FREE REVISION PACK

EMF & Internal Resistance

AQA A-level Physics · 7407 / 7408 · Specification 3.5.1.6

Easy Medium Hard **Multiple choice · past-paper questions**

8	8	≈ 10 min
QUESTIONS	TOTAL MARKS	SUGGESTED TIME*

Contents

Q	LEVEL	FOCUS	SOURCE	MARKS
1	Easy	Terminal pd with internal resistance	AQA June 2024 · A-level Paper 1 · Q27	1 mark
2	Easy	Combining cells for maximum current	AQA June 2017 · AS Paper 2 · Q7	1 mark
3	Medium	Voltmeter reading halves	AQA June 2019 · AS Paper 2 · Q33	1 mark
4	Medium	Two ideal cells in parallel	AQA June 2018 · AS Paper 2 · Q32	1 mark
5	Medium	Batteries in parallel with a resistor	AQA November 2021 · A-level Paper 1 · Q28	1 mark
6	Hard	Internal resistance from two readings	AQA June 2016 · AS Paper 2 · Q34	1 mark
7	Hard	Three cells in parallel	AQA June 2019 · AS Paper 2 · Q30	1 mark
8	Hard	Terminal pd against current	AQA June 2016 · AS Paper 2 · Q33	1 mark

Key ideas to have ready

- **emf** ε = energy transferred to each coulomb of charge by the source (J C^{-1}).
- $\varepsilon = I(R + r) = V + Ir$, where V is the terminal pd and Ir the "lost volts" inside the source.
- A graph of terminal pd V against current I is a straight line: intercept on the V axis = ε, gradient = $-r$.
- Identical cells in parallel: same emf as one cell, internal resistance divided by the number of cells. In series: emfs and internal resistances add.

How to use this pack

1. The questions are grouped into levels (Easy, Medium and Hard). Work through them in order, and check your answers at the end of each level before moving on.
2. Every question is multiple choice with one correct answer. Write down your working anyway; that is how you find mistakes.
3. The separate mark scheme uses the same numbers and explains every answer.

Levels are based on how students did in AQA's examiner reports where that information exists, plus our own difficulty rating. *About 1.5 minutes per question.

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Easy

Definitions and one-step ideas. Most students get these right.

Questions 1–2

Only **one** answer per question is allowed. For each question, completely fill in the circle alongside the appropriate answer.

AQA June 2024 · A-level Paper 1 · Q27

1 A $12\ \Omega$ resistor is connected across the terminals of a battery of emf $2.0\ \text{V}$ and internal resistance $4.0\ \Omega$.

What is the pd across the resistor?

[1 mark]

A $0.25\ \text{V}$ ⬭

B $0.75\ \text{V}$ ⬭

C $1.30\ \text{V}$ ⬭

D $1.50\ \text{V}$ ⬭

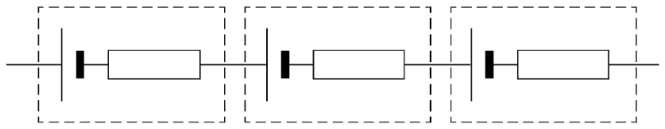
AQA June 2017 · AS Paper 2 · Q7

2 Three cells each have an emf $\varepsilon = 1.5\ \text{V}$ and an internal resistance $r = 0.6\ \Omega$.

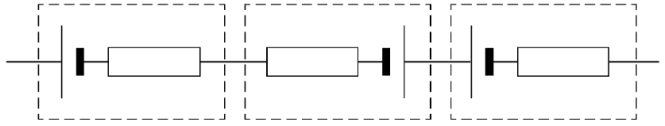
Which combination of these cells will deliver a total emf of $1.5\ \text{V}$ and a maximum current of $7.5\ \text{A}$?

