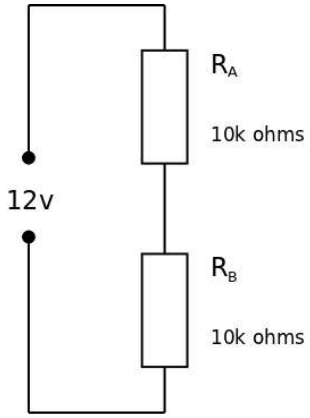
Q15

Using a voltmeter with a potential divider.

A simple potential divider is made from two 10 kΩ resistors as shown.
The combined resistance of the two 10 kΩ resistors in series is 20 kΩ.



(a) Show that the current in the circuit is 0.6 mA.

[2 marks]

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(b) Show that the potential difference across the bottom resistor, R_B, is 6 volts.

[2 marks]

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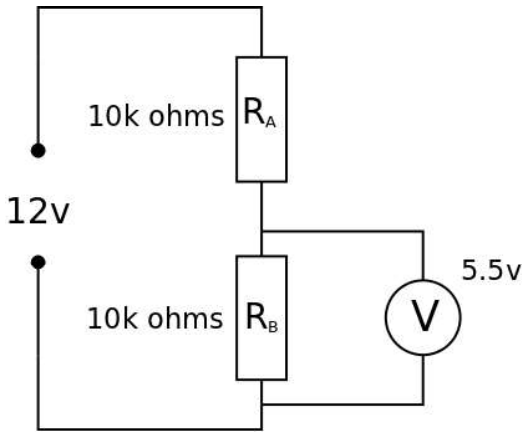
A voltmeter is now added in parallel with the bottom resistor. The reading on the voltmeter is only 5.5 volts – less than the expected value. This is because the voltmeter has a finite resistance and therefore some current flows through the voltmeter.



(c) Calculate the potential difference across the top resistor, R_A, with the voltmeter connected as shown in the diagram above.

Hence calculate the current flowing through the top resistor, R_A.

[2 marks]

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(d) Knowing the potential difference across the bottom resistor, R_B, calculate the current through **only this resistor**.

[1 mark]

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(e) Hence, calculate the resistance of the voltmeter.

[2 marks]

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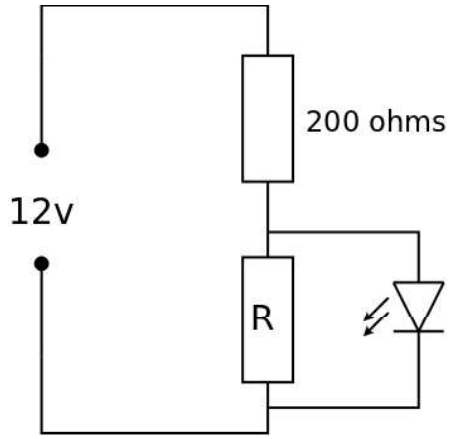
(f) A similar potential divider is now used to provide the correct voltage for an LED (Light Emitting Diode) although the resistors have lower values and the resistors are not the same as each other.



If the LED requires an operating voltage of 2 volts and a current of 20 mA, calculate a suitable value for the unknown resistor R.

[3 marks]

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