THE UNIVERSITY of York

Department of Education

Diagnostic questions on electric circuits

These questions are designed to help you check your subject knowledge in specific science domains that all science teachers are expected to be able to teach effectively up to the end of Key Stage 4.

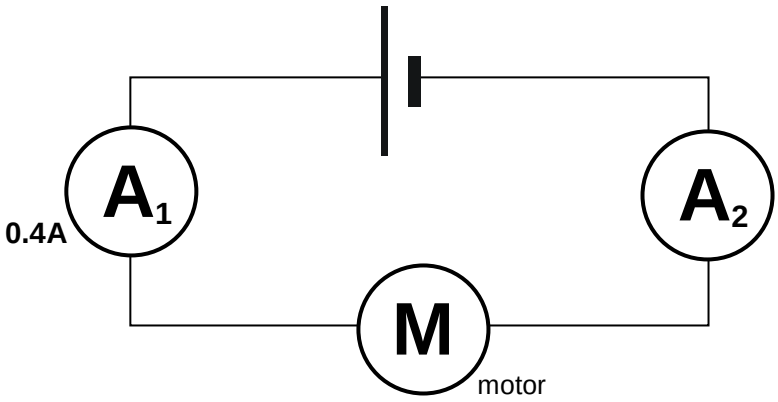
Feedback on your answers can help you identify areas of relative strength and weakness, and can help you focus your own efforts to improve subject knowledge on the aspects where this will be most useful.

Do not write on this question booklet.
Please answer the questions on the Answer Grid you have been given.

1

In this circuit a battery is connected to a motor.

The reading on ammeter A_1 is 0.4 amps.



(a) What is the reading on ammeter A_2?

A More than 0.4 amps

B Exactly 0.4 amps

C Less than 0.4 amps, but not zero

D Zero

(b) How would you explain this?

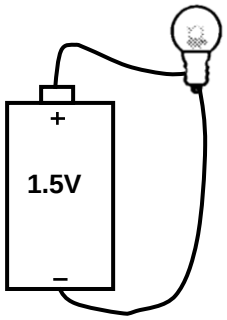
A Some of the current is used up by the motor.

B All of the current is used up by the motor.

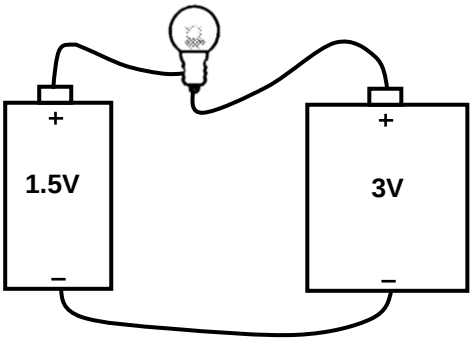
C The current is the same everywhere in a series circuit.

2

This bulb lights when it is connected to a 1.5V battery.



A 3V battery is then connected into the circuit, like this:



(a) What happens to the bulb now?

A It is lit – and brighter than before.

B It is lit – similar brightness as before

C It is lit – but a lot dimmer than before.

D It is not lit.

(b) How would you explain this?

A The two batteries together add to 4.5 V.

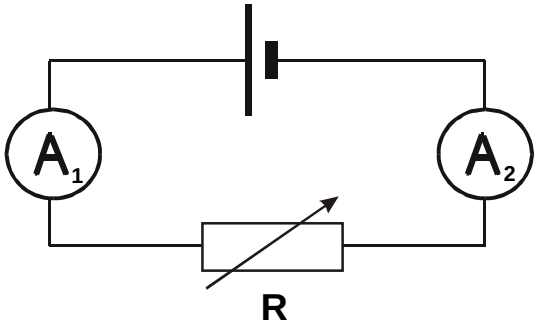
B The two batteries together add to 1.5 V.

C Current cannot pass through a battery in the wrong direction.

