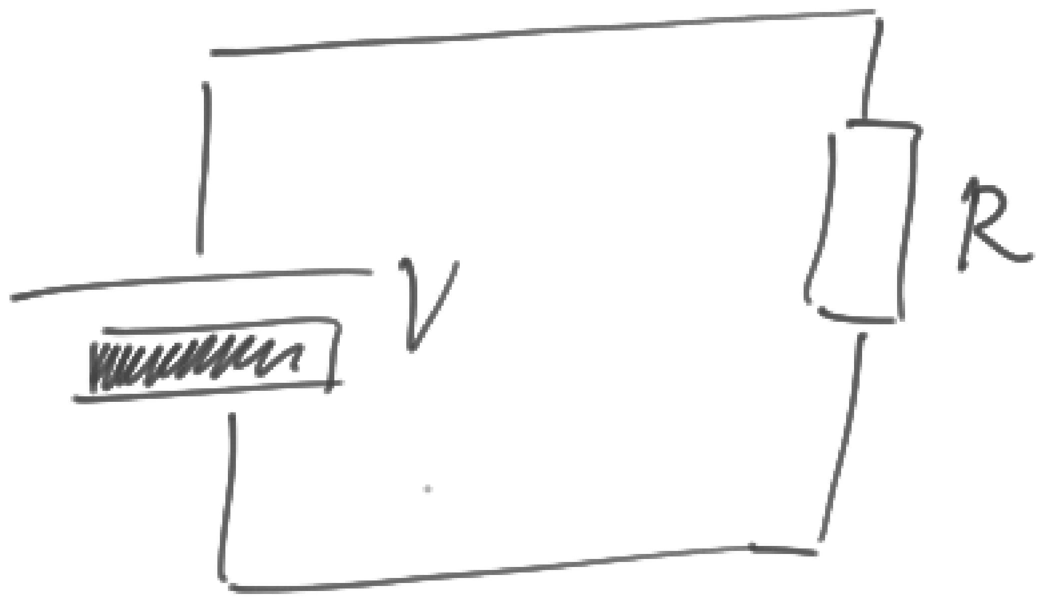
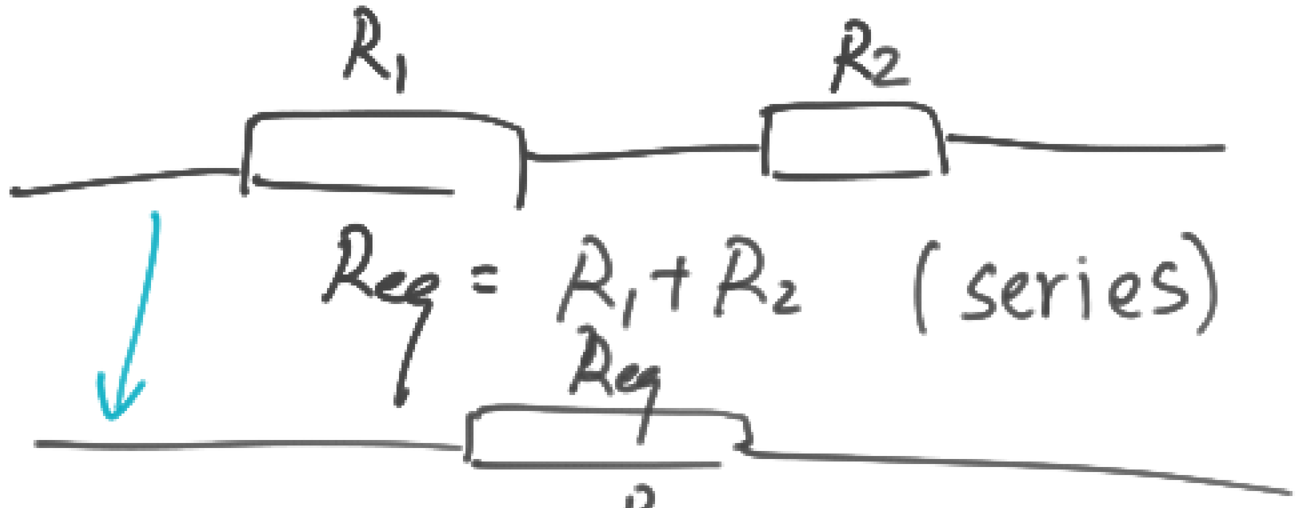
Circuit 💀

