

## **EPSE Project 1: Sample Diagnostic Questions - Set 4**

### **Potential difference**

Most of these questions probe pupils' understanding of potential difference (or voltage) in parallel and series circuits. Qs1-4 all test understanding that the p.d. (voltage) across resistors connected in parallel to a battery is the same as that of the battery. Qs5-6 then test understanding that the current in a parallel branch is the same as it would be if this were the only branch present. Qs7-8 test understanding of branch currents, and current in the main circuit, when an extra parallel branch is added.

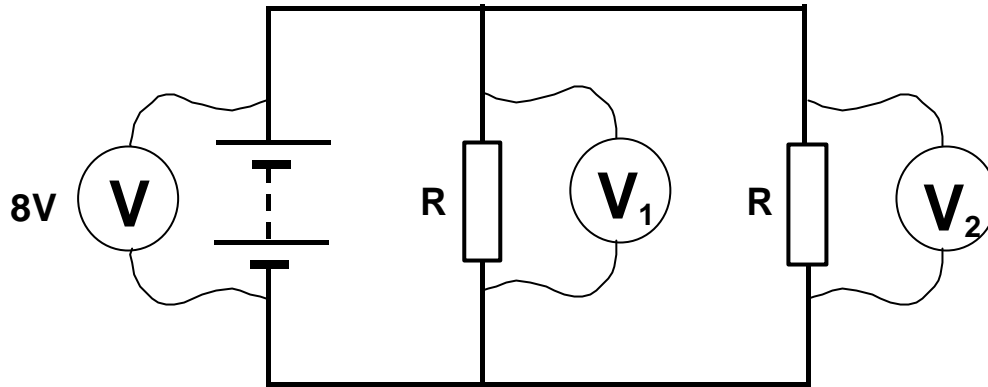
Qs9-10 deal with series circuits, testing understanding of how p.d. (voltage) behaves.

In our pilot testing, we have found that KS4 pupils find these questions difficult. Anyone who gets them right has a sound understanding of circuit behaviour. Having a mental 'picture' (or model) of potential difference as 'height' can help pupils see how circuits like these work, and make more accurate predictions about their behaviour.

These questions are taken from a larger bank of diagnostic questions and tasks developed by the *Evidence-based Practice in Science Education (EPSE) Research Network*. The EPSE network was funded between 1999 and 2003 by the UK Economic and Social Research Council (ESRC) as part of the *Teaching and Learning Research Programme (TLRP)*.

1

The two resistors in this circuit are identical. The voltmeter connected across the battery reads 8V.



(a) What is the reading on voltmeter  $V_1$ ? \_\_\_\_\_ volts

(b) What is the reading on voltmeter  $V_2$ ? \_\_\_\_\_ volts

How confident are you that your answers to this question are correct? Tick ONE box (✓)

Very confident

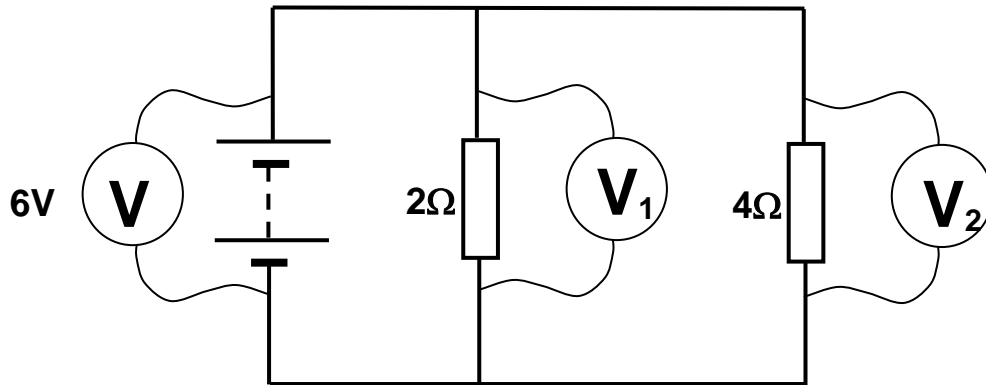
Fairly confident

Not confident

Just guessing

2

In this circuit, the voltmeter across the battery reads 6V.



