

10.1 Practical circuits

Name: _____ Class: _____ Date: _____

Total: 14 marks

KEY WORDS resistance 电阻 • internal resistance 内阻 • terminal p.d. 端电压
 • open circuit 开路 • cell 电池

Objective

Build the skills to answer exam questions on **practical circuits** — e.m.f., p.d., and internal resistance.

You must be able to:

- define **e.m.f.** and distinguish it from **p.d.**
- explain **internal resistance** and use $V = \varepsilon - Ir$
- describe how to measure internal resistance

1 Worked examples

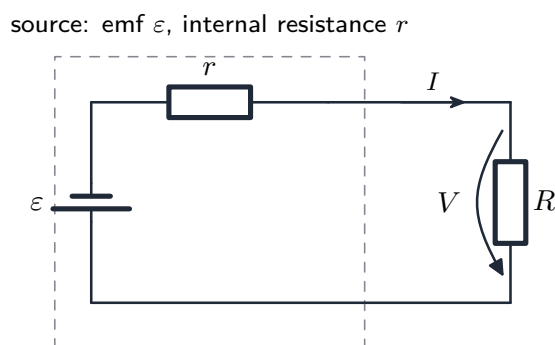
Study these first. Each one shows the method for a question type used later — follow the steps and you can do the Practice and Exam-style questions yourself.

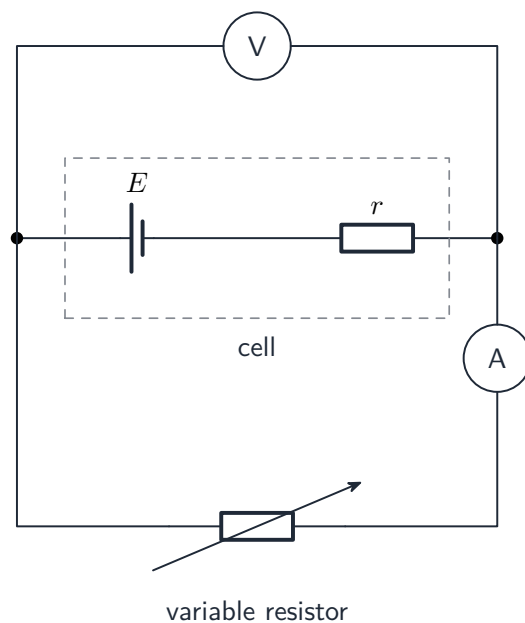
■ e.m.f. and p.d.

e.m.f. ε = energy given to each coulomb by the source (in driving it round the whole circuit). **p.d.** = energy transferred from electrical form by each coulomb in a component. Both in volts.

■ Internal resistance

A real cell has **internal resistance** r . When current flows, Ir is "lost" inside it, so the **terminal p.d.** is:





Internal resistance in a practical cell

$$V = \varepsilon - Ir.$$

- $I = 0$ (open circuit): $V = \varepsilon$;
- larger current $\rightarrow$ smaller terminal p.d.

Worked example. $\varepsilon = 1.5 \text{ V}$, $r = 0.50 \text{ } \Omega$, $R = 2.5 \text{ } \Omega$: $I = \frac{\varepsilon}{R + r} = \frac{1.5}{3.0} = 0.50 \text{ A}$;
 $V = \varepsilon - Ir = 1.5 - 0.25 = 1.25 \text{ V}$.

To **measure** r : vary R , plot V against I — the intercept is ε and the gradient is $-r$.

2 Practice

Now apply the methods above.

2.1 Define the **e.m.f.** of a source.

[1]

2.2 Write the equation linking **terminal p.d.**, e.m.f., current and internal resistance. [1]

2.3 State the terminal p.d. of a cell when **no current** flows.

[1]

2.4 State **one** cause of a cell's internal resistance. [1]

3 Exam-style questions

3.1 A battery of e.m.f. 9.0 V drives two resistors, of 12 Ω and 6.0 Ω , connected in **parallel** with each other. The terminal p.d. is measured as 8.0 V. **Determine** the internal resistance of the battery, and the energy wasted inside it each second. [5]

3.2 As the current drawn from a cell **increases**, the terminal p.d.: [1]

A	B
C	D

A increases

B decreases

C stays the same

D becomes equal to the e.m.f.

3.3 Explain, in terms of **energy**, the difference between e.m.f. and p.d. [2]

3.4 Describe how a graph can be used to find the **internal resistance** of a cell. [2]