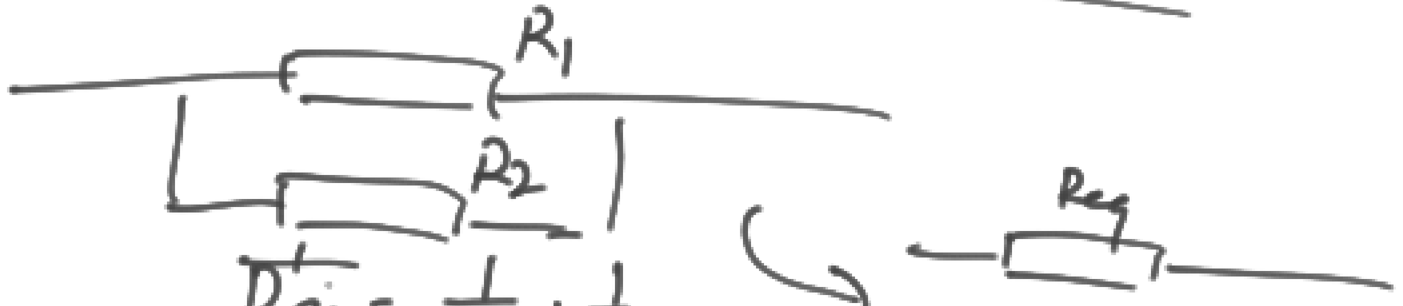


Trivial

$V = IR$

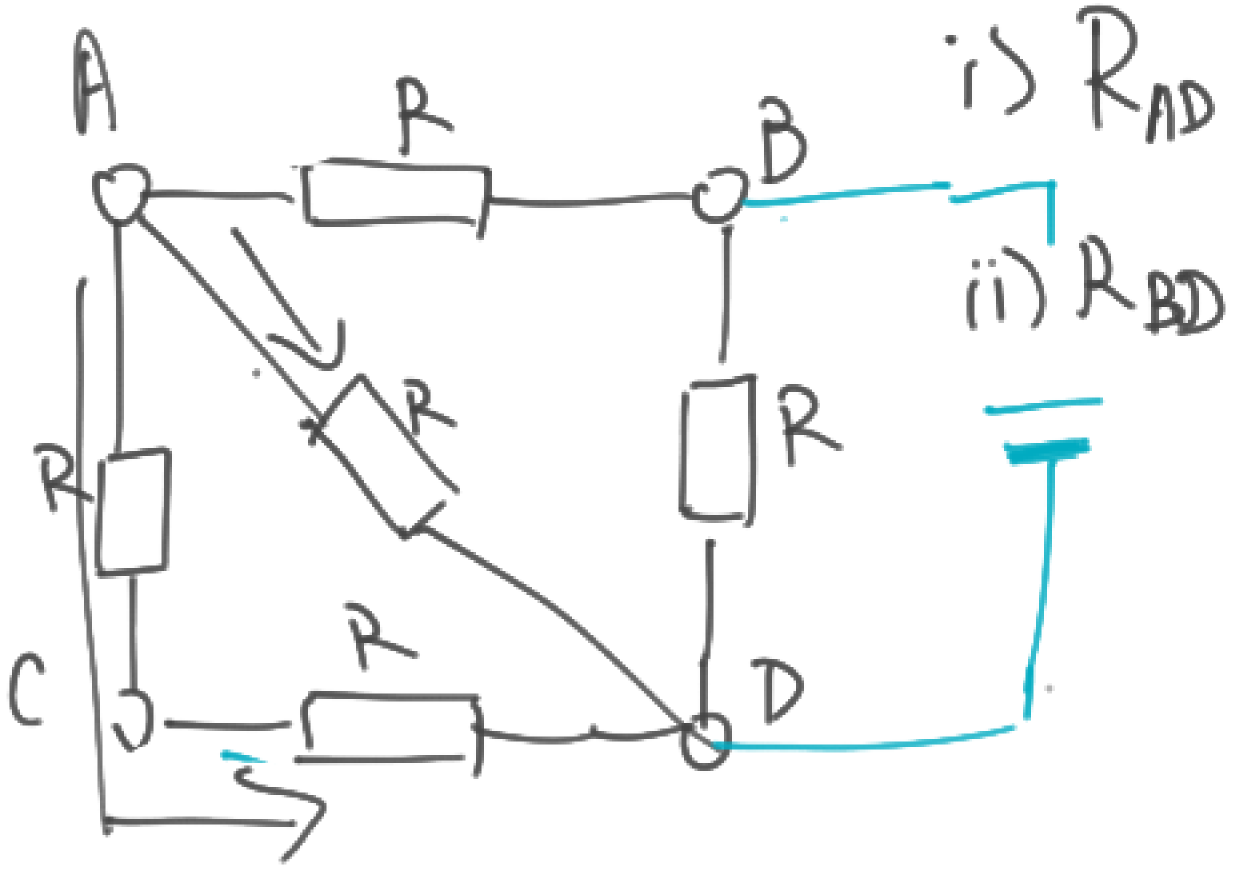


$R_{eq} = R_1 + R_2$ (series)



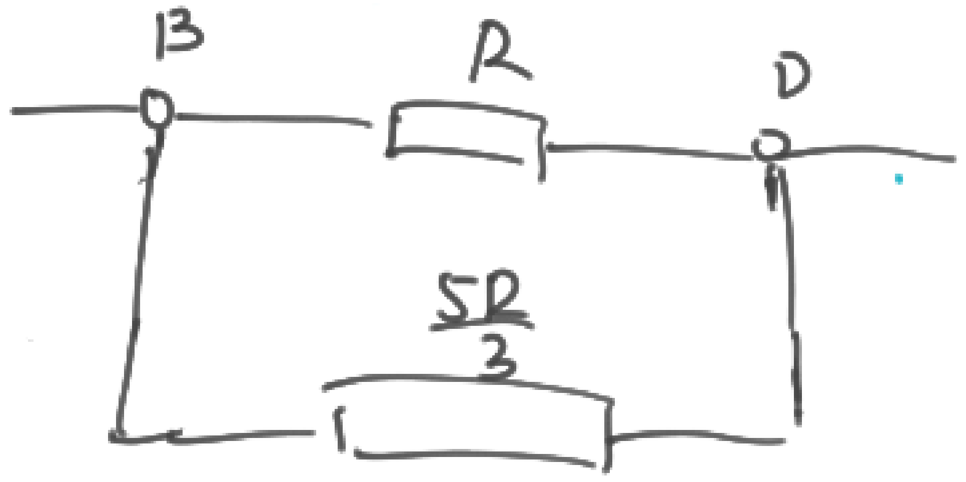
$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$ (parallel)