D The bulb is connected to the positive terminal of both batteries, so there is no current through it.

3

This circuit consists of two ammeters and a variable resistor, R. There is a reading on both ammeters.



The resistance of R is **increased**.

(a) What happens to the reading on ammeter A_1?

A It gets bigger.

B It stays the same.

C It gets smaller.

(b) What happens to the reading on ammeter A_2?

A It gets bigger.

B It stays the same.

C It gets smaller.

(c) How would you explain this?

A A large resistance needs more current than a small resistance.

B It is the same battery, so it supplies the same current.

C Increasing the resistance makes the current smaller everywhere in the circuit.

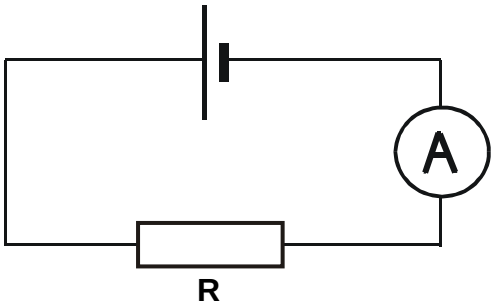
D Increasing the resistance makes the current smaller after the resistor. It has no effect on the current before the resistor.

E Increasing the resistance makes the current smaller after the resistor. The current before the resistor gets bigger.

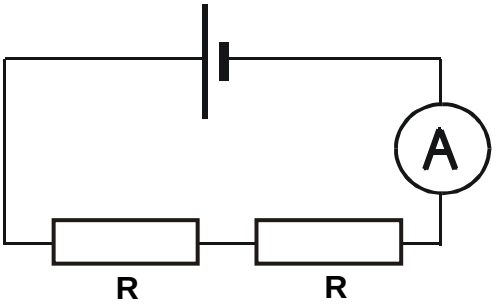
4

Sam makes this circuit.

There is a reading on the ammeter.



He then adds a second identical resistor.



(a) What happens to the reading on the ammeter?

A It gets bigger.

B It stays the same.

C It gets less, but not zero.

D It drops to zero.

(b) How would you explain this?

A The battery is not strong enough to push charges through two resistors.

B The battery cannot push as many charges every second through two resistors.

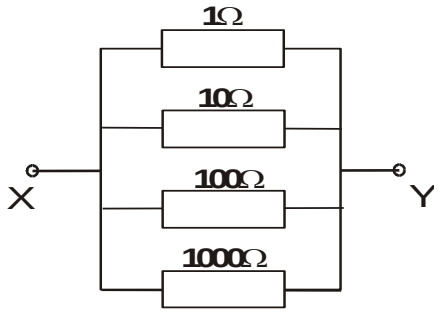
C It is the same battery, so it supplies the same current.

D Two resistors need more current than one on its own.

E The current is shared between the two resistors, so each gets half.

5

Look at this network of resistors



What is the total resistance between X and Y?
(Note: You are NOT expected to work out the exact value.)

A Less than 1 Ω

B Between 1 Ω and 10 Ω

C Between 10 Ω and 100 Ω

D Between 100 Ω and 1000 Ω

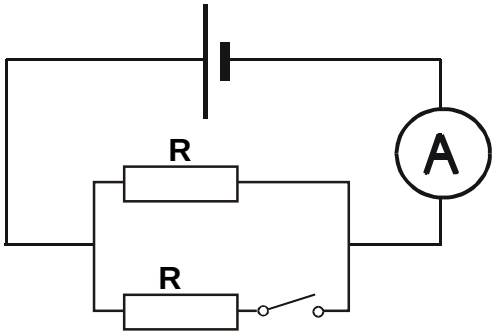
E More than 1000 Ω

6

The two resistors in this circuit are identical.

The switch is open.

There is a reading on the ammeter.



The switch is then **closed**.

(a) What happens to the reading on the ammeter?

A It gets bigger.

B It stays the same.

C It gets smaller.