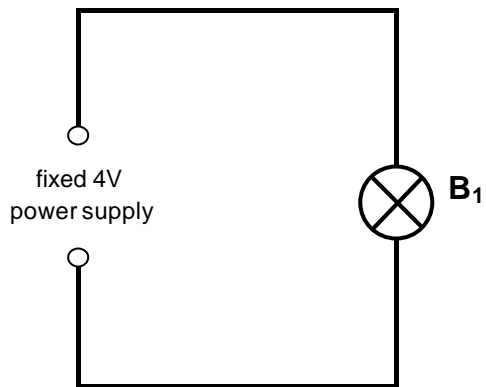
(a) What is the reading on voltmeter  $V_1$ ? \_\_\_\_\_ volts

(b) What is the reading on voltmeter  $V_2$ ? \_\_\_\_\_ volts

3

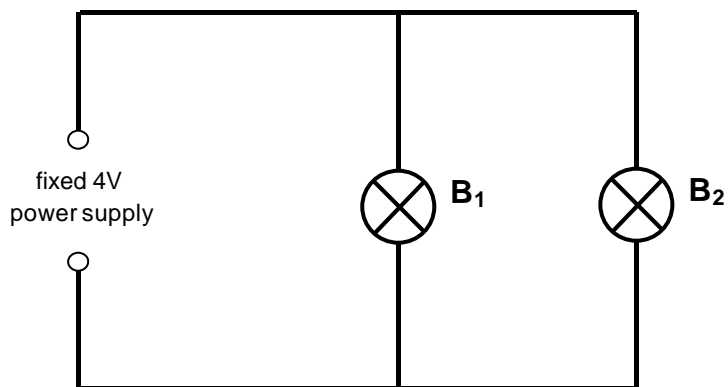
The power supply in this circuit has a fixed output voltage of 4V.

(a) A bulb  $B_1$  is connected to the power supply.



What is the voltage across bulb  $B_1$ ? \_\_\_\_\_ volts

(b) A second identical bulb  $B_2$  is then connected, to make this circuit.



What is the voltage now across bulb  $B_1$ ? \_\_\_\_\_ volts

What is the voltage across bulb  $B_2$ ? \_\_\_\_\_ volts

**How confident are you** that your answers to this question are correct? Tick ONE box (✓)

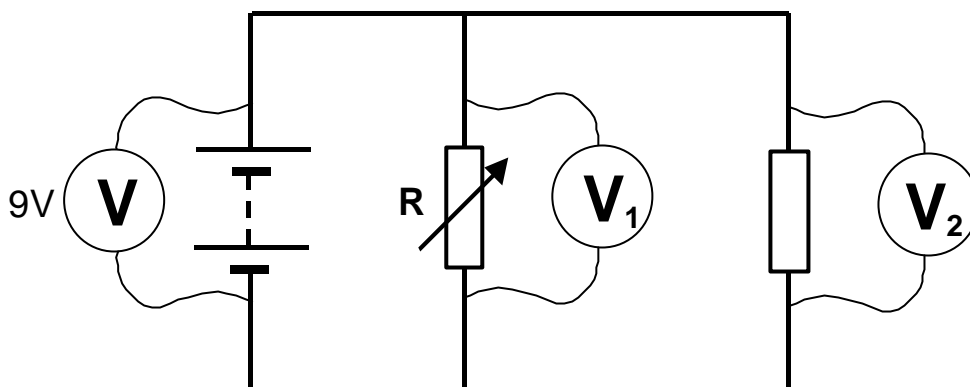
Very confident

Fairly confident

Not confident

Just guessing

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  $V_1$ ?

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

Tick ONE box (✓)

Tick ONE box (✓)

- It gets bigger.
- It stays the same.
- It gets smaller.

- It gets bigger.
- It stays the same.
- It gets smaller.