Test 1: Find R_{eq}

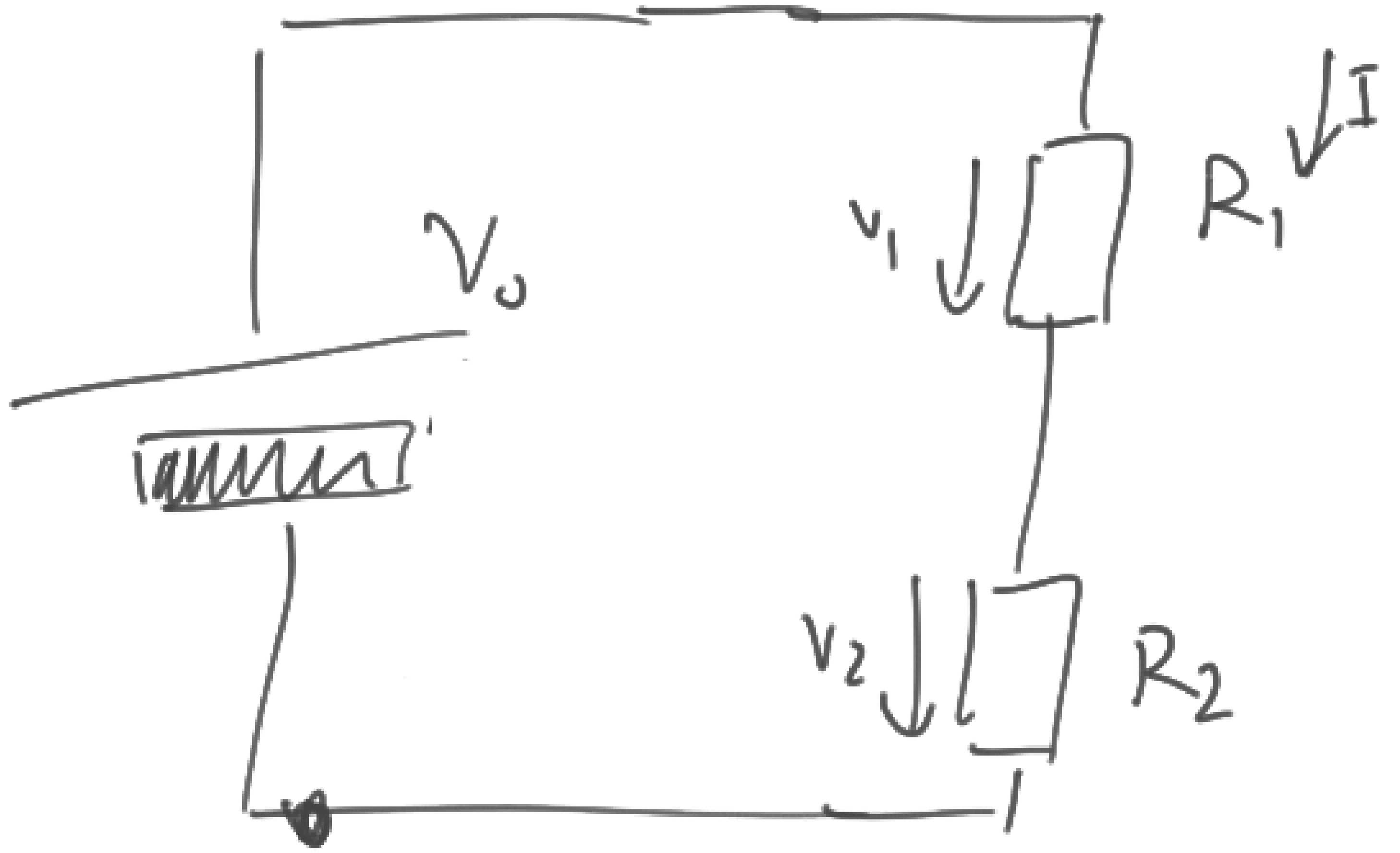


i) R_{AD}

ii) R_{BD}



$$\left(\frac{1}{\frac{5R}{3}} + \frac{1}{R}\right)^{-1} = \left(\frac{3}{5R} + \frac{5}{5R}\right)^{-1} = \left(\frac{8}{5R}\right)^{-1} = \frac{5R}{8}$$

