A-LEVEL PHYSICS • EXERCISE SHEET

9.2 Potential difference and power

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

Objective

Build the skills to answer exam questions on **potential difference and power**.

You must be able to:

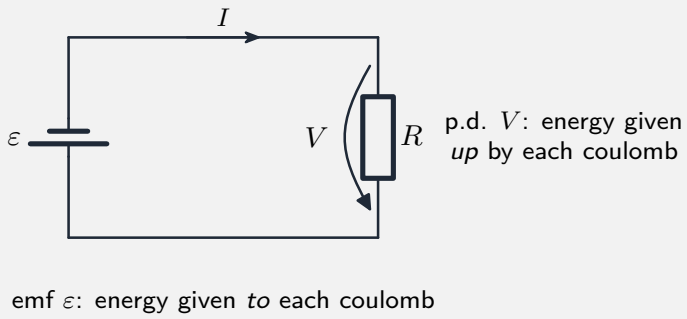
- define **potential difference** and use $V = W/Q$
- distinguish **e.m.f.** from **p.d.**
- use $P = VI = I^2R = V^2/R$

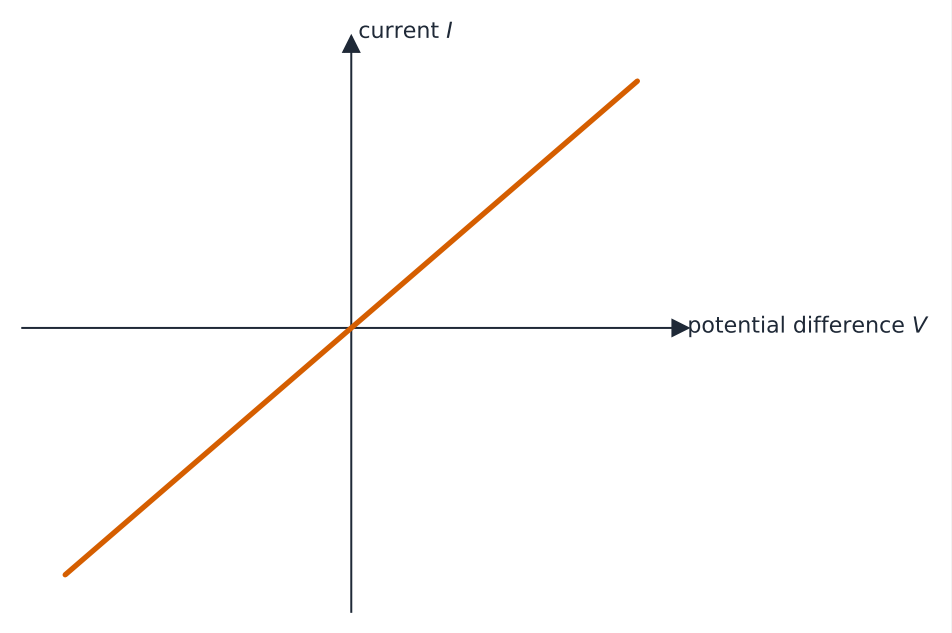
1 Worked examples

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.

■ Potential difference and e.m.f.

Potential difference is the energy transferred **per unit charge**: $V = W/Q$ (unit $\mathrm{V} = \mathrm{J\ C^{-1}}$).





The I-V graph of an ohmic conductor

e.m.f. is the energy given **to** each coulomb by the source; **p.d.** is the energy given **up** by each coulomb in a component. Same formula, opposite direction of energy transfer.

- **Power**

$$P = \frac{W}{t} = VI = I^2R = \frac{V^2}{R}.$$

Pick the form with the quantities you know. Energy: $E = Pt$.

Worked example. A kettle "2.4 kW, 240 V": $I = P/V = 10$ A; $R = V^2/P = 24\ \Omega$.

2 Practice

Now apply the methods above.

2.1 Define **potential difference**. [1]

2.2 State the difference between **e.m.f.** and **p.d.** [1]

2.3 Write the **three** forms of the electrical power equation. [2]

2.4 A 12 V supply drives a current of 2.0 A. Find the **power**. [1]

3 Exam-style questions

3.1 A lamp has 240 V across it and a current of 0.50 A. Its power is: [1]

- **A** 120 W
- **B** 480 W
- **C** 0.50 W
- **D** 240 W

3.2 A kettle is marked "2.4 kW, 240 V". Calculate (a) the current it draws, (b) its resistance. [4]

3.3 A 10 Ω and a 20 Ω resistor are each connected, separately, across the **same** 12 V supply. State which dissipates **more power**, and why. [2]

3.4 A 60 W lamp runs for 5.0 minutes. Calculate the **energy** transferred. [2]

4 Go further

You are now ready for the real exam questions on this subtopic. Open the **9.2 Potential difference and power** past-paper sheet in the Library, or try these in **Practice mode**:

- 9702/22 N25 —Q5 (p.d. and power, structured)
- 9702/22 J25 —Q6 (power, structured)

- 9702/24 J25 —Q5 (e.m.f. and p.d.)
- 9702/11 J25 —Q34 (power, multiple choice)
- 9702/12 N25 —Q32 (p.d., multiple choice)

Solutions

2.1 The **energy transferred per unit charge** as charge passes through a component ($V = W/Q$).

2.2 e.m.f. is energy given **to** each coulomb by the source; **p.d.** is energy given **up** by each coulomb in a component.

2.3 $P = VI$, $P = I^2R$, $P = V^2/R$.

2.4 $P = VI = 12 \times 2.0 = 24$ W.

3.1 A —$P = VI = 240 \times 0.50 = 120$ W.

3.2 (a) $I = P/V = 2400/240 = 10$ A. (b) $R = V^2/P = 240^2/2400 = 24\ \Omega$.

3.3 The 10 Ω resistor; at the same voltage $P = V^2/R$, so the **smaller** resistance gives the **larger** power.

3.4 $E = Pt = 60 \times (5.0 \times 60) = 60 \times 300 = 1.8 \times 10^4$ J.