(b) How would you explain this?

A The total resistance is now bigger, so the battery cannot push as big a current round the circuit.

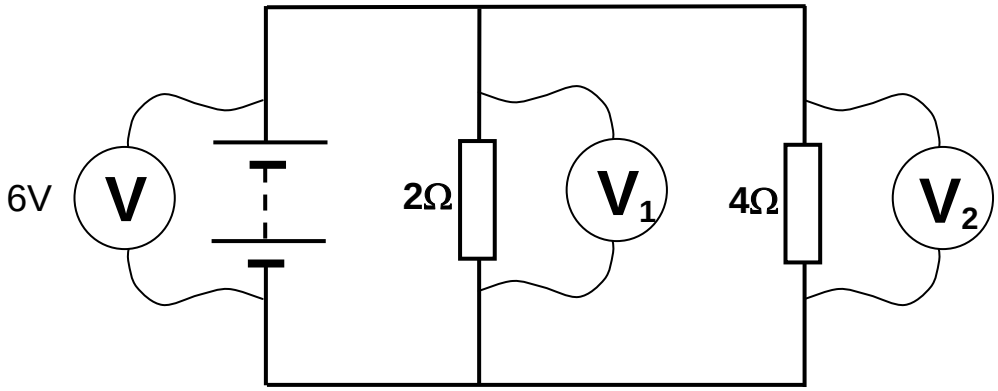
B It is still the same battery, so it supplies the same current.

C The total resistance is now smaller, because the second resistor provides an extra path for current to flow.

D The current divides at the junction with half going through each resistor. But the ammeter measures the total current, which will stay the same.

7

In this circuit, the reading on the voltmeter connected across the battery is 6V.

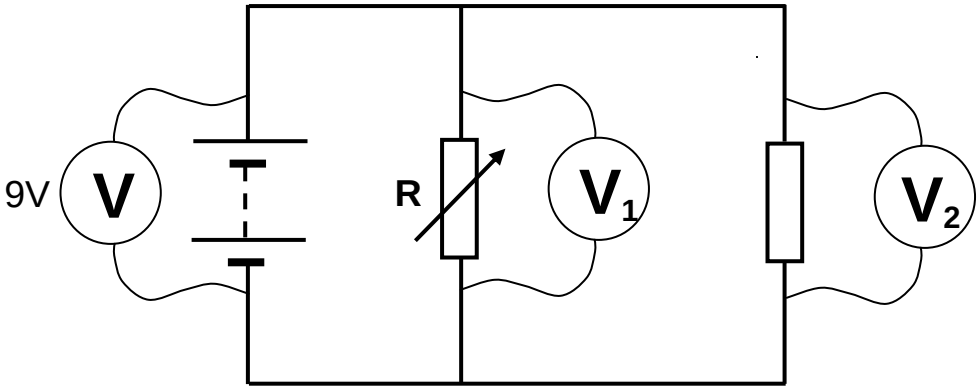


What are the readings on voltmeters V_1 and V_2?

	Voltmeter V_1	***Voltmeter V_2***
A	4V	2V
B	2V	4V
C	3V	3V
D	6V	6V

8

A 9V battery is connected to a fixed resistor and a variable resistor in parallel.



The resistance of the variable resistor, R, is **increased**.

The reading on the voltmeter across the battery (9V) **does not change**.

(a) What happens to the reading on voltmeter V_1?

A It gets bigger.

B It stays the same.

C It gets smaller.

(b) What happens to the reading on voltmeter V_2?

A It gets bigger.

B It stays the same.

C It gets smaller.

(c) How would you explain this?

A As R increases, the voltage across it gets bigger (because V=IR). The other voltmeter is across a fixed resistor, so it stays the same.

B As R increases, the voltage across it gets bigger (because V=IR). The two voltages have to add to 9V. So the voltage across the fixed resistor gets smaller.