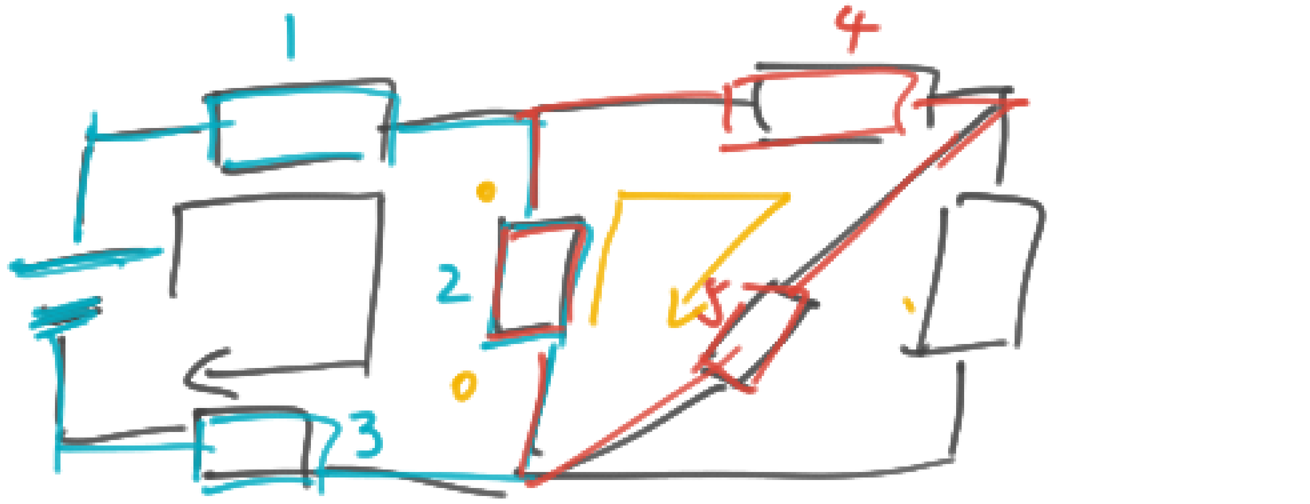


V consumed = V provided

Things that consume V	Things that give V
Resistor...	Battery

$\therefore V = IR_1 + IR_2$

$V_1 + V_2 = V_0$

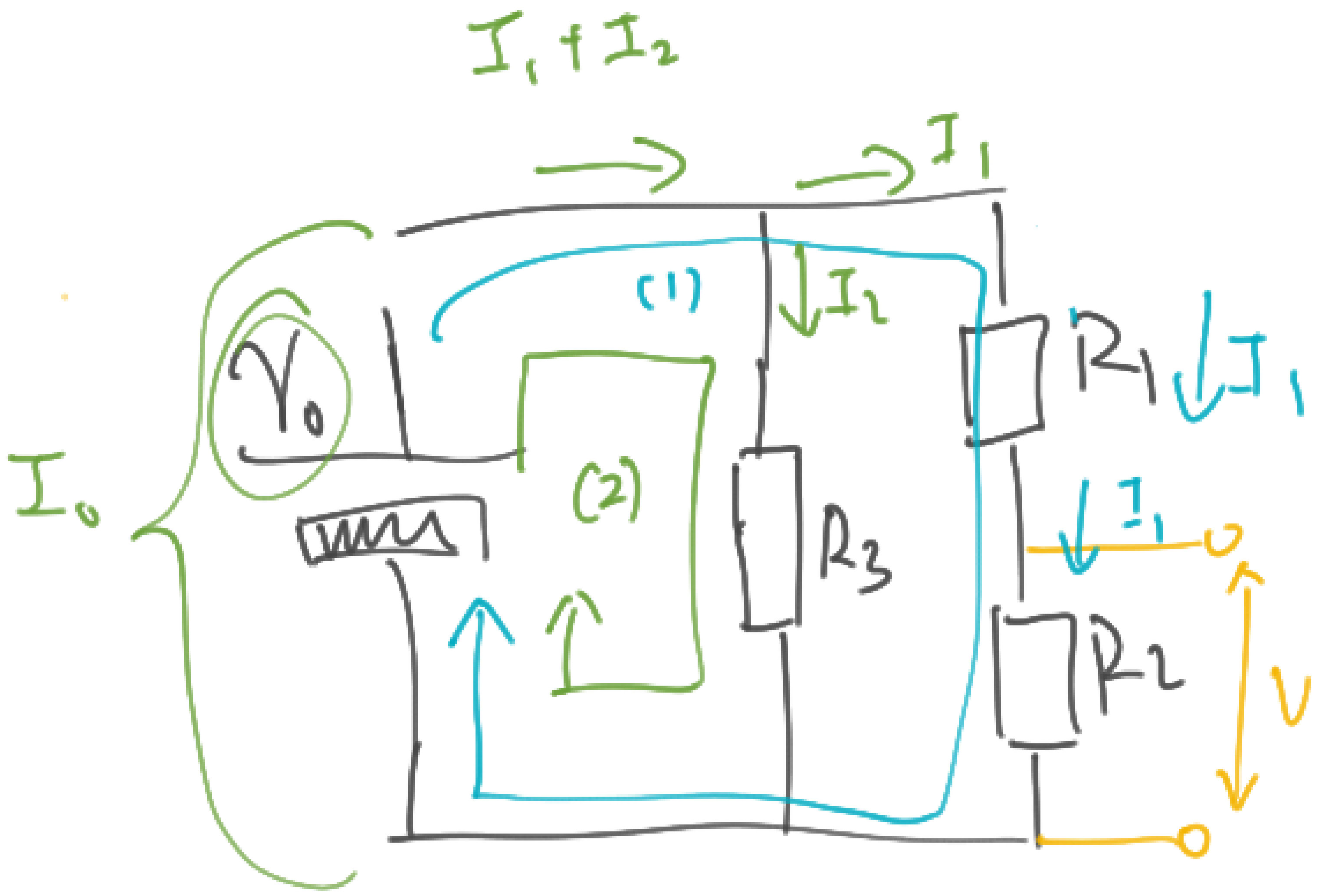


$V = V_1 + V_2 + V_3$

Provide

$V_2 = V_4 + V_5$

$V_2 - V_4 - V_5 = 0$



Find V across R_2.
in terms of V_0 R_1 R_2

$\rightarrow V_0 - V_1 - V_2 = 0$

$V_0 - I_1 R_1 - I_1 R_2 = 0$

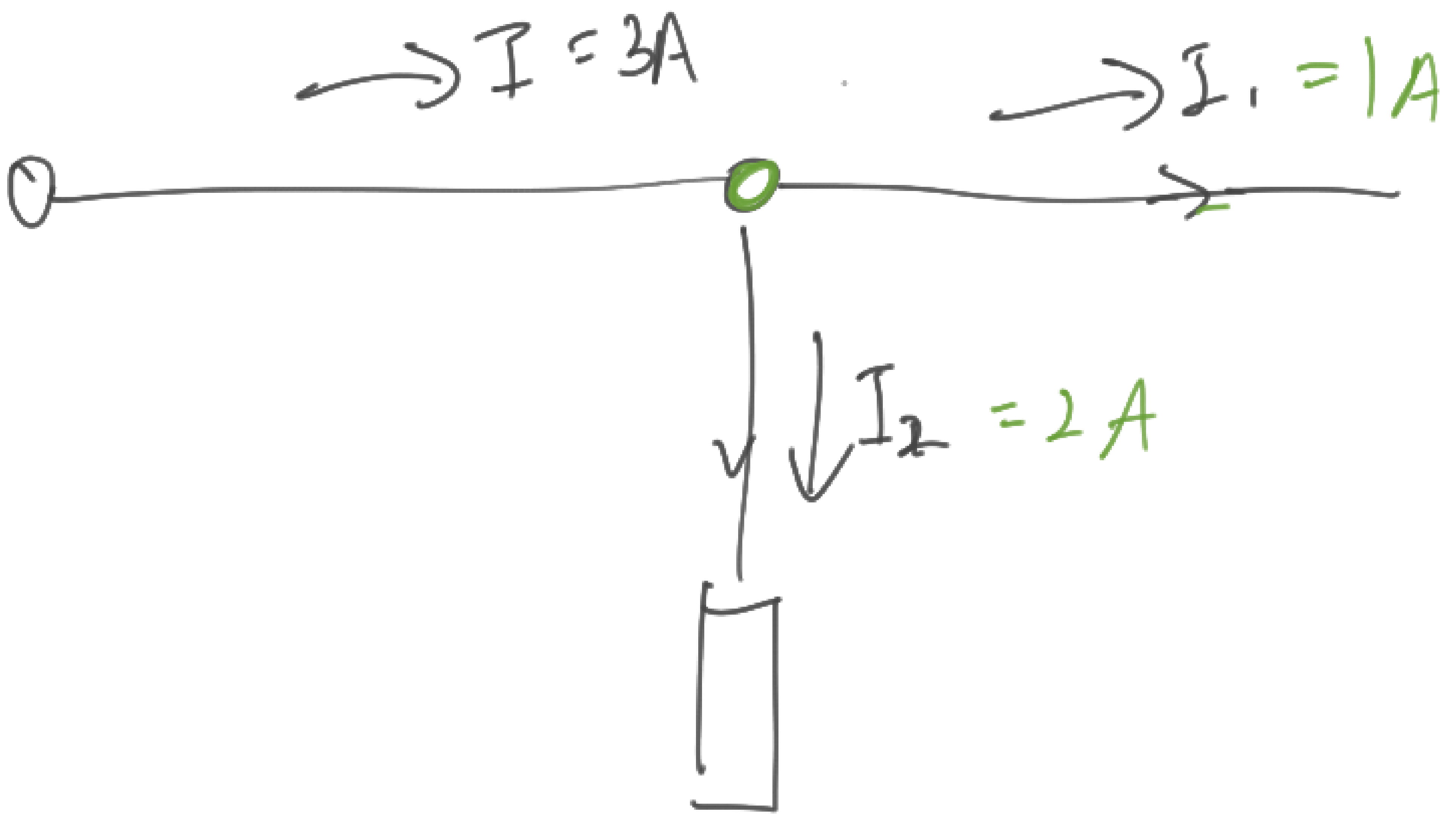