(c) How would you explain this?

Tick ONE box (✓)

- As  $R$  increases, the voltage across it gets bigger (because  $V=IR$ ). The other voltmeter is across a fixed resistance, so it stays the same.
- As  $R$  increases, the voltage across it gets bigger (because  $V=IR$ ). The sum of the two voltages has to be equal to the supply voltage. So the voltage across the other resistor gets smaller.
- Both resistors are connected directly across the power supply, so the readings on both voltmeters are equal to the supply voltage.

How confident are you that your answers to this question are correct? Tick ONE box (✓)

Very confident

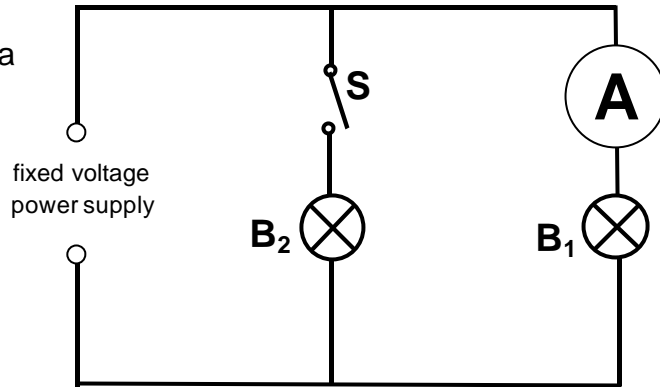
Fairly confident

Not confident

Just guessing

5

In this circuit, the power supply has a fixed voltage output.  
Switch S is open.  
Bulb B<sub>1</sub> is lit.  
There is a reading on the ammeter.



The switch S is then **closed**.

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

Tick ONE box (✓)

- It gets bigger.
- It stays the same.
- It gets smaller.

(b) What happens to the brightness of bulb B<sub>1</sub>?

Tick ONE box (✓)

- It get brighter.
- It stays the same brightness.
- It gets dimmer.

(c) How would you explain this?

Tick ONE box (✓)

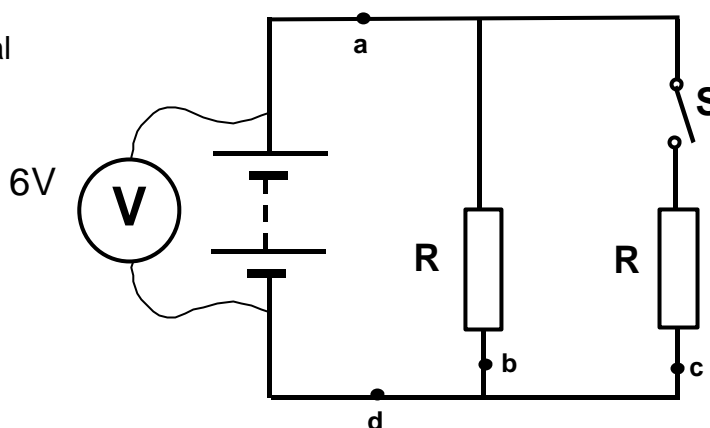
- Some of the current now goes through B<sub>2</sub>, bypassing B<sub>1</sub>.
- Two bulbs need a bigger current from the power supply.
- The voltage across each parallel branch stays the same.
- The total resistance is now bigger, so the current gets less.
- Other (please explain): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

How confident are you that your answers to this question are correct? Tick ONE box (✓)

- Very confident  Fairly confident  Not confident  Just guessing

6

In this circuit, a 6V battery is connected to two identical resistors in parallel. The switch S is open.



The switch S is then **closed**. The reading on the voltmeter is still 6V.

(a) What happens to the current at **a**?

Tick ONE box (✓)

- It gets bigger.
- It stays the same.
- It gets smaller.

(b) What happens to the current at **b**?

Tick ONE box (✓)

- It gets bigger.
- It stays the same.
- It gets smaller.

(c) What happens to the current at **c**?

Tick ONE box (✓)

- It gets bigger.
- It stays the same.
- It gets smaller.

