

Covering teacher guide

Series and parallel circuits

Start here / subject briefing

Before this lesson: Consolidation after pupils have met circuit symbols, current, voltage, resistance and $V = IR$. Pupils use calculators; no circuit-building is required.

Current is charge flowing each second. One series loop carries the same current throughout; its resistances add and its voltages share the supply. Parallel branches each connect across the full supply voltage, and their currents add. An open switch stops current only in paths it breaks.

Words and symbols you will need

Term	Plain-English meaning
Current, I (A)	Charge flowing per second, measured in amperes. Charge is conserved.
Voltage, V (V)	Also called potential difference: energy transferred per unit charge.
Resistance, R (Ω)	For these fixed resistors, $R = V/I$. At the same voltage, larger resistance gives less current.
Series	Components in one complete path.
Parallel	Separate complete branches between the same two supply terminals.
Ideal supply	Its stated voltage stays fixed when a branch opens in this lesson.

Help pupils choose a method

- Trace complete paths between supply terminals. Decide whether components share one loop or separate branches.
- Choose the rule first. For a resistor, use its own voltage and current in $V = IR$, $I = V/R$ or $R = V/I$.
- Check the sums. After a switch opens, trace which paths remain complete before recalculating.

Use the supplied model - pupil page 2

Pupil page 2 has the series model. Add $4\ \Omega$ and $8\ \Omega$ before finding the common current. The two resistors have the same current, but their unequal resistances give unequal voltages.

$R_{\text{total}} = 4 + 8 = 12\ \Omega$. $I = 12/12 = 1\ \text{A}$ through both resistors. Their potential differences are $1 \times 4 = 4\ \text{V}$ and $1 \times 8 = 8\ \text{V}$. The check is $4 + 8 = 12\ \text{V}$: equal current does not mean equal potential difference.

If pupils are still stuck

Use the relevant coaching and named retry within its replacement time. Trace one complete path together or write the correct equation with units. If the retry remains insecure, record whether paths, equation choice or arithmetic caused the problem for the usual teacher.

Turn to teacher page 2 for the timed run sheet. Keep this guide separate from the pupil booklet.

Run the lesson from this page

Series and parallel circuits

Download and print one complete 7-page pupil handout per pupil, in order. Double-sided printing is fine; staple each booklet.

Read the subject briefing on teacher page 1. Use the timed run sheet on page 2 and the numbered answers. Each check has Say / Ask / Expect coaching and a fresh retry.

Pupils need a pen, a different-coloured pen and a calculator. All reading and questions are included; no pupil accounts, devices or apparatus are needed.

Min	Pupil page / Q	Read aloud / check	Next action and answer key
0-5	1 / 1-3	"Start on page 1. Work from memory." At 5 minutes check the three answers.	If insecure, Try again A on page 1 in the first 2 reading minutes; otherwise page 2. Answers: teacher page 3. Coaching: page 7.
5-15	2 / reading	"Read the rules and follow the models. You can use this page during practice."	Check Try again A, if used. Do not add it to the lesson time.
15-20	3 / 4	"Choose an answer and write your reasons. Stop at the check."	Check B and both reasons. If insecure, Try again B on page 3 replaces 8-9. Answers: teacher page 3. Coaching: page 8.
20-30	3-4 / 5-9	"Work through questions 5-9. Show working and units."	If Try again B was used, leave 8-9 blank. Check the retry before continuing. Answers: teacher pages 4, 5.
30-33	4 / 10	"Pause the practice. Answer question 10 independently."	If insecure, Try again C on page 4 replaces 14-15. Otherwise continue. Answers: teacher page 4. Coaching: page 9.
33-45	5-6 / 11-18	"Continue the practice. Use page 2 if you need a rule."	Check support responses promptly. If finished early, improve the explanation in question 18. Answers: teacher page 5.
45-55	6 / 19	"Check your practice in a different colour, then explain one correction."	Read the practice answers from this guide. Keep the exit answer hidden. Answers: teacher page 5.
55-60	7 / 20	"Cover the earlier pages. Complete the final question on your own."	Collect every booklet. Check the exit afterwards; record any Try again D follow-up. Answers: teacher page 6. Coaching: page 10.

