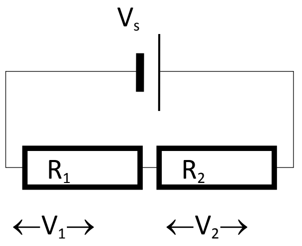
Potential Divider Circuits

National 5 Extension

In a series circuit the supply voltage is **divided up** between the components in the circuit i.e.

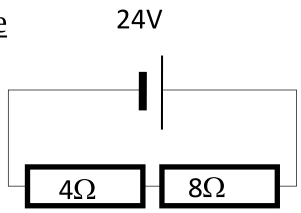


$V_s = V_1 + V_2$

where V_s = supply voltage
V_1 = voltage across R_1
V_2 = voltage across R_2

From Ohm's law we know that since current is constant in a series circuit, the higher the resistance of a component the greater the potential difference across it.
This idea is used in the following example to calculate the potential difference across components in a 'potential divider' i.e. series circuit.

Example



Use the fact that the voltage 'split' across each component is in the same ratio as the resistance of each component.

$V_1 = \frac{R_1 \times V_s}{R_t} = \frac{4 \times 24}{12} = 8V$

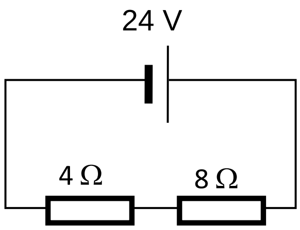
$V_2 = \frac{R_2 \times V_s}{R_t} = \frac{8 \times 24}{12} = 16\ V$

where R_t = total resistance

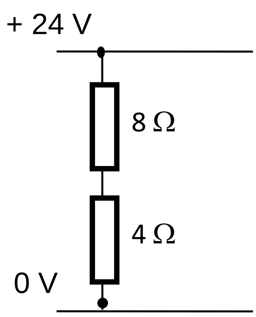
(Remember to check your answer e.g. does $V_1 + V_2 = V_s$)

Lastly!
Circuit problems in electronics are usually drawn slightly differently than you are used to seeing.

e.g.

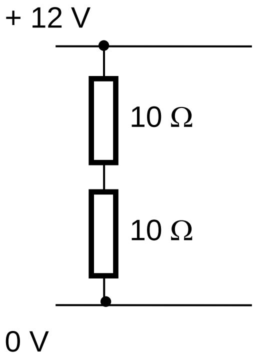


would be drawn as



Find the potential difference across each resistor in the following circuits:

(1)



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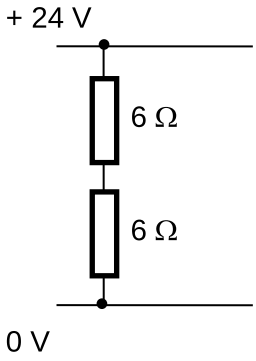

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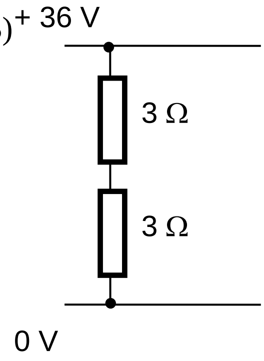

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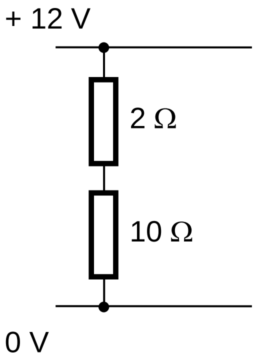

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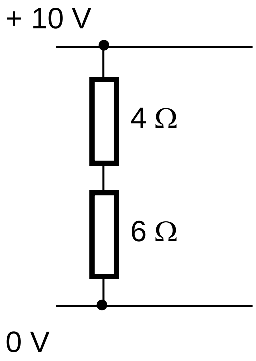

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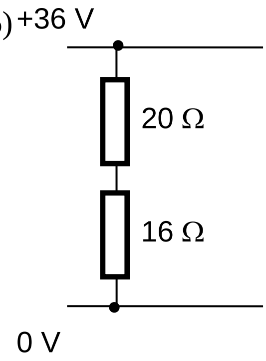

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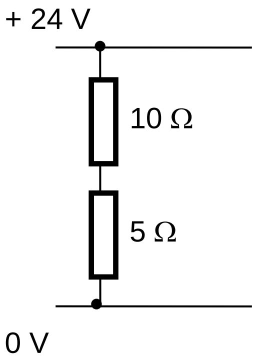

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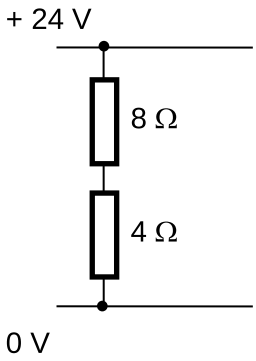

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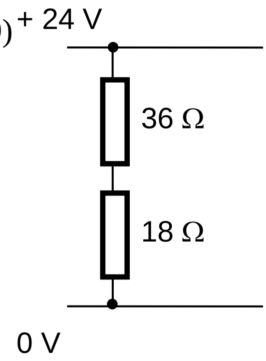

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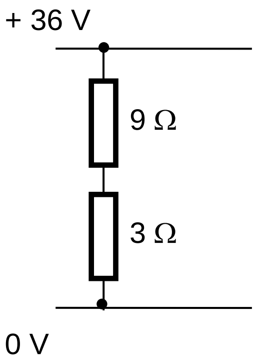

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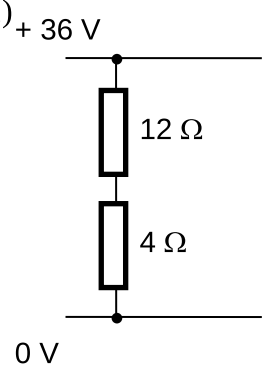