$I_1 = \frac{V_0}{R_1 + R_2}$

$V_2 = V_0 \frac{R_2}{R_1 + R_2}$

(2) $V_0 - V_3 = 0$

$R_3 I_2 = V_0$

$I_2 = \frac{V_0}{R_3}$

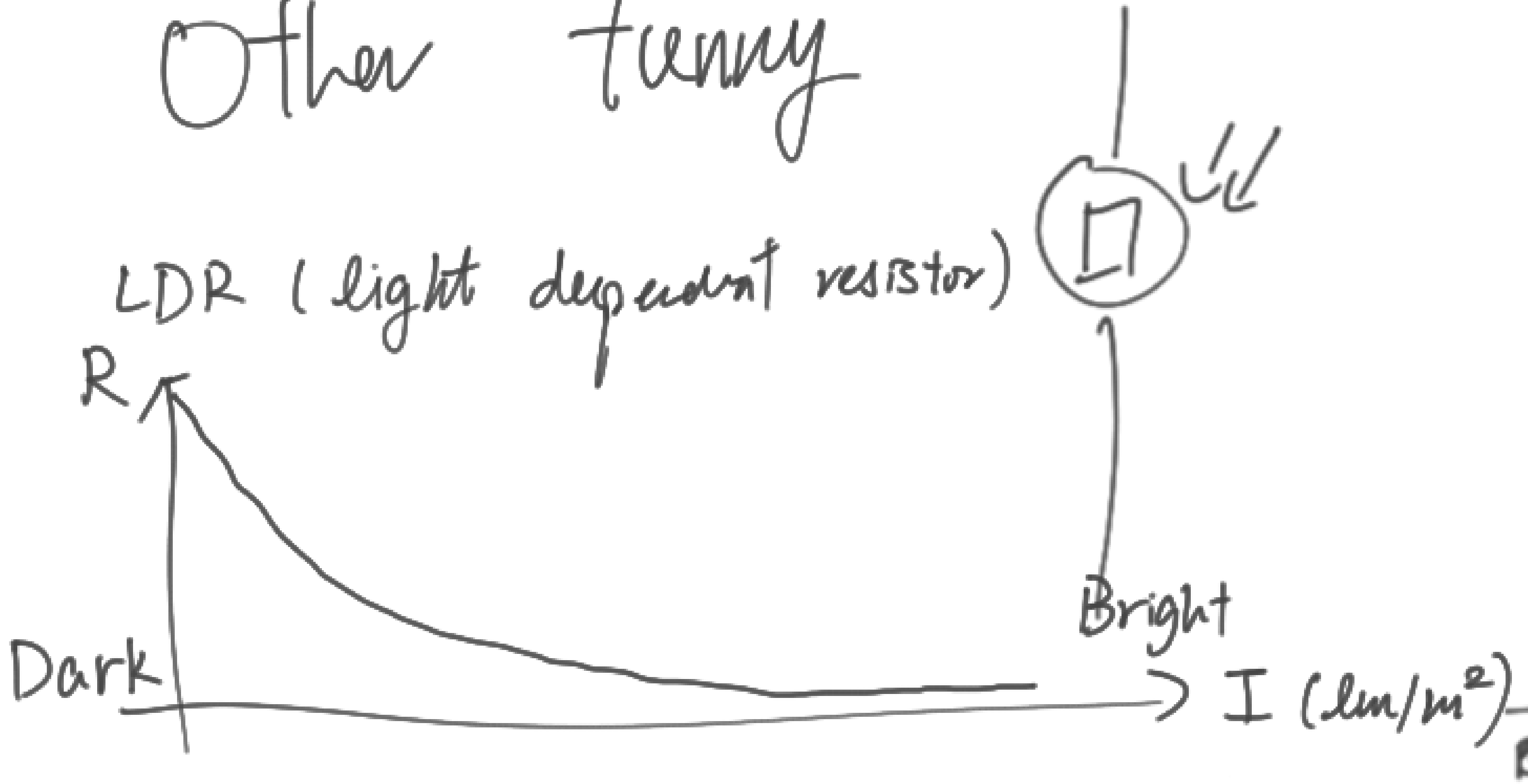


Current law

$$I_2 + I_1 = I = 3A$$

Other funny

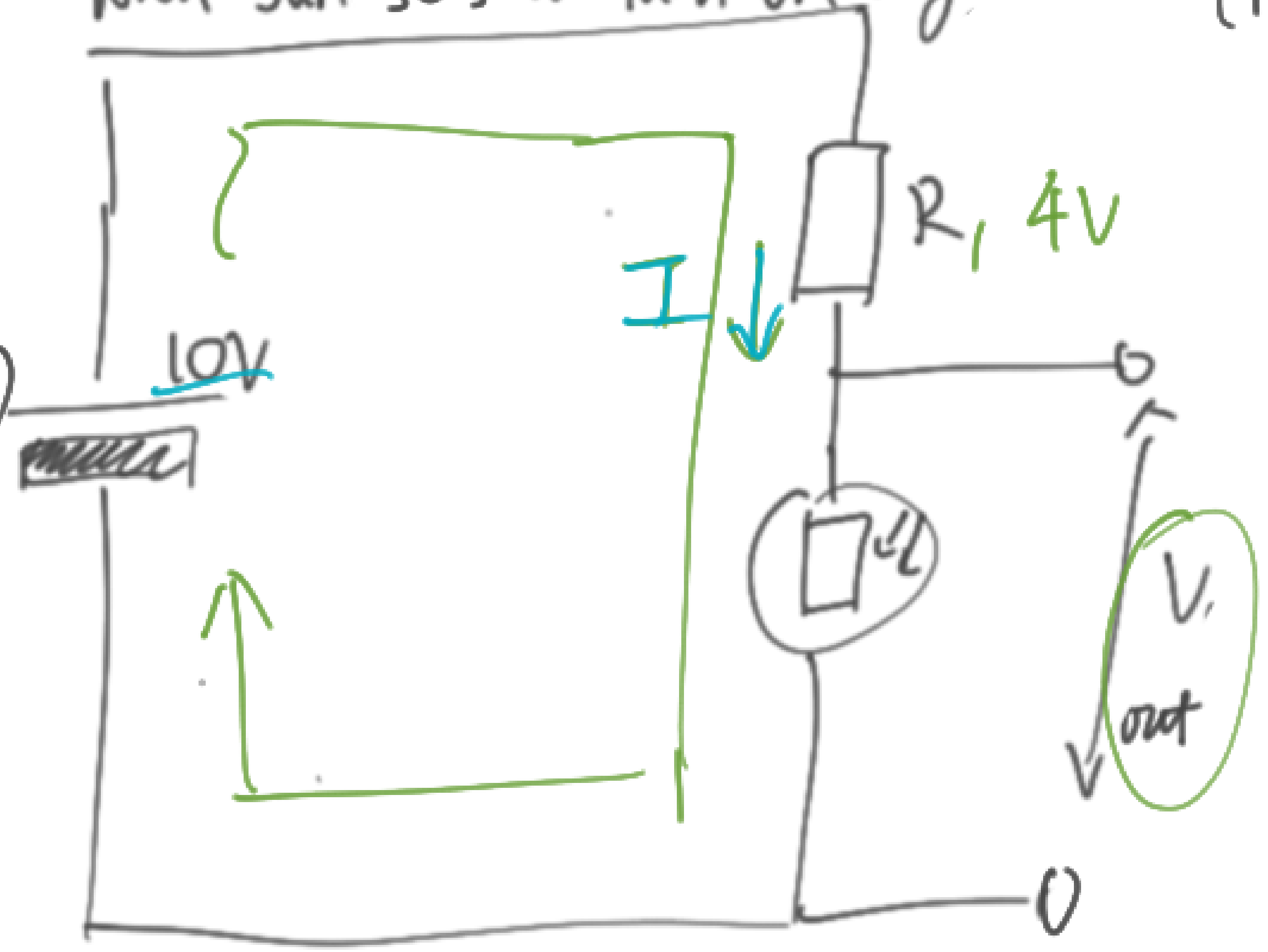
LDR (light dependent resistor)



Street lamp: Given R when sunset · 500 Ω

find suitable R_1 such that $V_{out} = 6V$

when sun sets to turn on light bulb. (in ext circuit)