(d) What happens to the current at **d**?

Tick ONE box (✓)

- It gets bigger.
- It stays the same.
- It gets smaller.

How confident are you that your answers to this question are correct? Tick ONE box (✓)

Very confident

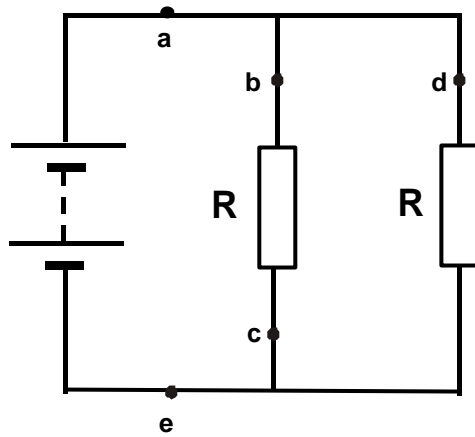
Fairly confident

Not confident

Just guessing

7

The two resistors in this circuit are identical.



For each of the sentences below, write one of the following in the gap to complete the sentence correctly:

<b>smaller than</b>	<b>the same size as</b>	<b>bigger than</b>
---------------------	-------------------------	--------------------

The current at **c** is ..... the current at **b**.

The current at **d** is ..... the current at **b**.

The current at **a** is ..... the current at **b**.

The current at **e** is ..... the current at **a**.

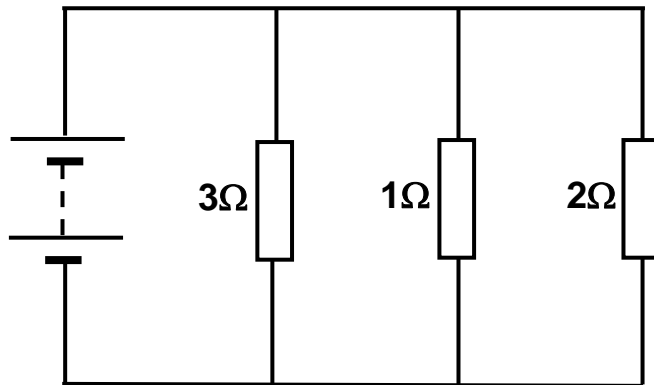
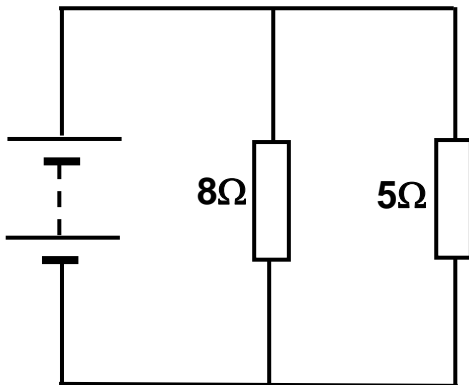
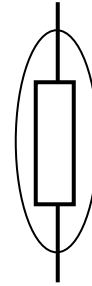
**How confident are you** that your answers to this question are correct? Tick ONE box (✓)

Very confident <input type="checkbox"/>	Fairly confident <input type="checkbox"/>	Not confident <input type="checkbox"/>	Just guessing <input type="checkbox"/>
-----------------------------------------	-------------------------------------------	----------------------------------------	----------------------------------------



8

In each of the circuits below, draw a circle like this



What rule are you using to pick out the right resistor to circle?

Tick *ONE* box (✓)

- The biggest current is through the biggest resistor.
- The biggest current is through the smallest resistor.
- The biggest current is through the resistor closest to the battery.
- The biggest current is through the resistor farthest from the battery.
- Other (please explain): \_\_\_\_\_

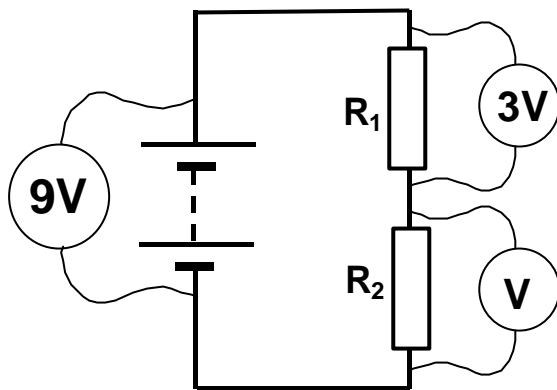
---

---

9

This circuit consists of a 9V battery connected to two resistors in series. The two resistors have different resistances.

