C - 10}{470} + \frac{V_C - V_B}{1000} + \frac{V_C}{330} = 0$$

$$\frac{1000}{470}(V_C - 10) + (V_C - V_B) + \frac{1000}{330} V_C = 0$$

$$-V_B + (2.127 + 1 + 3.0303)V_C = 21.2765$$

$$\boxed{-V_B + 6.157963 V_C = 21.276596}$$

3) Solving (B) - (C):

(C) $V_B = 6.1579 \; V_C - 21.2765$

put into B

$$5.0303(6.1579 V_C - 21.276) - V_C = 30.30$$

$$(30.9764 - 1)V_C - 107.02 = 30.303$$

$$29.976422 V_C = 137.3 \quad \boxed{V_C = 4.58V}$$

$$V_B = 6.157(4.58) - 21.27 = \boxed{6.92V}$$

Scanned with CamScanner

Circuits
Lab 1

Part 3 analysis

2) currents in every element

$$I = \frac{V_{left} - V_{right}}{R}$$

*check B $(2.344 + 6.92) - 9.33 = 0V$ ✓

*check C $(13.88) - (11.53 + 2.344) = 0V$ ✓

Through A-B (330Ω)

$\Delta V = 10 - 6.92 = 3.076V \rightarrow I_{AB} = 3.076/330 \approx \boxed{9.33mA}$

Through B-C (1kΩ)

$\Delta V = 6.92 - 4.58 = 2.344V \rightarrow I_{BC} = \boxed{2.344mA}$

Through A-C (470Ω)

$\Delta V = 10 - 4.58 = 5.421V \rightarrow I_{AC} = 5.421/470 \approx \boxed{11.53mA}$

B to ground (1kΩ) $I_{B\downarrow} = V_B/1000 \; 6.92/1000 = \boxed{6.92mA}$

C to ground (330Ω) $I_{C\downarrow} = V_C/330 \approx \boxed{13.88mA}$

3) Power dissipated $P = \frac{(\Delta V)^2}{R}$

- 330Ω (A-B) $P_{AB} = (3.076)^2/330 = \boxed{28.7mW}$
- 1kΩ (B-C) $P_{BC} = (2.344)^2/1000 = \boxed{5.50mW}$
- 470Ω (A-C) $P_{AC} = (5.421)^2/470 = \boxed{62.6mW}$
- 1kΩ (B-G) $P_{B\downarrow} = (6.92)^2/1000 = \boxed{47.9mW}$
- 330Ω (C-G) $P_{C\downarrow} = (4.58)^2/1000 = \boxed{63.6mW}$

