

Series and parallel

Name: _____ Class: _____ Date: _____

A circuit only works if there is a **complete loop** from one side of the battery to the other.

Series: one path. Components share the battery's voltage. **Parallel:** separate paths. Each component gets the full voltage.

Part A · Circuits

A1 Which of these circuits will light the lamp? Explain your answer. [2]



(a)



(b)



(c)

A2 Two identical 6 V lamps are connected to a 6 V battery.

a) In series, what voltage does each lamp get? [1]

b) In parallel, what voltage does each lamp get? [1]

c) Which way are the lamps brighter? [1]

A3 In **Twelve Volts**, two 6 V lamps must work on a 12 V supply.

a) How should the lamps be connected? Explain why. [2]

b) What would happen to a 6 V lamp connected straight across 12 V? [1]

A4 A 6 V, 3 W lamp takes 0.5 A from a 6 V battery.

a) Two of these lamps are connected in parallel to the battery. How much current does the battery give? [1]

b) Why does adding a lamp in parallel make the battery give more current?

[1]

Part B · Play levels 1 to 4

Before you press **Check circuit**, predict what will happen. Record your best design for each level.

Level	What I built	Cost	Stars	What went wrong, and how I fixed it
1		£		
2		£		
3		£		
4		£		

Part C · Read the numbers

This is **Two Rooms** with both lamps in parallel and **Numbers** turned on. Each label shows the voltage and the current.



C1 What current does each lamp take?

[1]

C2 What current does the battery give? How does it compare with the lamps' currents?

[2]

C3 The lamps get 5.89 V and 5.86 V, not quite 6 V. Suggest why. [2]

C4 Where would you put a switch to turn off only the bedroom lamp? [1]

Part D • Explain

D1 The lights in a house are wired in parallel, not in series. Give three reasons why. [3]

Resistance, power and safety

Name: _____

Class: _____

Date: _____

$V = I \times R$ · $P = I \times V$ · $P = I^2 \times R$ · resistors in series: $R = R_1 + R_2$ · resistors in parallel: $1/R = 1/R_1 + 1/R_2$
Potential divider: $V_{\text{out}} = V_{\text{in}} \times R_2 \div (R_1 + R_2)$

