

Emf, internal resistance and kirchhoff's laws

Physics grades 11-12 (A Level · IB · Class 11-12) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test covers emf, internal resistance, Kirchhoff's laws and potential dividers. Give every numerical answer with its unit and show the formula and the substitution. Treat voltmeters as ideal unless the question states otherwise.

Level: Physics grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB B.5

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Emf and lost volts (2 marks)

Distinguish between the emf of a battery and the potential difference across its terminals when it delivers a current.

Question 2 Cell and resistor (3 marks)

A cell of emf 6.0 V and internal resistance $0.50\ \Omega$ is connected to a $2.5\ \Omega$ resistor.

- Calculate the current. (1 mark)
- Calculate the lost volts. (1 mark)
- Calculate the terminal p.d. (1 mark)

Question 3 Junction (2 marks)

At a junction, currents of 4.5 A and 1.2 A enter. Three wires leave, carrying 2.0 A, 1.3 A and a third current I. Calculate I and name the law you used.

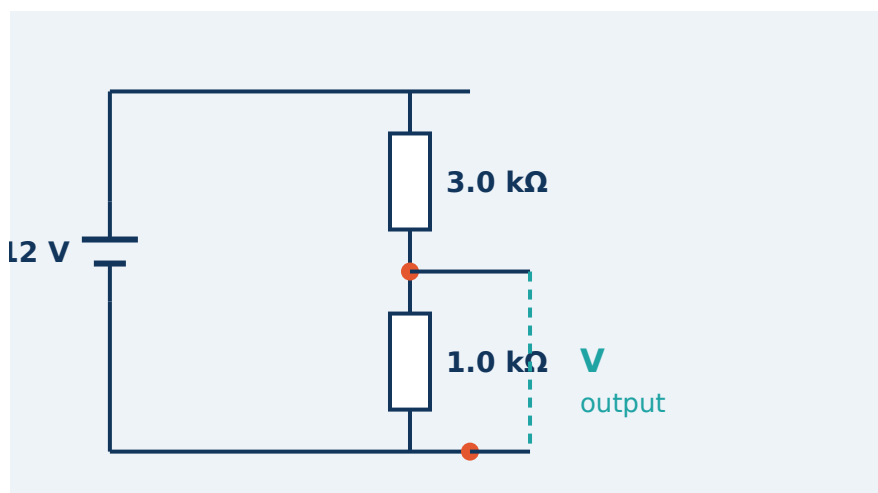
Question 4 Loop equation (3 marks)

A 15 V battery of negligible internal resistance is connected in series with resistors of $2.0\ \Omega$ and $3.0\ \Omega$ and an unknown resistor R. The current is 2.0 A.

- Write the equation from Kirchhoff's second law. (1 mark)
- Calculate R. (1 mark)
- Calculate the p.d. across the $3.0\ \Omega$ resistor. (1 mark)

Question 5 Potential divider (3 marks)

The circuit is a potential divider. The output is taken across the $1.0\text{ k}\Omega$ resistor.



Potential divider for question 5.

- Calculate the unloaded output voltage. (1 mark)
- A $1.0\text{ k}\Omega$ load is connected across the output. Calculate the new output voltage. (2 marks)

Question 6 Power in a battery (3 marks)

A battery of emf 9.0 V and internal resistance $0.60\text{ }\Omega$ delivers a current of 1.5 A .

- Calculate the total power produced by the battery. (1 mark)
- Calculate the power wasted in the battery. (1 mark)
- Calculate the efficiency. (1 mark)

Question 7 Short circuit (2 marks)

A lorry battery has emf 12 V and internal resistance $0.040\text{ }\Omega$. Calculate the short-circuit current and state one danger.

Question 8 Falling terminal voltage (2 marks)

Explain why the terminal potential difference of a battery falls when the current drawn from it increases.