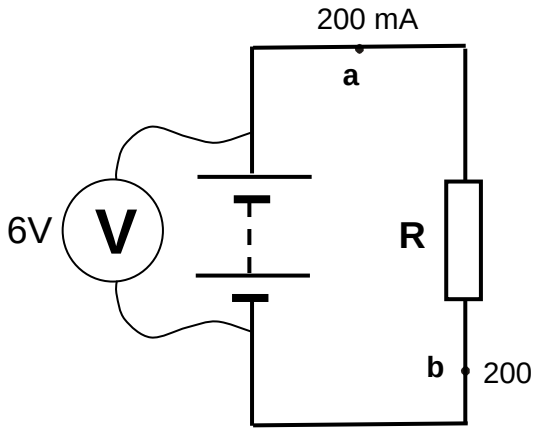
C Both resistors are connected directly across the power supply, so the readings on both voltmeters are equal to the battery voltage.

9

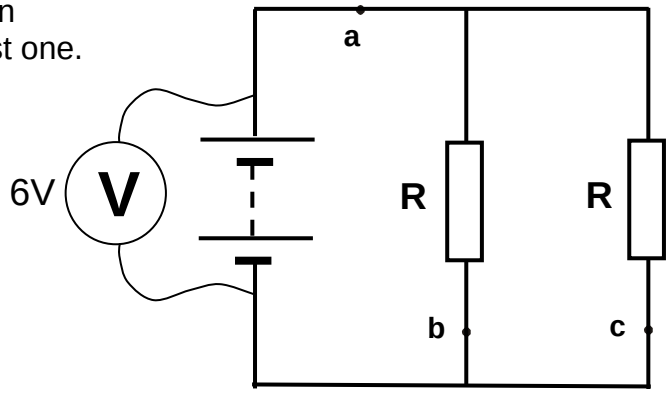
In this circuit, a 6V battery
is connected to a resistor R.

The current is measured at **a** and **b**.

It is 200 mA at both points.



A second, identical resistor is then
connected, in parallel with the first one.



The reading on the voltmeter is still 6V.

What is the current now at **a, b** and **c**?

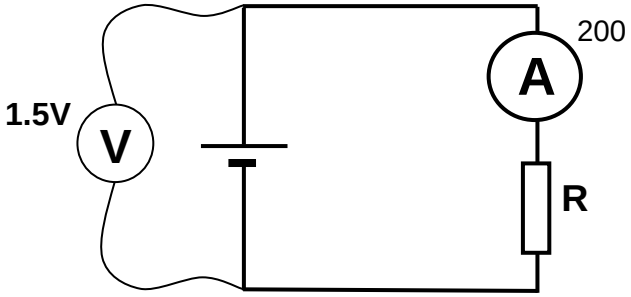
	At a	***At b***	***At c***
A	100 mA	50 mA	50 mA
B	200 mA	100 mA	100 mA
C	200 mA	200 mA	0 mA
D	400 mA	200 mA	200 mA

10

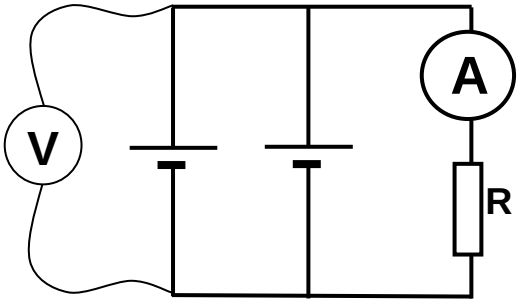
In this circuit, a battery is connected to a resistor R.

The voltmeter reads 1.5 V.

The ammeter reads 200 mA.



A second identical battery is then added, like this.



(a) What is the reading on the voltmeter now?

A 3 V

B 1.5 V

C 0.75 V

D Zero

(b) What is the reading on the ammeter now?