The voltmeter connected across  $R_1$  reads 3V.



- (a) What is the reading on voltmeter V, connected across  $R_2$ ? \_\_\_\_\_ volts
- (b) Which has the bigger resistance,  $R_1$  or  $R_2$ ? \_\_\_\_\_

How confident are you that your answers to this question are correct? Tick ONE box (✓)

Very confident

Fairly confident

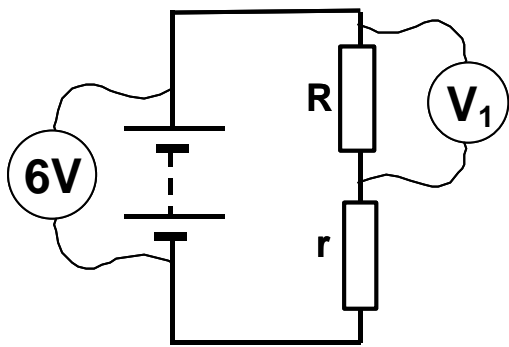
Not confident

Just guessing

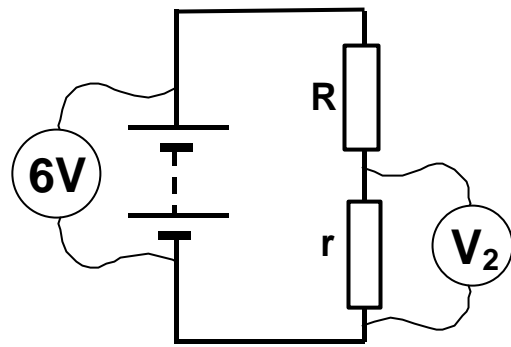
In each of these circuits, the resistor **R** has a large resistance and the resistor **r** has a small resistance.

For each circuit, say what you think the reading on the voltmeter will be, by writing one of the letters A-E in the box, as follows:

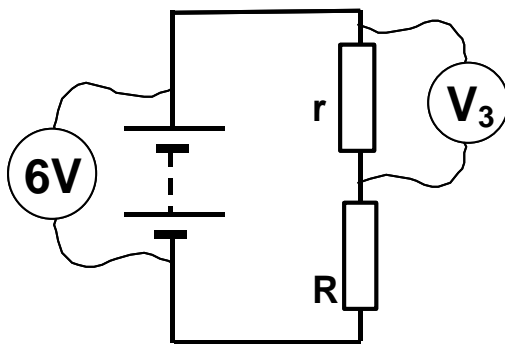
- A exactly 6V
- B slightly less than 6V
- C exactly 3V
- D slightly above 0V
- E exactly 0V



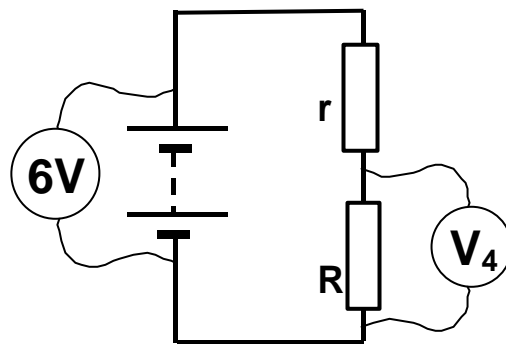
Reading on voltmeter  $V_1$



Reading on voltmeter  $V_2$



Reading on voltmeter  $V_3$



Reading on voltmeter  $V_4$

How confident are you that your answers to this question are correct? Tick ONE box (✓)

Very confident

Fairly confident

Not confident

Just guessing