$$\boxed{\begin{aligned} V_{R1} &= 10-6 \\ &= 4V \end{aligned}}$$

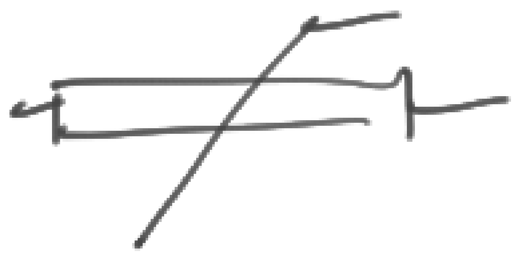
$$V_0 - (V_{R1} + V_{R2}) = 0$$

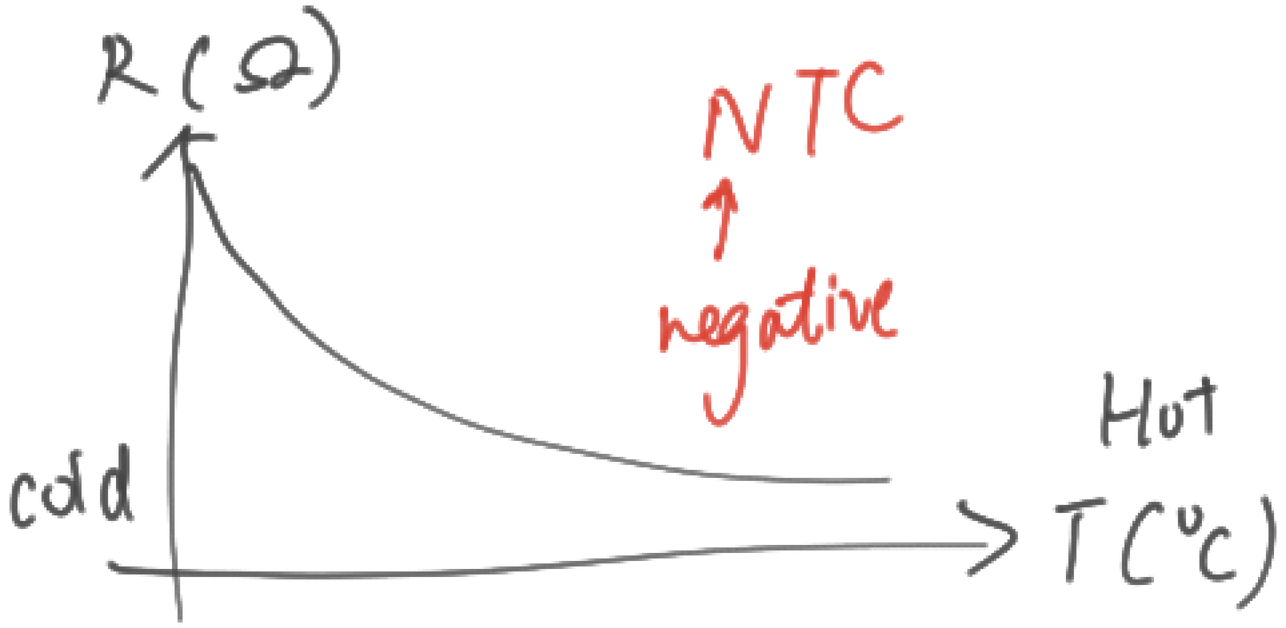
$$V_{R1} = I \cdot R_1$$

$$V_{R2} = 6V = I(500)$$

$$I = \frac{6}{500}$$

Thermistor





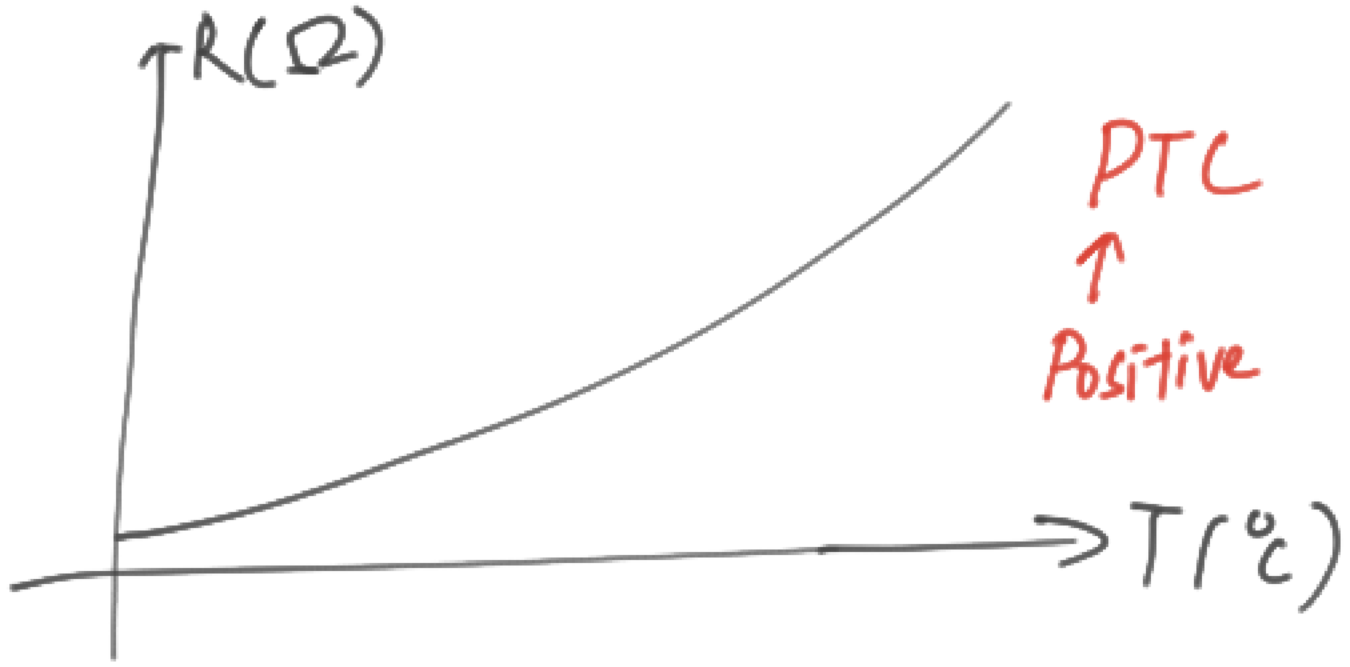
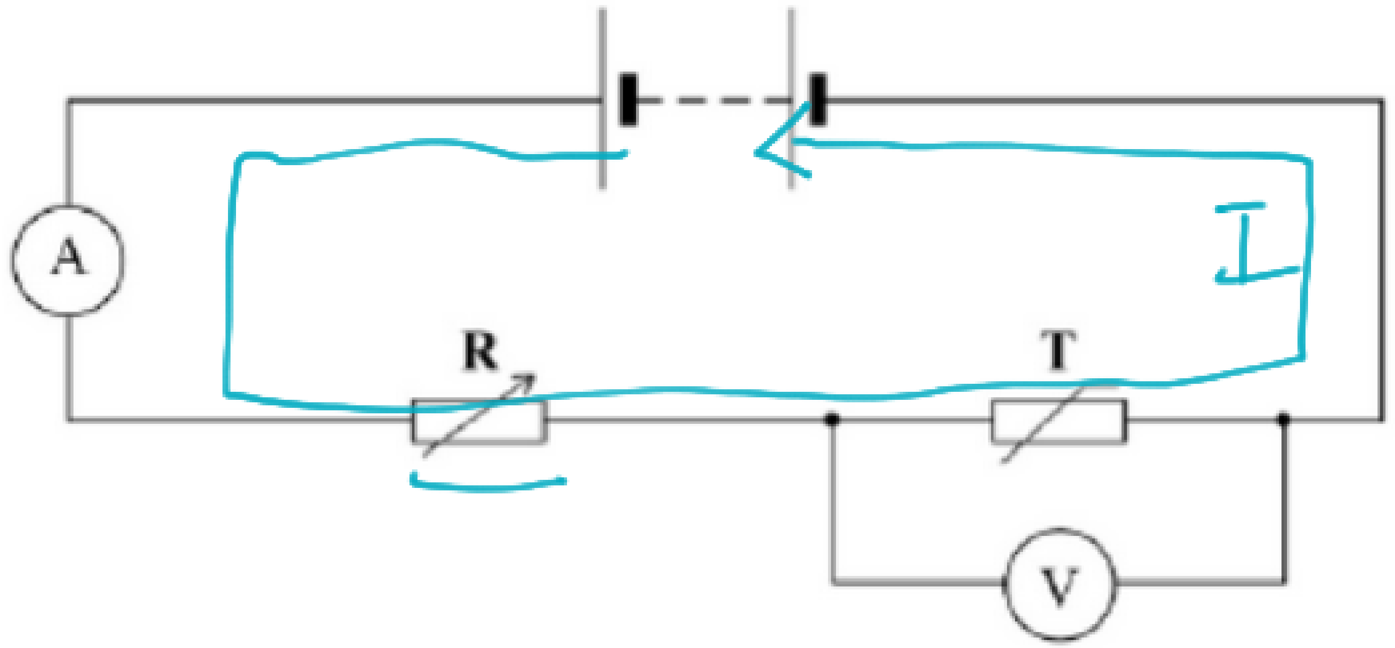


