Student Exercise Core

1. A 12V power supply is connected to a 3kΩ resistor. What is the current flowing in the circuit?

$I = \frac{V}{R} = \frac{12}{3\times10^3} = 4\,mA$

2. A 9V battery provides a current of 1.5A to a resistor, What is the value of the resistance?

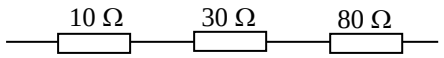
$R = \frac{V}{I} = \frac{9}{1.5} = 6\,\Omega$

3. A resistor of 15 Ω is connected to a battery of unknown voltage. The current in the circuit is measured to be 0.1A. What is the voltage of the battery ?

$V = I \times R = 15 \times 0.1 = 1.5V$

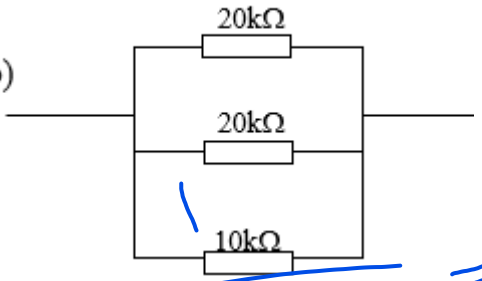
4. Find the total resistance in each of the following combinations of resistors.

(a)



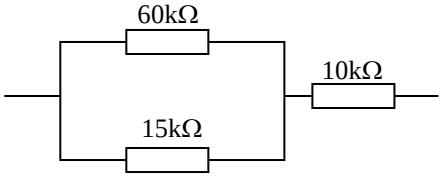
$10 + 30 + 80 = 120\,\Omega$

(b)



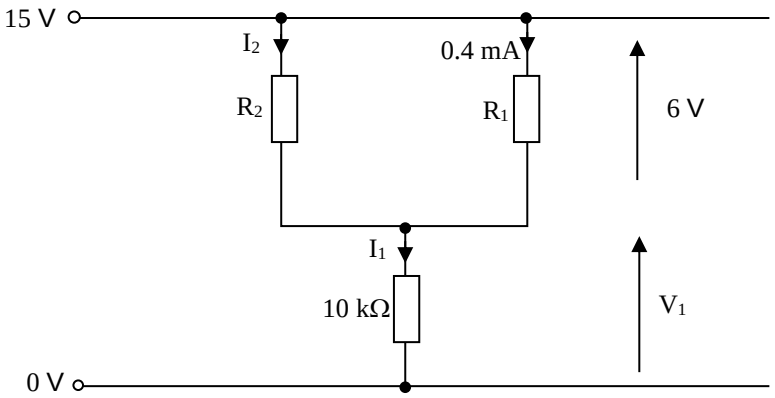
$\frac{1}{\frac{1}{20}+\frac{1}{20}+\frac{1}{10}} = 5k\Omega$

(c)



$12k + 10k = 22k\Omega$

5. Determine the values of R_1, V_1, I_1, I_2 and R_2 in the following circuit.



(a) R_1 $= \frac{V}{I} = \frac{6}{0.4 \times 10^{-3}} = 15\,k\Omega$

(b) V_1 $15 - 6 = 9\,V$

(c) I_1 $R = \frac{V}{I} = \frac{9}{10k} = 900\,\mu A$

(d) I_2 $900\,\mu A - 0.4\,mA = 500\,\mu A$

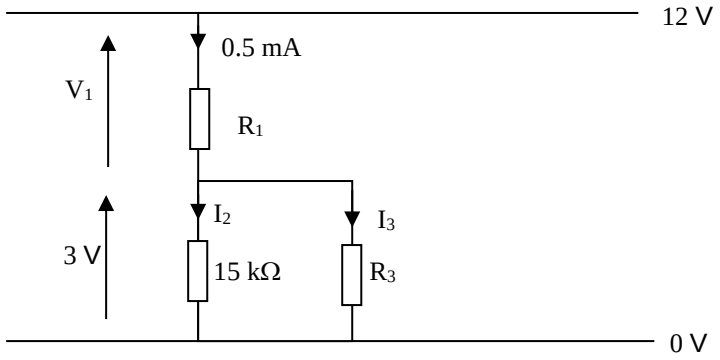
(e) R_2 $\frac{6}{500\,\mu A} = 12\,k\Omega$

(f) What is the power dissipated in R_1 ?

$P = I \times V = 0.4\,mA \times 6V = 2.4\,mW$

or $\frac{V^2}{R} = \frac{6^2}{15k} = 2.4\,mW$

6. Determine the values of V_1, R_1, I_2, I_3 and R_3 in the following circuit. Hence determine the power dissipated in the 15kΩ resistor.



(a) V_1 12 − 3 = 9 V

(b) R_1 $= \frac{V}{I} = \frac{9}{0.5mA} = 18k\Omega$

(c) I_2 $\frac{V}{R} = \frac{3}{15k} = 200\mu A$

(d) I_3 $0.5mA - 200\mu A = 300\mu A$

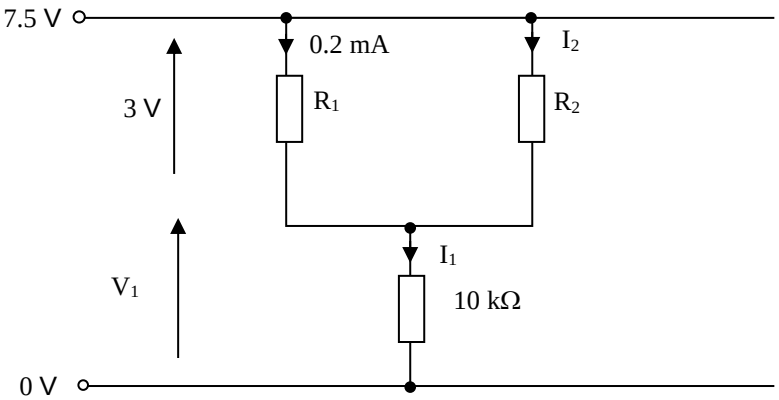
(e) R_3 $\frac{V}{I} = \frac{3V}{300\mu A} = 10k\Omega$

(f) What is the power dissipated in the 15kΩ resistor.