$\boxed{\Sigma P = 208.3mW}$

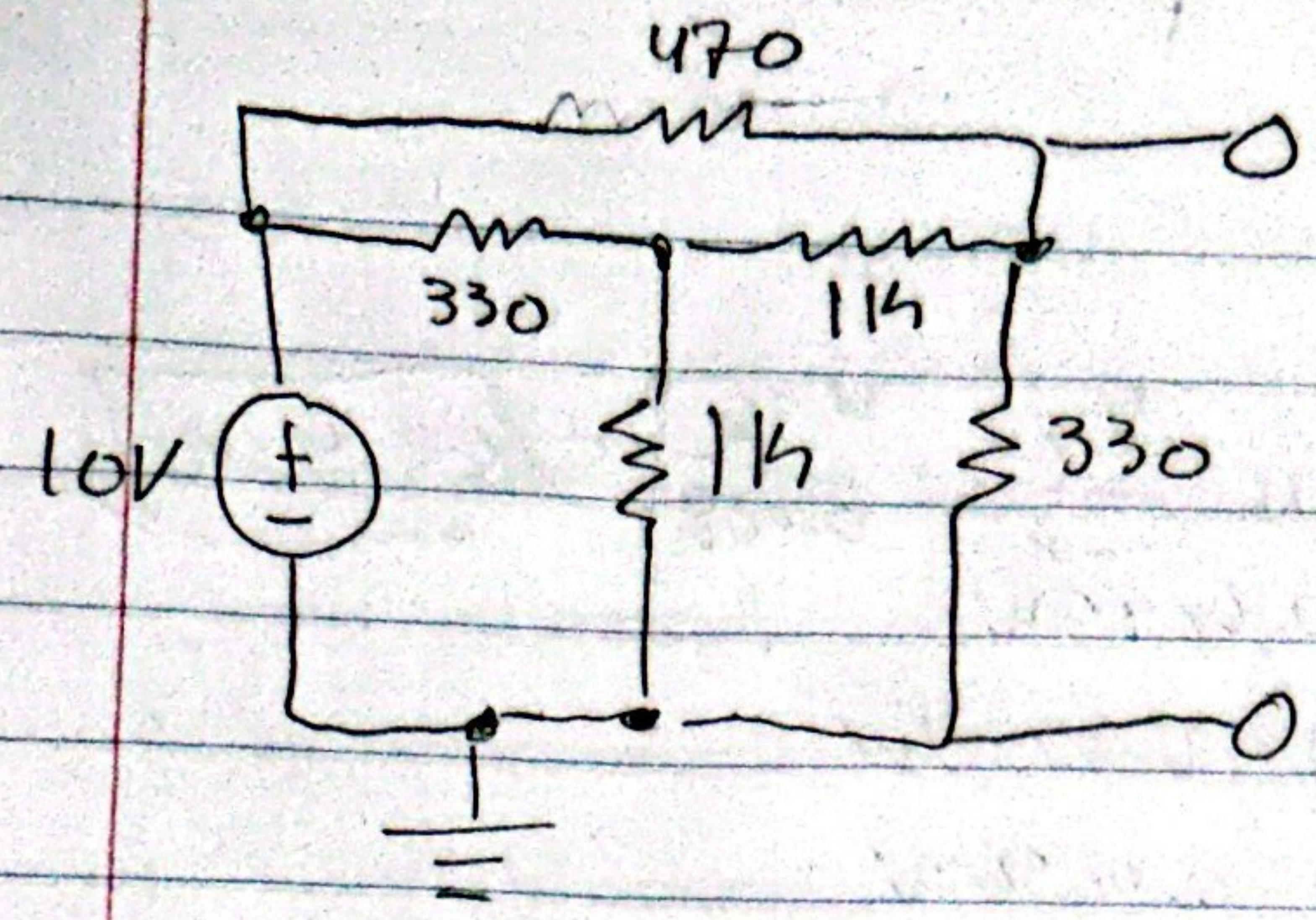
4) $I_{source} = I_{AB} + I_{AC} = 9.33mA + 11.53mA = \boxed{20.86mA}$

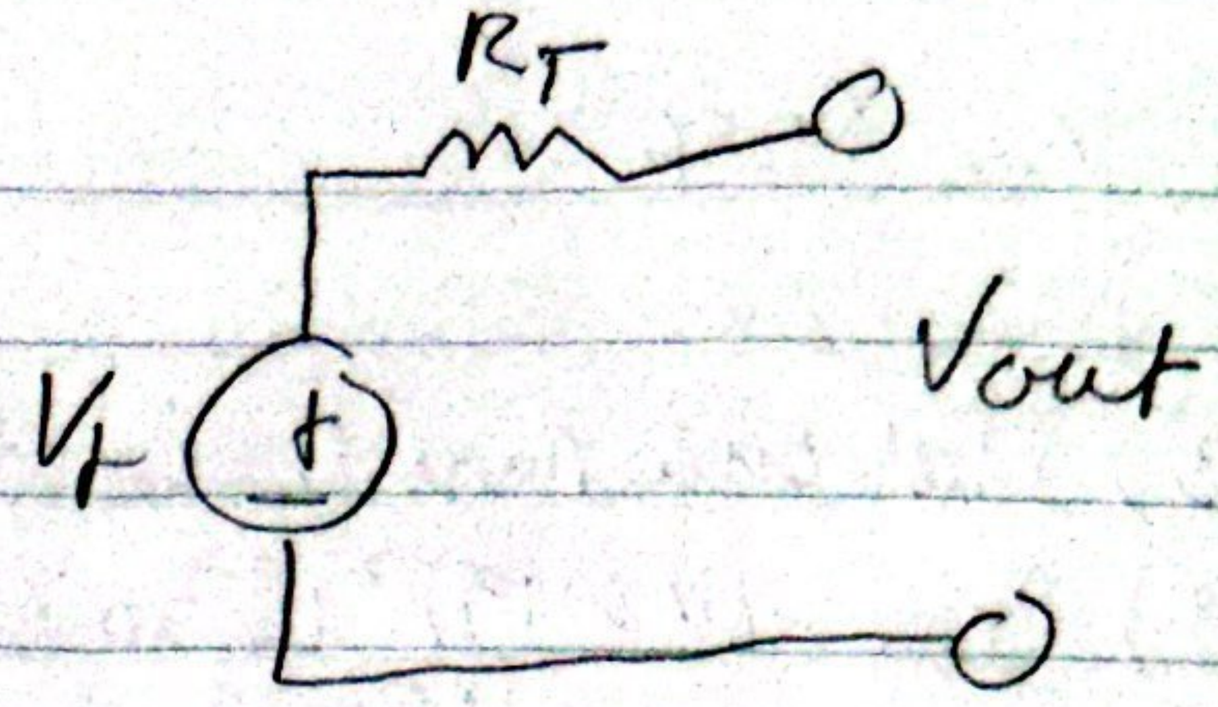
$P_{source} = 10V \times 0.02086A \approx \boxed{208.6mW}$