[1 mark]

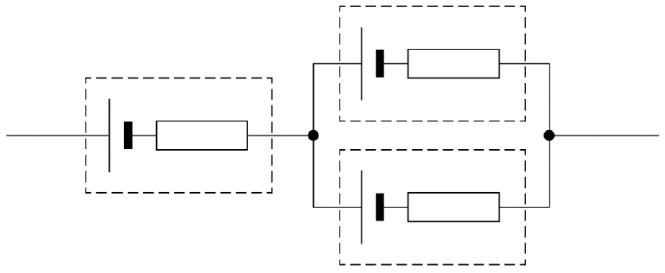
A



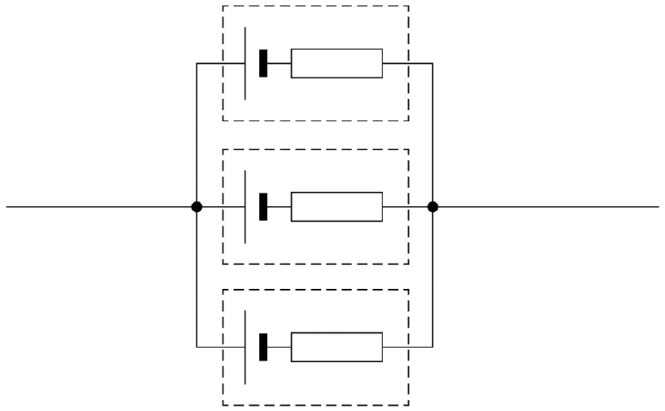
B



C



D



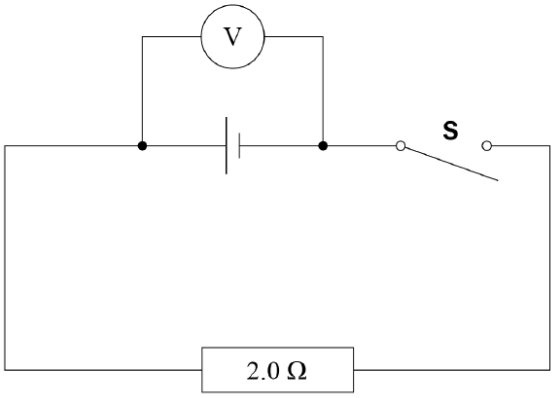
Medium

Two or three steps. Roughly a third to a half of students get these right.

Questions 3–5

AQA June 2019 · AS Paper 2 · Q33

3 The reading on the voltmeter halves when switch **S** is closed.



What is the internal resistance of the cell?

[1 mark]

A 0.50 Ω ⬭

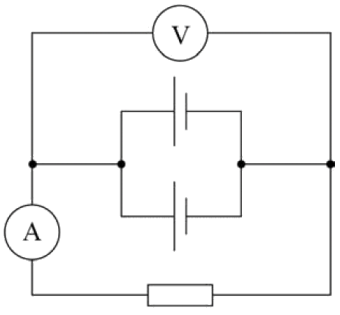
B 1.0 Ω ⬭

C 2.0 Ω ⬭

D 4.0 Ω ⬭

AQA June 2018 · AS Paper 2 · Q32

4 A circuit consists of two identical cells, a resistor, an ammeter and a voltmeter. The cells each have an emf of 3.0 V and the resistor has a resistance of 12 Ω
The cells have negligible internal resistance.



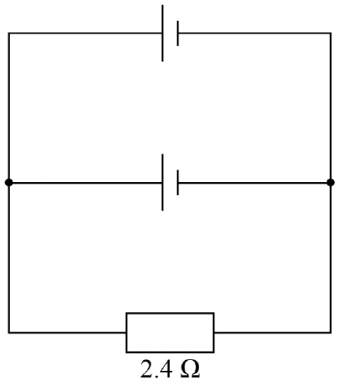
Which row shows the readings on the voltmeter and ammeter?

[1 mark]

	Voltage / V	Current / A	
A	3.0	0.25	⬭
B	3.0	0.50	⬭
C	6.0	0.25	⬭
D	6.0	0.50	⬭

AQA November 2021 · A-level Paper 1 · Q28

5 Two identical batteries each of emf $1.5\ \text{V}$ and internal resistance $1.6\ \Omega$ are connected in parallel. A $2.4\ \Omega$ resistor is connected in parallel with this combination.



What is the current in the $2.4\ \Omega$ resistor?

[1 mark]

A $0.38\ \text{A}$ ⬭

B $0.47\ \text{A}$ ⬭

C $0.75\ \text{A}$ ⬭

D $0.94\ \text{A}$ ⬭

Hard Several steps, often with a trap built in. Fewer than 3 in 10 students get these right. **Questions 6–8**

AQA June 2016 · AS Paper 2 · Q34

6 A battery is connected to a $10\ \Omega$ resistor and a switch in series. A voltmeter is connected across the battery. When the switch is open (off) the voltmeter reads $1.45\ \text{V}$. When the switch is closed the reading is $1.26\ \text{V}$.

