

Circuit rules, power and mains safety

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet

Name: _____ Date: _____ Class: _____

These 20 problems train the rules for series and parallel circuits, the three power formulas, energy costs and mains safety. They climb from one-step recall to multi-step circuits, graphs and design tasks.

Level 1 problems use single formulas, level 2 combine two or three steps, and level 3 asks for reasoning and design. They suit GCSE, IGCSE, O Level, CBSE Class 9-10 and NGSS high-school physics.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE P2, HS-PS3-3

Problem 1 Series or parallel? (easy)

Aarav is wiring a model house in Pune. For each statement say whether it describes a series circuit, a parallel circuit, or both.

1. The current is the same at every point.
2. Every branch has the full supply voltage across it.
3. If one lamp is unscrewed, the others stay lit.
4. The total resistance is larger than any single resistor.

Problem 2 Phone charger power (easy)

Chiamaka in Lagos charges her phone with a charger that supplies 5.0 V at 2.0 A.

1. Calculate the power delivered.
2. Calculate the energy delivered in 30 minutes, in joules.
3. Convert that energy into watt-hours.

Problem 3 Three resistors in series (easy)

For a science fair, Mei in Singapore joins resistors of 15 Ω , 25 Ω and 10 Ω in series with a 9.0 V battery.

1. Calculate the total resistance.
2. Calculate the current.
3. Calculate the potential difference across the 25 Ω resistor.

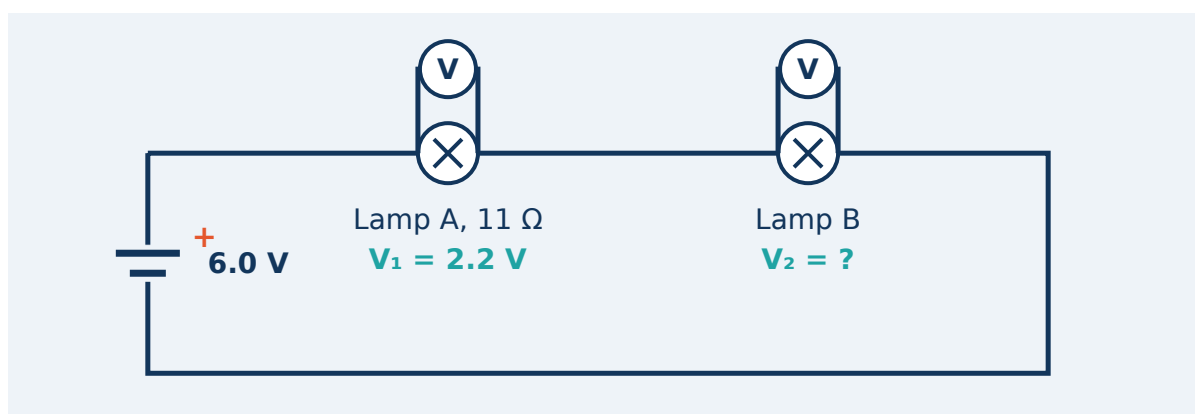
Problem 4 Reading labels (easy)

Rosa reads labels in a hardware store in Houston. Convert:

1. 2.5 kW into watts.
2. 450 mW into watts.
3. 90 minutes into hours.
4. 3.6 MJ into kilowatt-hours.

Problem 5 Voltage in a series loop (easy)

Hana in Addis Ababa builds the circuit in the figure. Lamp A has a resistance of $11\ \Omega$.

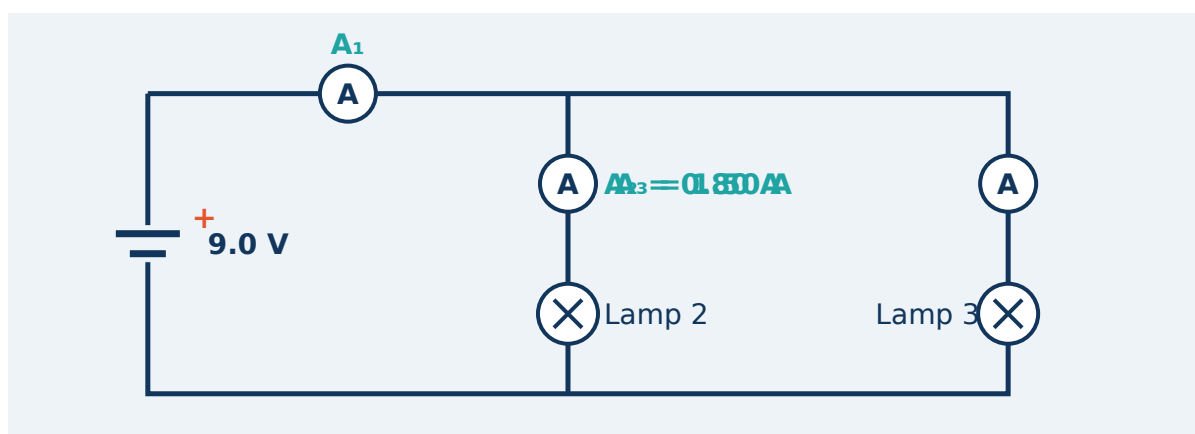


Two lamps in series on a 6.0 V cell, each with a voltmeter across it.