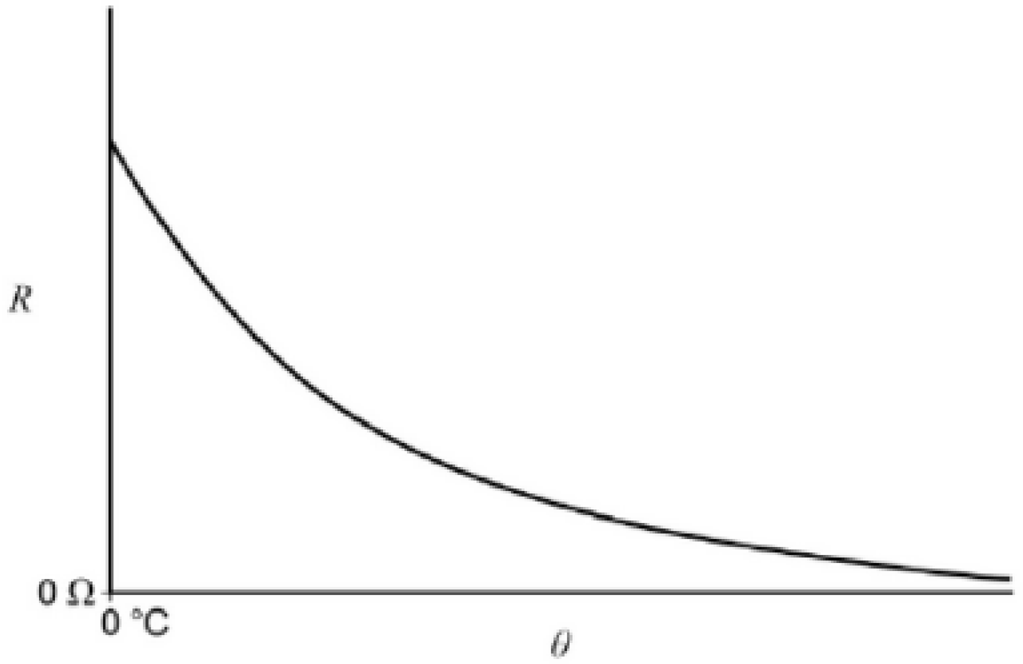
Figure 1 shows a circuit including a thermistor **T** in series with a variable resistor **R**. The battery has negligible internal resistance.

Figure 1



The resistance–temperature (R–θ) characteristic for **T** is shown in **Figure 2**.

Figure 2



(a) The resistor and thermistor in **Figure 1** make up a potential divider.

Explain what is meant by a potential divider.

Voltage in circuit is split up / divided by resistors connected in series

(b) State and explain what happens to the voltmeter reading when the resistance of **R** is increased while the temperature is kept constant.

$V_0 - V_R - V_T = 0 \Rightarrow V_0 - IR - IT = 0$

$I = \frac{V_0}{R+T}$

$V_T = IT = \frac{V_0 T}{R+T}$

$\Rightarrow R_{eq}\uparrow \Rightarrow I\downarrow \Rightarrow V_T = IT \Rightarrow V_T\downarrow$

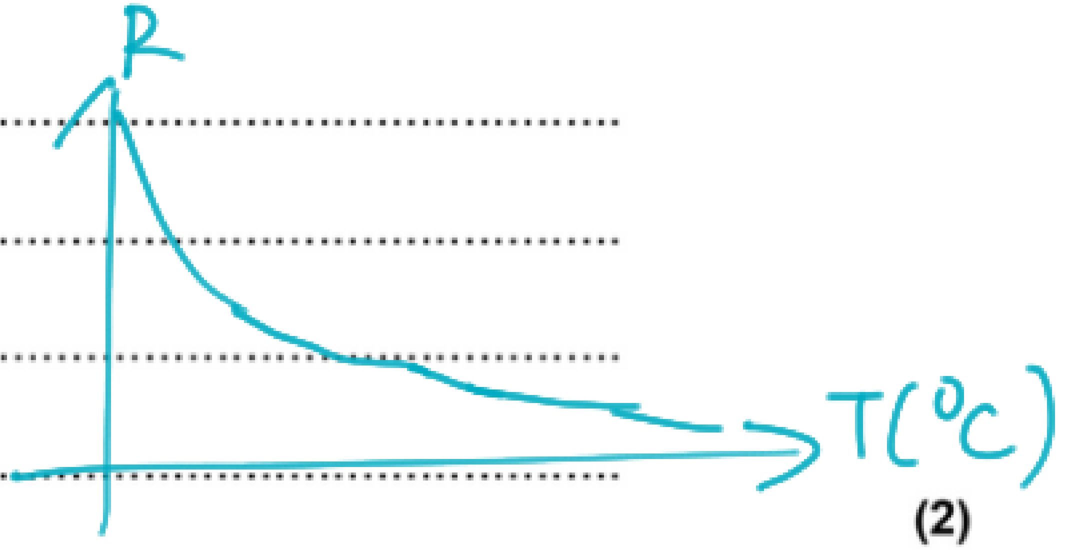
(c) State and explain what happens to the ammeter reading when the temperature of the thermistor increases.

$R_T \downarrow$

As $I = \dfrac{V_0}{R+T}$

when T increase, $R_T \downarrow$

therefore $I \uparrow$ A $\uparrow$



(2)

//V

(d) The battery has an emf of 12.0 V. At a temperature of 0 °C the resistance of the thermistor is 2.5 10³ Ω.