The run sheet totals 60 minutes. Try again A uses reading time; B and C replace named practice questions; D is next lesson only. Timings are estimates, not classroom-trial results.

Checks 1 and 2: pages 1 and 3

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

1. (pupil p1) 0.30 A. Charge is conserved and does not get used up in the lamp, so the steady current is the same at both points in this unbranched loop.
2. (pupil p1) $R = V/I = 6.0/0.20 = 30 \Omega$. Divide potential difference by current.
3. (pupil p1) Parallel. There is a separate complete path through each component between the same two terminals.
4. (pupil p3) B: 12 V and 0.70 A. P connects across the same supply terminals, so it has the full 12 V. The supply current is the sum of the branch currents: $0.20 + 0.50 = 0.70$ A.

Try again A - pupil page 1

Only if your teacher asks. Use the first 2 minutes of reading time, then turn to page 2.

The second resistor carries 0.40 A because charge is conserved in the single complete loop. The separate sketch is parallel: the resistors lie on separate complete paths between the same terminals. In the final test, $R = V/I = 3.6/0.30 = 12 \Omega$.

Try again B - pupil page 3

Only if your teacher asks. Complete this instead of questions 8 and 9. Then answer questions 5-7.

Y has 9.0 V because it connects across the supply terminals. The total is $0.15 + 0.25 = 0.40$ A because branch currents add at a junction.

Practice: page 4

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

7. (pupil p4) $R = 10 + 20 = 30 \Omega$. $I = 6.0 / 30 = 0.20 \text{ A}$.

8. (pupil p4) $R = 15 + 25 = 40 \Omega$. $I = 12 / 40 = 0.30 \text{ A}$.

9. (pupil p4) 15Ω resistor: $V = 0.30 \times 15 = 4.5 \text{ V}$. 25Ω resistor: $V = 0.30 \times 25 = 7.5 \text{ V}$. The values add to 12 V .

10. (pupil p4) Each branch has 6.0 V . Through 10Ω : $I = 6.0/10 = 0.60 \text{ A}$. Through 30Ω : $I = 6.0/30 = 0.20 \text{ A}$. The total is $0.60 + 0.20 = 0.80 \text{ A}$. At the same potential difference, the larger resistance gives the smaller current.

Try again C - pupil page 4

Only if your teacher asks. Complete this instead of questions 14 and 15. Then continue with the other questions.

$I_{30} = 12/30 = 0.40 \text{ A}$; $I_{60} = 12/60 = 0.20 \text{ A}$; $I_{\text{supply}} = 0.60 \text{ A}$. The 30Ω branch carries more current because its resistance is lower at the same 12 V potential difference.

Practice and review: pages 3, 5 and 6

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

- 5. (pupil p3)** A series circuit has one complete path. A parallel circuit has separate complete branches between the same two supply terminals.
- 6. (pupil p3)** The current is the same through both series resistors. Charge is conserved and is not used up; energy is transferred in the resistors.
- 11. (pupil p5)** 0.20 A: the same current flows everywhere in this single loop.
- 12. (pupil p5)** R1: $V = 0.20 \times 10 = 2.0 \text{ V}$. R2: $V = 0.20 \times 20 = 4.0 \text{ V}$.
- 13. (pupil p5)** 6.0 V across each resistor: both branches connect across the supply.
- 14. (pupil p5)** R1: $I = 6.0 / 10 = 0.60 \text{ A}$. R2: $I = 6.0 / 20 = 0.30 \text{ A}$.
- 15. (pupil p5)** $I = 0.60 + 0.30 = 0.90 \text{ A}$.
- 16. (pupil p6)** 0.30 A. The R1 branch is broken, but the R2 branch remains complete across 6.0 V and carries 0.30 A.
- 17. (pupil p6)** 0 A through both. Opening the switch breaks the only complete path.
- 18. (pupil p6)** B. Each unit connects across the full 6.0 V supply, and each has a separate complete path, so opening one branch leaves the other operating. In A the supply potential difference is shared and breaking the loop stops both.
- 19. (pupil p6)** Accept a corrected assigned answer with the applicable rule and a clear explanation of the original error. For the all-correct alternative: both branches have the supply potential difference, but $I = V/R$ gives a smaller current in the larger resistance. Merely copying a final value is not an explained correction.