1. Find the voltage across lamp B.
2. Calculate the current through lamp A.
3. Calculate the resistance of lamp B.
4. Calculate the power of lamp B.

Problem 6 Currents in branches (easy)

Emma in Leeds connects two lamps in parallel to a 9.0 V cell, with ammeters as shown.



Two lamps in parallel on a 9.0 V cell with an ammeter in each branch and one in the main wire.

1. Find the reading on A_1 .
2. State the voltage across each lamp.
3. Calculate the resistance of lamp 2 and of lamp 3.
4. Calculate the total power, to 2 significant figures.

Problem 7 Toaster fuse (easy)

Wanjiru in Nairobi has an 800 W toaster on a 240 V supply. Fuses of 3 A, 5 A and 13 A are available.

1. Calculate the current.
2. Choose the correct fuse and give a reason.
3. Calculate the energy transferred in 4 minutes.

Problem 8 Night fan costs (medium)

Kofi in Accra runs a 60 W fan for 8 hours every night. Electricity costs 1.50 cedis per kWh.

1. Calculate the energy used per night in kWh.
2. Calculate the energy used in 30 nights.
3. Calculate the cost for 30 nights.

Problem 9 Two resistors in parallel (medium)

Priya in Chennai joins a 12 Ω and a 4 Ω resistor in parallel across a 9.0 V supply.

1. Calculate the total resistance.
2. Calculate the total current.
3. Calculate the current in each resistor.

Problem 10 Heating coil (medium)

Tariq in Dhaka tests a heating coil of resistance 46 Ω carrying a current of 5.0 A.

1. Calculate the power.
2. Calculate the potential difference across the coil.
3. Calculate the energy transferred in 2.0 minutes.

Problem 11 Resistance of an iron (medium)

Bilal in Lahore has a 1000 W iron designed for 220 V.

1. Use $P = V^2/R$ to calculate its resistance.
2. Calculate the current it draws.
3. Explain why a 3 A fuse would not be suitable.

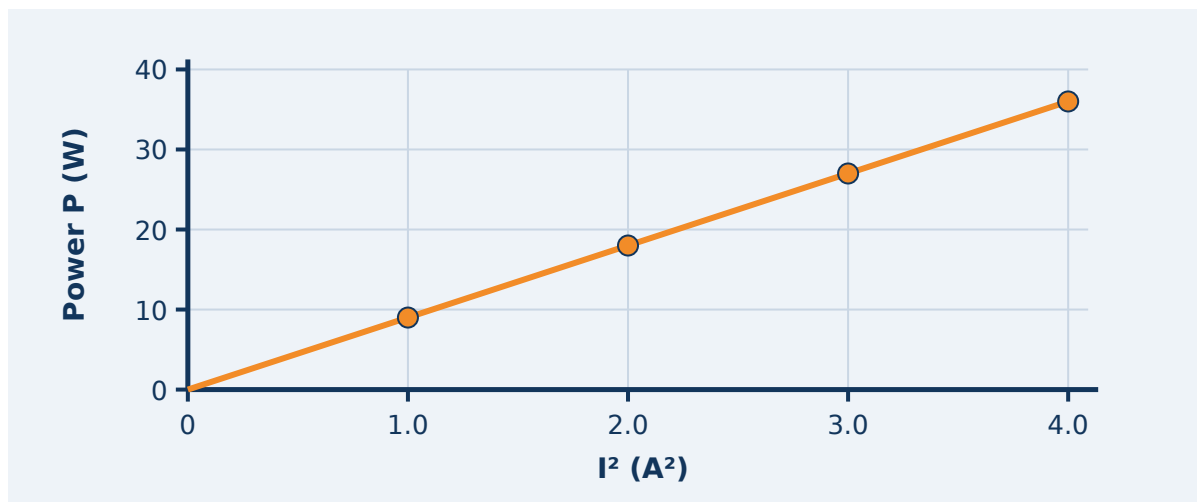
Problem 12 Why parallel at home? (medium)

Naledi in Johannesburg asks why the lamps in her house are wired in parallel.

1. Give two advantages of parallel wiring for house lamps.
2. Describe what would happen in a series house circuit when one lamp failed.
3. Explain what happens to the brightness of the lamps already lit when a new lamp is added in parallel, and in series.

Problem 13 Power against current squared (medium)

Lakshmi measured the power in a resistor for several currents and plotted the graph.



Measured power in a resistor plotted against the square of the current.

1. State what the gradient of the graph represents.
2. Calculate the gradient.
3. Read the power when $I^2 = 2.5 \text{ A}^2$.
4. Calculate the current when the power is 18 W.