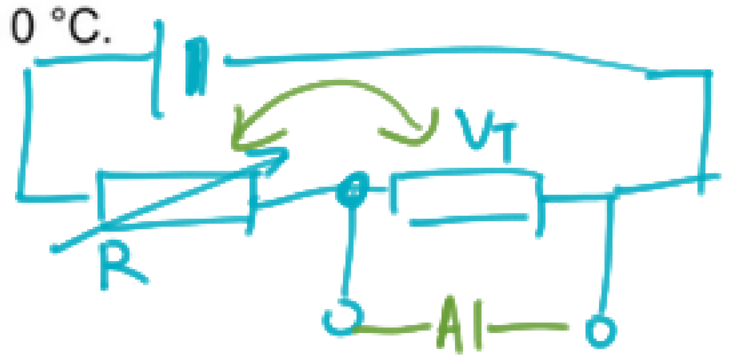
The voltmeter is replaced by an alarm that sounds when the voltage across it exceeds 3.0 V.

Calculate the resistance of R that would cause the alarm to sound when the temperature of the thermistor is lowered to 0 °C.

$V_R = 12 - 3 = 9V$

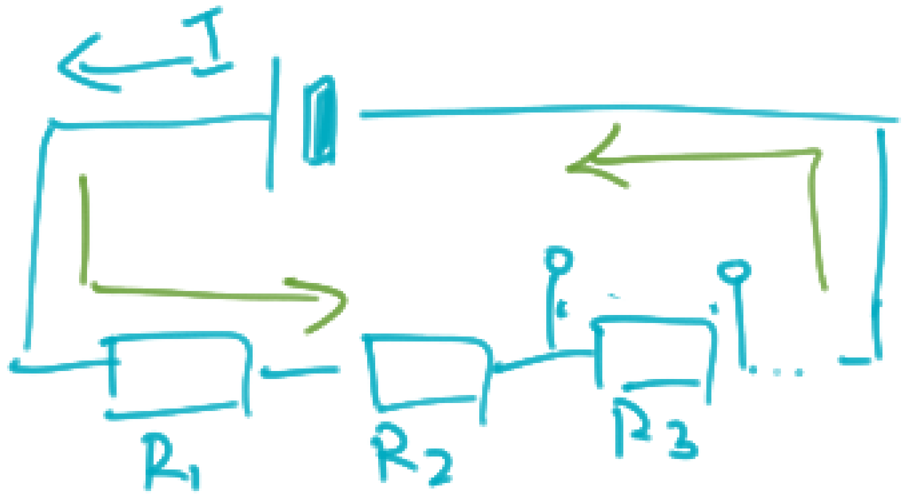
$V_R = 9 = 3 \cdot V_T$

$IR = 3(IR_T)$



resistance = 7500 Ω

(2)



$V - V_1 - V_2 \ldots = 0 \Rightarrow V_1 + V_2 + \ldots = V_0$

$I(R_1 + R_2 \ldots) = V_0$

$V_i = I \cdot R_i$

$I = \dfrac{V_0}{\sum R}$

$V_i = \dfrac{V_0}{\sum R} R_i$

(e) State **one** change that you would make to the circuit so that instead of the alarm coming on when the temperature falls, it comes on when the temperature rises above a certain value.

....

....

....

(1)

(Total 9 marks)

8.

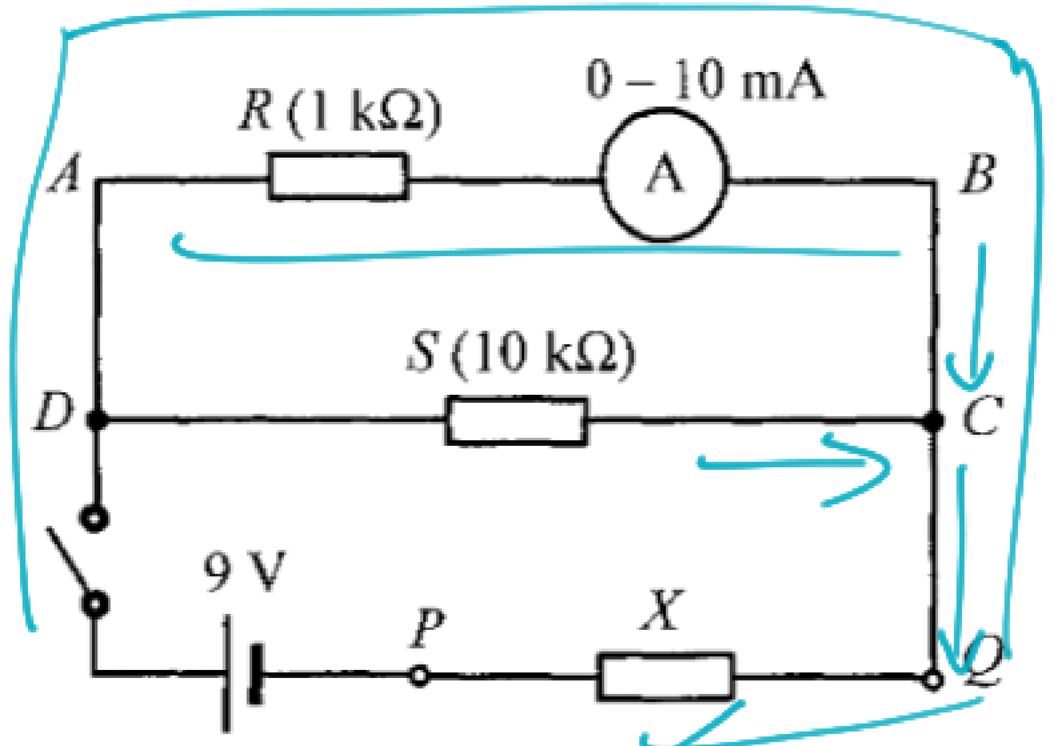


Figure 8.1

Figure 8.1 shows a circuit for measuring the resistance of resistor X connected across P and Q. The resistanc of resistor S is 10 kΩ. The internal resistance of the 9 V cell and that of the ammeter are negligible.

(a) When the switch is closed, the ammeter reads 8.5 mA.

(i) What is the p.d. between A and B? (2 marks

$V_{AB} = IR$

$= 8.5 V$

(ii) Find the current passing through resistor S. (2 marks

$I_{AB} \cdot R_r = I_{DC} \cdot R_s$

$R_s = \cancel{0}\ \cancel{0}\ 0.85 mA$

(iii) Indicate on Figure 8.1 the direction of current in each of the three branches via C.

(iv) Deduce the p.d. across resistor X. Hence, find the resistance of X.

$V_0 - V_s - V_x = 0$

$V_x = 0.5 V$

$I_x = 8.5 \times 10^{-4} + 8.5 \times 10^{-3}$

$I_x = 9.35 \times 10^{-3} A$

$R_x = \frac{V_x}{I_x} \approx 53.5 \Omega$

(b) State the purpose of connecting resistor R in series with the ammeter.

$I = \frac{V}{R}$ $R \to 0$ $I \to \infty$

To prevent an excessive current from flowing through the ammeter, which may damage circuit components.