Year 13 Science: DC circuits, internal resistance and Kirchhoff's laws

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. An AA cell of EMF 1.50 V and internal resistance 0.400 Ω is connected to a 2.60 Ω resistor. Find the current and the terminal voltage.

2. A battery reads 9.00 V on open circuit and 8.40 V when it supplies 0.300 A. Find its internal resistance.

3. Currents of 2.0 A and 0.5 A flow into a junction and 1.2 A flows out along one wire. What current flows in the only other wire, and which way?

4. An e-bike battery has an EMF of 36.0 V and internal resistance 0.150 Ω. Climbing a hill, the motor draws 12.0 A. Find the terminal voltage and the power wasted in the battery.

Exam-style question: two boat batteries

On a fishing boat in the Hauraki Gulf, battery A (EMF 12.0 V, internal resistance 0.200 Ω) runs a bilge pump modelled as a 4.00 Ω resistor.

5. Calculate the current in the pump and the terminal voltage of battery A.

6. Explain why the terminal voltage is less than the EMF.

7. An older battery B (EMF 11.4 V, internal resistance 0.300 Ω) is connected in parallel with A, positive to positive. Use Kirchhoff's laws to calculate the current through each battery.

8. Explain what the sign of battery B's current tells you, and why connecting it this way wastes energy.

Fix the mistake

9. Correct this statement: "$I = \varepsilon \div R = 9.00 \div 3.50 = 2.57$ A, leaving out the battery."

10. Correct this statement: "The EMF of the battery drops when a bigger current is drawn."

11. Correct this statement: "The answer for I_2 came out negative, so I must have made a mistake."

12. Correct this statement: "In the loop equation every EMF and every IR term is added as positive."