5) error calculation (done in the lab

circuits lab 1

Part 4 Thevenin equivalent circuits




- ground (bottom rail) = 0V
- node A = top of the source → $V_A = 10V$
- node B = middle junction (330Ω, 1kΩ, 1kΩ↓)
- node C = right terminal (joins 470Ω from A, 1kΩ from B, 330Ω) → $V_{out}$

Resistors: A–B: 330Ω; B–C: 1kΩ, A–C: 470Ω, B–G: 1kΩ, C–G: 330

open circuit Voltage $V_{oc}$ ($V_{Th}$)

1) -Thel at B–C

node B: $\frac{V_B-10}{330}+\frac{V_B-V_C}{1000}+\frac{V_B}{1000}=0$ $\boxed{V_B = 6.934V}$

node C: $\frac{V_C-10}{470}+\frac{V_C-V_B}{1000}+\frac{V_C}{330}=0$ $\boxed{V_C = 4.581V}$

$V_{OC} = V_{Th} = 4.5183V$

2) Short circuit current $I_{sc}$

$\frac{V_B-10}{330}+\frac{V_B}{1000}+\frac{V_B}{1000}=0$ $\boxed{V_B = 6.024096V}$

$I_{sc}=\frac{10-0}{470}+\frac{V_B-0}{1000}=0.0212766+0.0060241\approx\boxed{0.0273007A=27mA}$

3) Thevenin resistance $R_{Th}=\frac{V_{oc}}{I_{sc}}\approx\frac{4.581293}{0.0273007}\approx\boxed{167.809\Omega}$

1. 330Ω (C–G) 2. 470Ω (C–A=G)

3. 1kΩ (330∥1000) $R_3=1000+(330\parallel1000)=1000+248.12=\boxed{1248.12\Omega}$

$R_{eq}=(1/330+1/470+1/1248)^{-1}=\boxed{167.809\Omega}$

$\boxed{\text{Verify } I = V_{Th}/R_{Th} = 4.518/167.809 = 27mA}$

Circuits Lab 1

Part 4 actual

1) $V_{oc} = 4.56$

2) $I_x = 2.8$

3) Thevenin Resistance : $R_{TN} = \frac{V_{oc}}{I_x} = \frac{4.56}{0.028} = \boxed{163.4\,\Omega}$

4) $P_{330} = (0.0093)^2(330) = 0.0285W$

$P_{470} = (0.01157)^2(470\,\Omega) = 0.0629W$

$P_{1k\Omega} = (0.00237)^2(1000) = 0.0056W$

$P_{1k} = (0.00693)^2(1000) = 0.0480W$

$P_{R6} = (0.01382)^2(330) = 0.0630W$

Total $= 0.208W$

$I_2 = I_{330} + I_{470} \approx \boxed{20.87mA}$

5) Power $V_2 \cdot I_2 = (0.010)(0.02087) = \boxed{0.2087W}$

a very small difference can be seen. Largely because the circuit is following the laws of the conservation of energy