Exit and next lesson: page 7

Match the pupil number. Accept equivalent correct wording. Keep this guide separate from pupils.

20. (pupil p7) Initially $I_P = 8.0/20 = 0.40$ A and $I_Q = 8.0/40 = 0.20$ A, so $I_{\text{supply}} = 0.60$ A. After Q opens, $I_P = 0.40$ A and $I_{\text{supply}} = 0.40$ A. P still has a complete path across the unchanged 8.0 V; its resistance is unchanged. Q carries zero current.

Try again D - next lesson - pupil page 7

Leave this today. Your usual teacher may ask you to do it next lesson.

Initially $I_{25} = 10/25 = 0.40$ A and $I_{50} = 10/50 = 0.20$ A, giving 0.60 A total. After the 25 Ω branch opens, the 50 Ω branch and supply each carry 0.20 A: the remaining branch still has a complete path across 10 V. Opening the only series path gives 0 A everywhere.

Collect and follow up

Collect the whole named booklet. Check the independent exit against the key, record which learning objectives are secure, and tell the usual teacher which pupils need Try again D next lesson.

Source provenance - for the usual teacher

Pupil question	Original worksheet part / page
5	WS-04 Q1(a) / source p1
6	WS-04 Q1(b) / source p1
7	WS-04 Q2(a) / source p1
8	WS-04 Q2(b) / source p1
9	WS-04 Q2(c) / source p1
11	WS-04 Q3(a) / source p2
12	WS-04 Q3(b) / source p2
13	WS-04 Q3(c) / source p2
14	WS-04 Q3(d) / source p2
15	WS-04 Q3(e) / source p2
16	WS-04 Q4(b) / source p3
17	WS-04 Q4(c) / source p3
18	WS-04 Q4(e) / source p3

Selected practice is reformatted from the maintained PhysicsUK worksheet. Required context is included; unassigned parts are omitted.

[Source worksheet](#) | [Maintained solutions](#) | [Revision notes](#)

Check 1: Entry

Question 1, Question 2, Question 3

Look for: Question 1: 0.30 A with conserved charge. Question 2: 30 Ω from V/I . Question 3: parallel with separate complete paths between the same terminals.

If secure: Turn to the reading and models on pupil page 2.

If: question 1 reduces current after the lamp, or question 3 misidentifies the arrangement or gives no path reason.

Likely issue: Charge conservation or the distinction between one path and separate branches is insecure.

Say: Charge is conserved: a lamp transfers energy but does not use up charge. Current is the same through one unbranched loop. Separate complete branches between the same terminals are parallel.

Ask: What does the ammeter after the lamp read in question 1? What arrangement is described in question 3?

Expect: 0.30 A after the lamp; parallel in question 3, because there are separate complete paths between the same terminals.

Next: Use pupil page 2, Series: one complete path and Parallel: separate complete branches. Then ask pupils to attempt Try again A independently on pupil page 1. Use the first 2 reading minutes. Check the fresh response against the numbered answer key.

pupil page 2, Series: one complete path and Parallel: separate complete branches; Try again box on pupil page 1; online #concept-1.

If: question 2 has a wrong equation, calculation or unit.

Likely issue: Identify whether equation choice, substitution, arithmetic or units caused the error.