1 Pick the Resistor. A desk lamp needs 6 V and takes 0.5 A. The battery gives 9 V.

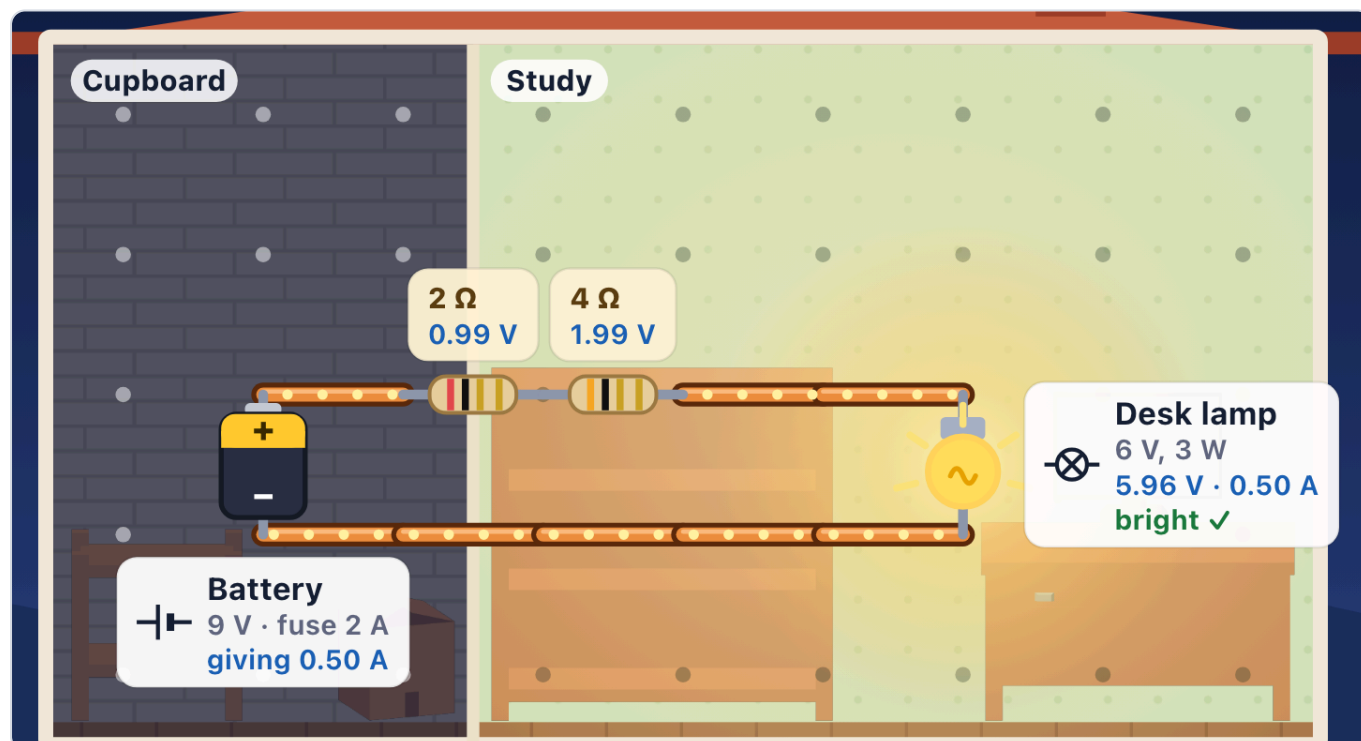
a) What voltage must a resistor in series with the lamp take? [1]

b) What resistance does it need? [2]

c) The box has 2 Ω , 4 Ω , 10 Ω and 22 Ω resistors. How can you make the resistance you need? [1]

d) How much power does the resistor waste as heat? [2]

2 Read the numbers. This is the finished Pick the Resistor circuit, with Numbers turned on.



a) Add up the voltages across the two resistors and the lamp. Compare the total with 9 V, and explain any difference. [2]

b) Use the numbers to work out the lamp's resistance. Check it against its rating (6 V, 3 W). [2]

3 Two Fuses. Two 12 V circuits each have a 3 A fuse. The appliances are a 24 W heater, an 18 W fridge, a 12 W TV and a 3 W lamp.

a) Work out the current each appliance takes. [2]

b) Explain why the heater and the fridge can't share a circuit. [1]

c) Suggest a way to share the four appliances between the two circuits. [1]

d) Why is it dangerous to replace a 3 A fuse with a 13 A fuse? [2]

4 Smart Doorbell. A 9 V battery feeds a potential divider: $R_1 = 94\ \Omega$ (two $47\ \Omega$ in series) on top and $R_2 = 47\ \Omega$ below. The battery has a 100 mA fuse.

a) With nothing connected, what is the output voltage across R_2 ? [2]

b) What current flows through the divider? Is it safe for the fuse? [2]

c) The 1 k Ω doorbell is connected across R_2 . Work out the combined resistance of R_2 and the doorbell, and the new output voltage. [3]

d) Why wouldn't a 22 Ω resistor on top and a 10 Ω resistor below work? [2]

5 Power to the Shed. The shed heater is rated 12 V, 36 W. Assume its current stays the same.

a) What current does the heater take? [1]

b) Its loop is 20 sections of thin wire, 0.1 Ω each. What is the loop's resistance, and how much voltage is lost in it? [2]

c) Repeat (b) for thick cable at $0.01\ \Omega$ per section. [1]

d) Use $P = I^2 \times R$ to work out the power wasted in each loop. [2]

e) Explain why the National Grid sends electricity at very high voltages. [2]

6 Evaluate. Evaluate how the wiring of a house is designed to be safe and efficient. Refer to parallel circuits, fuses and cable thickness, and use evidence from Light It Up. [6]

Continue on lined paper if you need more space.