Problem 14 Which bulb is brighter? (medium)

Ingrid in Oslo has two 12 V lamps: lamp X is rated 24 W and lamp Y is rated 6.0 W. She joins them in series across a 12 V supply.

1. Calculate the resistance of each lamp from its rating.
2. Calculate the current in the circuit.
3. Calculate the power in each lamp.
4. State which lamp is brighter and explain why this is surprising.

Problem 15 Overloaded extension lead (medium)

Emma plugs a 2.2 kW kettle, a 0.90 kW toaster and a 0.10 kW lamp into one extension lead on a 230 V supply, protected by a 13 A fuse.

1. Calculate the current in each appliance.
2. Calculate the total current.
3. Predict what happens to the fuse and explain.
4. Suggest a safe way to use these appliances.

Problem 16 Farm lighting (hard)

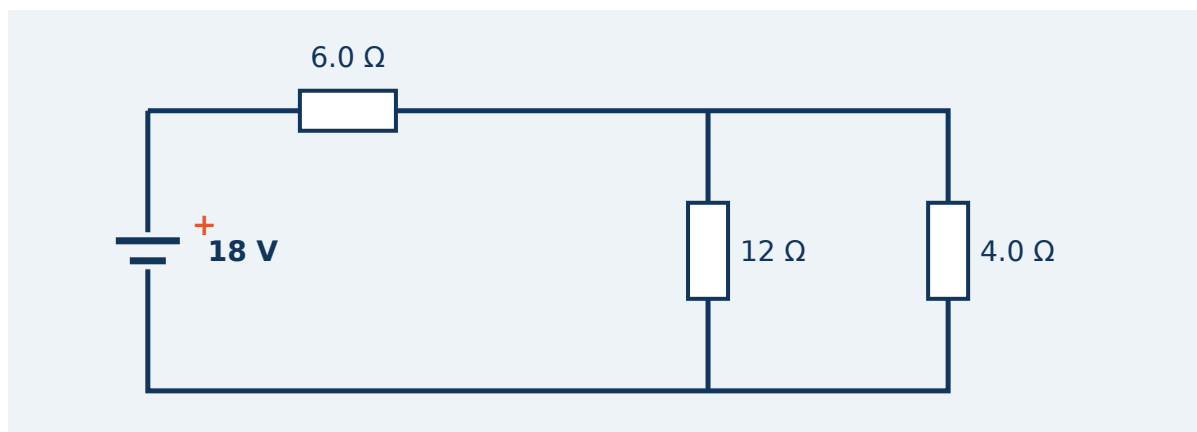
Samuel on a farm in Uganda runs three LED strips of 6.0 W, 9.0 W and 15 W in parallel from a 12 V solar battery.

1. Calculate the total power.
2. Calculate the total current.

3. Calculate the current in each strip.
4. Calculate the total resistance of the three strips.
5. The lights run for 5 hours. Calculate the energy in kWh and in joules.

Problem 17 Series-parallel network (hard)

A student builds the circuit shown.



A 6.0 Ω resistor in series with a 12 Ω and a 4.0 Ω resistor in parallel, on an 18 V supply.

1. Calculate the resistance of the parallel pair.
2. Calculate the total resistance and the total current.
3. Calculate the potential difference across the 6.0 Ω resistor and across the parallel pair.
4. Calculate the current in the 12 Ω and in the 4.0 Ω resistor.
5. Calculate the power in each resistor and check the total against the supply power.

Problem 18 Spot the errors (hard)

Mei in Singapore made three mistakes in her homework. Identify each error, explain it and give the correct result.

1. "5 Ω and 20 Ω in parallel give $5 + 20 = 25 \Omega$."
2. "A 1.2 kW heater on 230 V draws $I = P \times V = 1200 \times 230 = 276\,000 \text{ A}$."
3. "A 10 Ω resistor carries 3.0 A, so $P = I \times R = 30 \text{ W}$."

Problem 19 Losing power in cables (hard)

Olumide in Ibadan's generator must deliver 2.0 kW to a workshop through cables with a total resistance of 0.50 Ω . Ignore the voltage drop in the cables.

1. Calculate the current if the power is sent at 200 V.
2. Calculate the power wasted in the cables.
3. Calculate the current if the power is sent at 2000 V.
4. Calculate the power wasted in the cables now.
5. Explain why sending power at high voltage wastes less energy.

Problem 20 Design a lamp circuit (hard)

Fatima in Kano has a 12 V battery rated 2.0 A·h and two lamps, each marked 6.0 V, 3.0 W.

1. Calculate the current each lamp needs at full brightness.
2. Calculate the resistance of each lamp.
3. Show that connecting the lamps in series across the battery lights both at full brightness.
4. Calculate how long the battery can run both lamps (energy stored = 12 V × 2.0 A·h).
5. She wants to run only one lamp from the 12 V battery. Calculate the series resistor needed and the power it wastes.