Say: Use quantities for the same resistor. Rearrange $V = IR$ to find resistance: divide the voltage by the current. Volts per ampere give ohms.

Ask: For question 2, which division uses 6.0 V and 0.20 A?

Expect: $R = 6.0 \div 0.20 = 30 \Omega$. A correct equation with an arithmetic slip needs a calculator check.

Next: Use pupil page 2, equation box: $R = V \div I$. Then ask pupils to attempt Try again A independently on pupil page 1. Use the first 2 reading minutes. Check the fresh response against the numbered answer key.

pupil page 2, equation box: $R = V \div I$; Try again box on pupil page 1; online #concept-1.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 2: Hinge

Question 4

Look for: B, with both reasons: each branch spans 12 V and the branch currents add to 0.70 A. A correct letter alone is insufficient.

If secure: Start questions 5-9. Require the explanation as well as the correct choice.

If: A, or a reason that divides 12 V between the parallel branches.

Likely issue: The series sharing rule has been applied to parallel branches.

Say: Each parallel branch joins the same two supply terminals, so each has the full supply voltage. Sharing the supply voltage applies to components in series.

Ask: In question 4, branch P spans which two terminals? What voltage is across it?

Expect: The same two supply terminals; the full 12 V is across P.

Next: Use pupil page 2, Parallel: separate complete branches. Then ask pupils to attempt Try again B independently on pupil page 3. This replaces questions 8-9. Then continue with questions 5-7. Check the fresh response against the numbered answer key.

pupil page 2, Parallel: separate complete branches; Try again box on pupil page 3; online #concept-2.

If: C uses one branch as the total; D subtracts two branch currents as though one were the total.

Likely issue: The given branch currents have not been distinguished from the current entering the junction.

Say: At a junction, the current entering equals the sum leaving. Here both given currents belong to branches, so add them to find the supply current.

Ask: Are 0.20 A and 0.50 A in question 4 branch currents or the total? What must the total be?

Expect: They are branch currents; supply current = $0.20 + 0.50 = 0.70$ A. Subtract only if the total and one branch are given.

Next: Use pupil page 2, Worked model - junction. Then ask pupils to attempt Try again B independently on pupil page 3. This replaces questions 8-9. Then continue with questions 5-7. Check the fresh response against the numbered answer key.

pupil page 2, Worked model - junction; Try again box on pupil page 3; online #concept-2.

If: B without both requested reasons.

Likely issue: The correct choice may be a guess; understanding has not yet been demonstrated.

Say: The correct letter needs both rules: a parallel branch has the full supply voltage, and the supply current equals the sum of branch currents.

Ask: Explain the voltage and current values in your choice for question 4.

Expect: B: 12 V because P spans the supply terminals; 0.70 A because $0.20 + 0.50 = 0.70$ A.

Next: Use pupil page 2, Parallel rule and Worked model - junction. Then ask pupils to attempt Try again B independently on pupil page 3. This replaces questions 8-9. Then continue with questions 5-7. Check the fresh response against the numbered answer key.

pupil page 2, Parallel rule and Worked model - junction; Try again box on pupil page 3; online #concept-2.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 3: Mid Practice

Question 10

Look for: 0.60 A through 10 Ω ; 0.20 A through 30 Ω ; 0.80 A total. Both branches have 6.0 V, so the larger resistance gives less current.

If secure: Continue with questions 11-18 on pages 5-6.

If: Adds 10 Ω and 30 Ω first, shares 6 V between branches, or makes the branch currents equal.

Likely issue: A series/equal-sharing model is being used for unequal parallel resistors.

Say: These resistors are on separate branches, each across 6.0 V. Find each branch current using its own resistance, then add the two currents.

Ask: For question 10, divide 6.0 V by each branch resistance. What are the currents and their sum?

Expect: Through 10 Ω : 0.60 A. Through 30 Ω : 0.20 A. Total: 0.80 A. Do not add the resistances as if they were in series.