A 400 mA

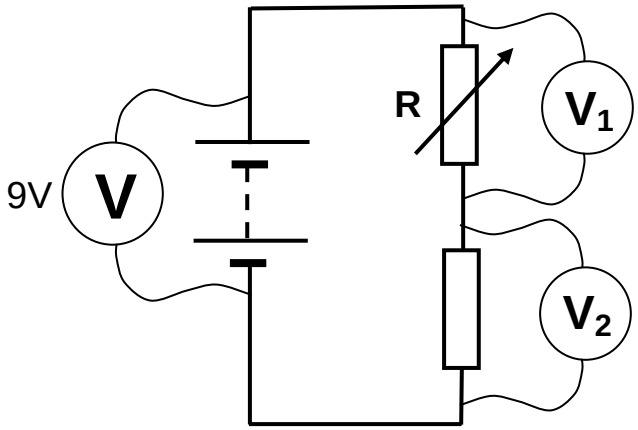
B 200 mA

C 100 mA

D Zero

11

A 9V battery is connected to a fixed resistor and a variable resistor in series.



The resistance of the variable resistor, R, is **increased**.

The reading on the voltmeter across the battery (9V) does not change.

(a) What happens to the reading on voltmeter V_1?

A It gets bigger.

B It stays the same.

C It gets smaller.

(b) What happens to the reading on voltmeter V_2?

A It gets bigger.

B It stays the same.

C It gets smaller.

(c) What happens to the **sum** of the voltages ($V_1 + V_2$) as R is increased?

A It gets bigger.

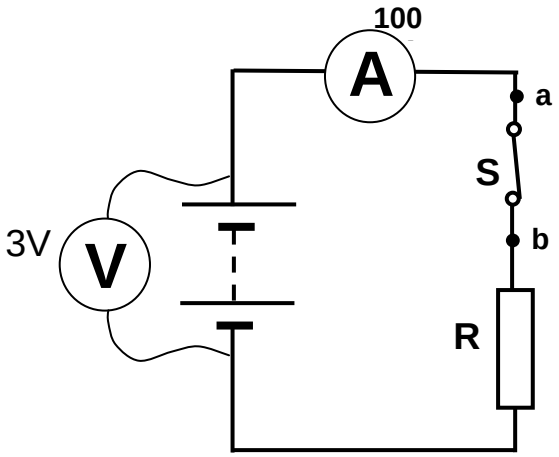
B It stays the same.

C It gets smaller.

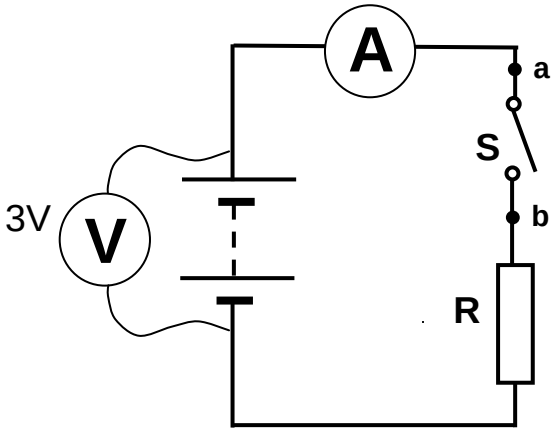
12

This circuit consists of a 3V battery, connected to a resistor R and a switch S.

The switch is **closed**. The ammeter reads 100 mA.



The switch S is then **opened**. The voltmeter across the battery still reads 3V.



Which line in the table below correctly shows the voltage between **a** and **b**, and the reading on the ammeter, in the two situations?

	When switch S is **closed**		After switch S is **opened**	
	Voltage between **a** and **b**	Reading on the ammeter	Voltage between **a** and **b**	Reading on the ammeter
A	3 V	100 mA	3 V	100 mA
B	0 V	100 mA	3 V	0 mA
C	3 V	100 mA	3 V	0 mA
D	0 V	100 mA	0 V	0 mA