$\frac{V^2}{R} = \frac{3^2}{15k} = 600\mu W$

[7]

7. Determine the values of V_1, I_1, I_2, R_1, and R_2 in the following circuit.



(a) V_1 $7.5 - 3 = 4.5V$

(b) I_1 $\frac{V}{R} = \frac{4.5}{10k} = 450\mu A$

(c) I_2 $450\mu A - 0.2mA = 250\mu A$

(d) R_1 $\frac{V}{I} = \frac{3}{0.2mA} = 15k\Omega$

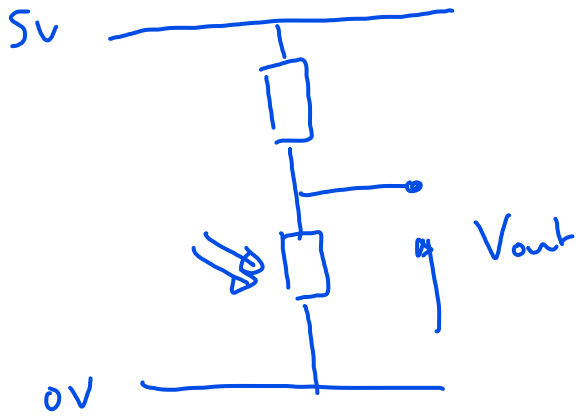
(e) R_2 $\frac{3}{250\mu A} = 12k\Omega$

(f) What is the effective resistance of R_1 and R_2 in parallel?

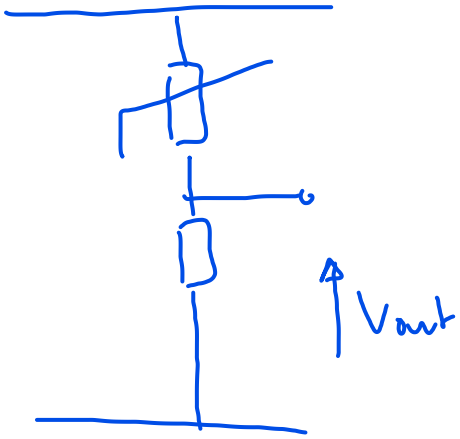
$\frac{1}{\frac{1}{12k} + \frac{1}{15k}} = 6.67k\Omega$

[7]

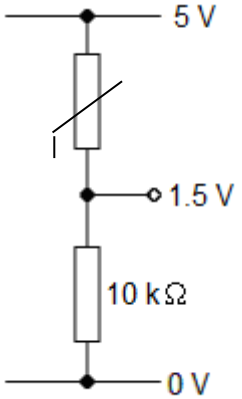
Draw a light sensing circuit where the output voltage falls with increasing illumination?



Draw a Temperature sensor where the output rises as it gets hotter?



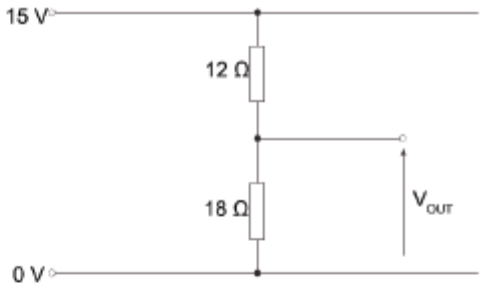
Calculate the Thermistor resistance value



$I = \frac{V}{R} = \frac{1.5}{10k} = 150\mu A$

$R = \frac{V}{I} = \frac{5-1.5}{150\mu A} = 23.3k\Omega$

7. Thevenin's theorem is used to produce an equivalent circuit for the voltage divider circuit shown.



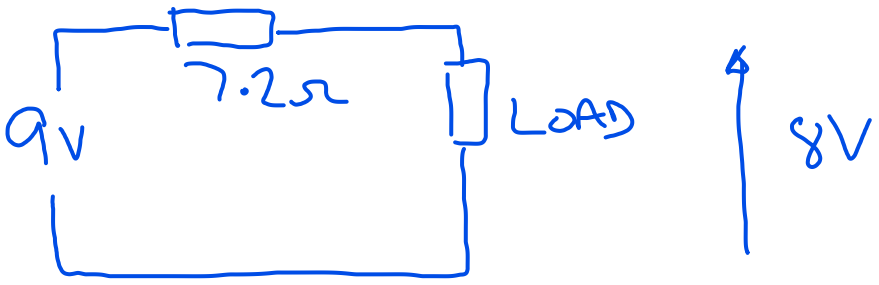
(a) Calculate the values of V_{oc} and R_{eq}.

$V_{oc} = \frac{18}{12+18} \times 15 = 9V$

$I_{sc} = \frac{15}{12\Omega} = 1.25A$

$R_{EQUIV} = \frac{V_{oc}}{I_{sc}} = \frac{9}{1.25} = 7.2\Omega$

(b) (i) Draw the equivalent circuit with a load resistance connected across the output terminals.



(ii) Use the equivalent circuit to calculate the maximum permissible load current to ensure the output voltage V_{OUT} does not fall below 8·0 V.

$\therefore V_{across\ 7.2\Omega} = 9 - 8 = 1V$

$I = \frac{V}{R} = \frac{1}{7.2} = \frac{5}{36}A\ (138.9mA)$

$R = \frac{V}{I} = \frac{8}{138.9mA} = 57.6\Omega$