Next: Use pupil page 2, Parallel: separate complete branches. Then ask pupils to attempt Try again C independently on pupil page 4. This replaces questions 14-15. Continue with the other practice questions. Check the fresh response against the numbered answer key.

pupil page 2, Parallel: separate complete branches; Try again box on pupil page 4; online #concept-2.

If: Gives each branch 6.0 V but has a calculation/sum/unit error or no reason for the unequal currents.

Likely issue: The path model may be correct; identify the method error or missing fixed-voltage/resistance link.

Say: Keep 6.0 V across each branch. At the same voltage, a larger resistance gives less current because $I = V/R$. Add the branch currents for the supply current.

Ask: Which branch in question 10 carries less current, and why? Check the two divisions and sum.

Expect: The 30 Ω branch: 0.20 A rather than 0.60 A through 10 Ω , because its resistance is larger. Total = 0.80 A.

Next: Use pupil page 2, equation box: $I = V \div R$, then add the branch currents. Then ask pupils to attempt Try again C independently on pupil page 4. This replaces questions 14-15. Continue with the other practice questions. Check the fresh response against the numbered answer key.

pupil page 2, equation box: $I = V \div R$, then add the branch currents; Try again box on pupil page 4; online #concept-2.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Check 4: Exit

Question 20

Look for: Initially 0.60 A total; after Q opens, P and the supply each carry 0.40 A. The reason identifies P's complete path, unchanged 8.0 V and fixed resistance.

If secure: Record the objectives demonstrated. If insecure, use Try again D next lesson after revisiting the named reading.

If: After Q opens, P becomes zero, rises to the old total, or receives a different voltage.

Likely issue: Opening one parallel branch has been treated like breaking the only loop or redistributing a fixed total current.

Say: Opening Q breaks only Q's branch. P still has a complete path across the unchanged 8.0 V supply, so its own current stays the same.

Ask: In question 20, is P's path still complete after Q opens? What voltage and current does P have?

Expect: Yes: 8.0 V and $8.0 \div 20 = 0.40$ A. With only P conducting, the supply current is also 0.40 A.

Next: Next lesson, first use pupil page 2, What happens when a switch opens? and the parallel rule. Then ask pupils to attempt Try again D independently on pupil page 7. This is outside today's 60 minutes. Check the fresh response against the numbered answer key.

pupil page 2, What happens when a switch opens? and the parallel rule; Try again box on pupil page 7; online #concept-3.

If: Predicts P is unchanged, but its value or the initial total is wrong, or gives no physical reason.

Likely issue: The method, current sum or explanation needs confirming before the objective is secure.

Say: Find each initial branch current with $I = V/R$, then add. After Q opens, use P's unchanged voltage and resistance; do not send the old total current through P.

Ask: Calculate the initial P and Q currents in question 20. What remains after Q opens?

Expect: Initially $P = 0.40$ A, $Q = 0.20$ A, total = 0.60 A. Afterwards P and supply = 0.40 A because P remains complete across 8.0 V.

Next: Next lesson, first use pupil page 2, equation box, parallel rule and complete-path explanation. Then ask pupils to attempt Try again D independently on pupil page 7. This is outside today's 60 minutes. Check the fresh response against the numbered answer key.

pupil page 2, equation box, parallel rule and complete-path explanation; Try again box on pupil page 7; online #concept-2.

If the retry remains insecure, use the support guidance on teacher page 1 and record the precise difficulty for the usual teacher.

Specification and review

AQA 8463: 4.2.2 | AQA 8464: 6.2.2. Series and parallel rules, fixed-resistor calculations and complete-path fault explanations. Both courses and tiers use the same selection. Parallel equivalent-resistance calculations, mixed circuits and practical-method questions are excluded.

PhysicsUK original cover lesson. Reviewed 2026-10-31. Timings estimated.