What is the internal resistance of the battery?

[1 mark]

A $0.66\ \Omega$ ⬭

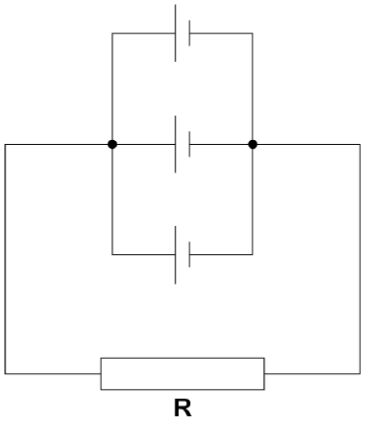
B $0.76\ \Omega$ ⬭

C $1.3\ \Omega$ ⬭

D $1.5\ \Omega$ ⬭

AQA June 2019 · AS Paper 2 · Q30

7 Three identical cells, each of emf $1.5\ \text{V}$ and internal resistance $6.0\ \Omega$, are connected to resistor **R**. The resistance of **R** is $6.0\ \Omega$.



What is the current in **R**?

[1 mark]

A $0.19\ \text{A}$ ⬭

B $0.25\ \text{A}$ ⬭

C $0.56\ \text{A}$ ⬭

D $0.75\ \text{A}$ ⬭

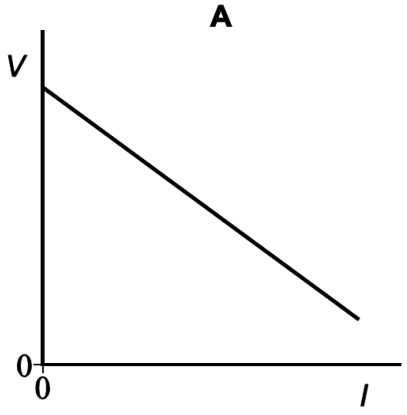
AQA June 2016 · AS Paper 2 · Q33

8 A student investigates how the potential difference *V* across the terminals of a cell varies with the current *I* in the cell.

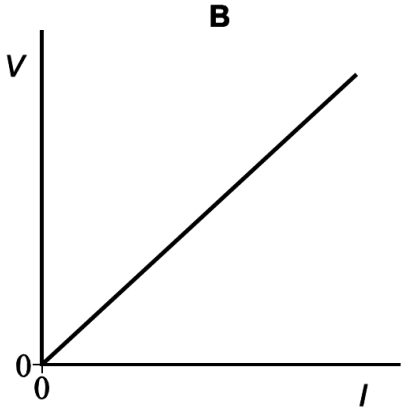
Which graph correctly shows how *V* varies with *I*?

[1 mark]

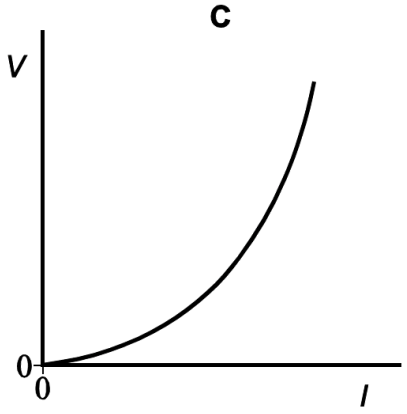
A



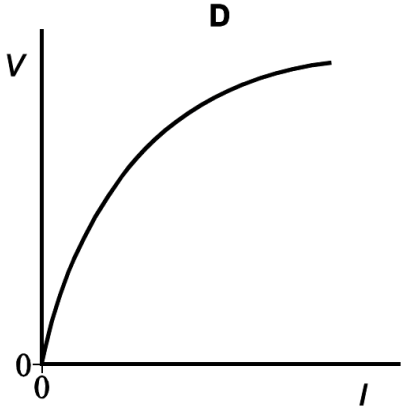
B



C



D



End of questions. Check your answers with the matching mark scheme. More free packs and 1-to-1 tuition: **www.getbetteratphysics.co.uk**