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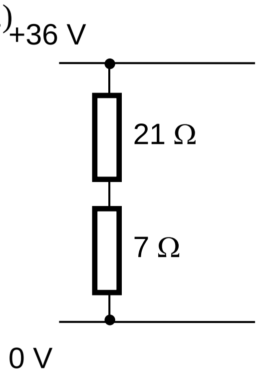

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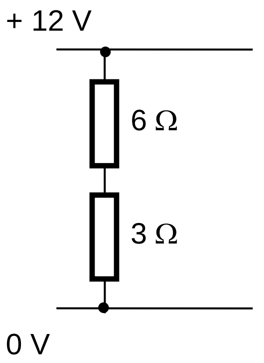

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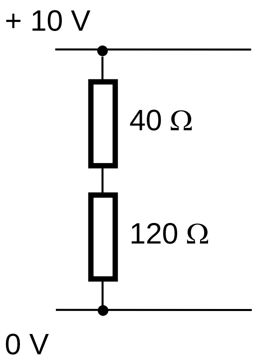

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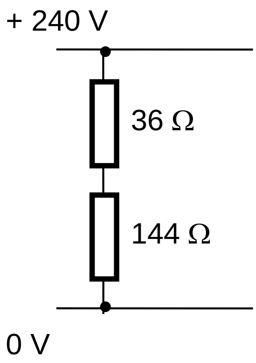

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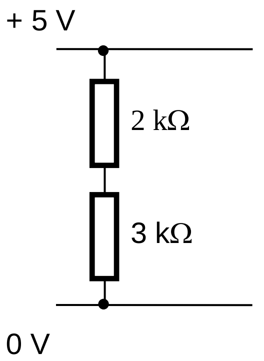

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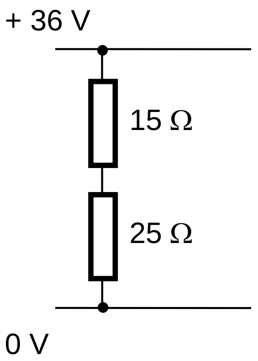

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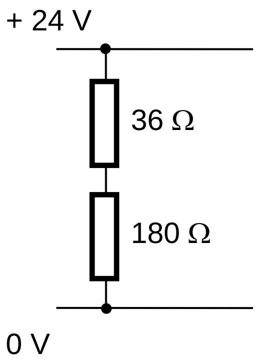

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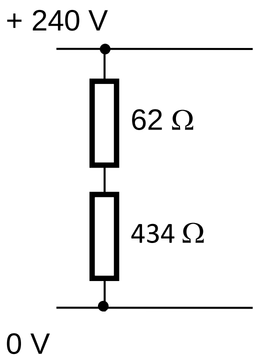

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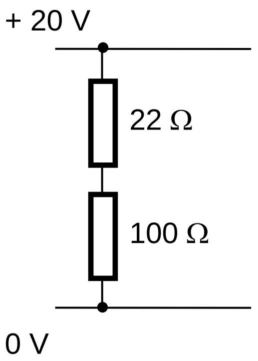


Helpful Hint
LDR's and thermistors often make up part of a potential divider circuit in electronic systems. It is important to remember that the **resistance** of these components varies with external conditions.

Use the following data to answer questions 21 – 25.

The tables below show how the resistances of a certain LDR and thermistor vary with external conditions.

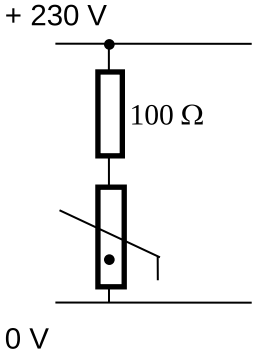
LDR

light condition	*resistance (Ω)*
dark	10 000
light	2 500
bright	20

Thermistor

temperature (^{o}C)	*resistance (Ω)*
10	4 000
40	1 980
100	200

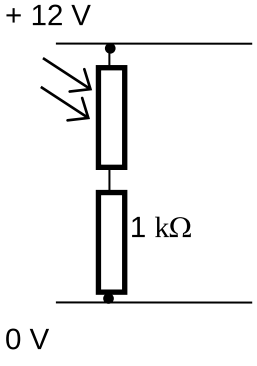
21. The following circuit is part of the input to an electronic frost alarm.



Calculate the potential difference across the thermistor when it is

(a) 10 ^{o} C
(b) 40 ^{o} C

22. The following circuit could be part of a light meter for a camera.

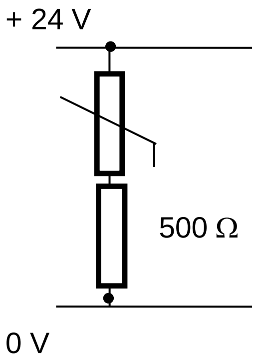


Use the information above to find the potential difference across the LDR when it is:

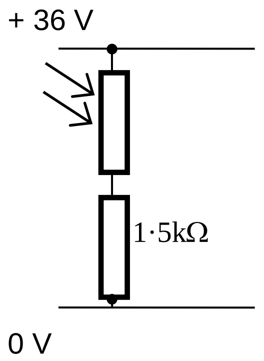
(*a*) dark
(*b*) light

23. Calculate the potential difference across the **resistor** in the following circuit when the temperature is:

(*a*) $100\,^{o}$ C
(*b*) $40\,^{o}$ C



24. A young engineer designs part of an electronic system to trigger an alarm when it gets too bright.
Determine the 'trigger voltage' across the resistor in the following system when the light level becomes 'bright'.



25. Determine the temperature at which the following voltmeters will show identical readings.