| Name | Date started | Target end date |
|---|---|---|
| | | |

GCE AS / A LEVEL — OHM'S LAW & I-V GRAPHS QUESTION PACK

Legacy PH1 · New spec Unit 2 Topic 2a · AS unit, 20% of A-level

REVISE
.wales

# PHYSICS — UNIT 2 · OHM'S LAW & I-V GRAPHS

## *PH2.2 Resistance — Ohm's law, I-V characteristics & resistor networks*

*Defining resistance R = V/I, distinguishing ohmic and non-ohmic conductors from I-V graphs, and combining resistors in series and parallel.*

NEW 2015 SPEC · UNIT 2 TOPIC 2A

**Estimated time for entire question pack: ~1 h 13 min**

*Derived from the legacy PH1 paper's pace of 80 marks in 1¼ hours.*

*You are advised to **not** attempt to complete all of this in one sitting.*

### ABOUT THIS QUESTION PACK

This is a **comprehensive practice question pack**, not a single mock paper. It contains every question from the legacy WJEC PH1 papers (2008 modular spec) that maps onto new-spec Unit 2 Topic 2a (2.2).

Questions are ordered chronologically within each section.

### INSTRUCTIONS

Use black ink or black ball-point pen. Answer all questions in the spaces provided.

*The number of marks is given in brackets at the end of each question or part-question. A calculator is required. The Data Booklet is allowed.*



*For Examiner's use only*

| Q | Source | Max | Mark |
|---|---|---|---|
| 1 | PH1 Jan 09 Q4 | 8 | |
| 2 | PH1 Jan 11 Q2 | 8 | |
| 3 | PH1 Jan 10 Q2 | 12 | |

| Q | Source | Max | Mark |
|---|---|---|---|
| 4 | PH1 Jun 10 Q4 | 12 | |
| 5 | PH1 Jan 14 Q4 | 12 | |
| | | | |
| **Total** | | **52** | |

# Ohm's Law & I-V Graphs — what the new spec asks

WJEC GCE AS / A Level Physics (from 2015) · Unit 2: Electricity & Light · Topic 2.2.

## Resistance A

- Define resistance R = V/I; the ohm.
- Resistor as a passive component obeying R = V/I.

## Ohm's law A

- State Ohm's law and conditions under which it applies.
- Distinguish ohmic and non-ohmic conductors.

## I-V characteristics A

- Sketch I-V curves for metallic conductor, filament lamp, diode.
- Interpret the gradient and reciprocal-gradient of I-V plots.

## Resistor networks A

- Apply series rule: $R = R_1 + R_2 + \ldots$
- Apply parallel rule: $1/R = 1/R_1 + 1/R_2 + \ldots$


Crib sheet »

# Ohm's Law & I-V Graphs in one page

Quick-reference notes — revisit before each section.

### Resistance

Defined for any element; units ohm Ω.

Ohm's law: $V \propto I$ for fixed conditions.

### I-V curves

Metal: straight line through origin.

Filament lamp: curve flattens as T rises.

Diode: zero current below ~0.6 V, then sharp rise.

### Gradient = 1/R

On I (y) vs V (x): R = 1/gradient.

On V (y) vs I (x): R = gradient.

### Series

$R_{tot} = R_1 + R_2 + \ldots$

$V_{tot} = V_1 + V_2 + \ldots$

### Parallel

$1/R_{tot} = 1/R_1 + 1/R_2 + \ldots$

Two equal R in parallel ⇒ R/2.

### Strategy

Collapse parallel parts first ⇒ simpler series.

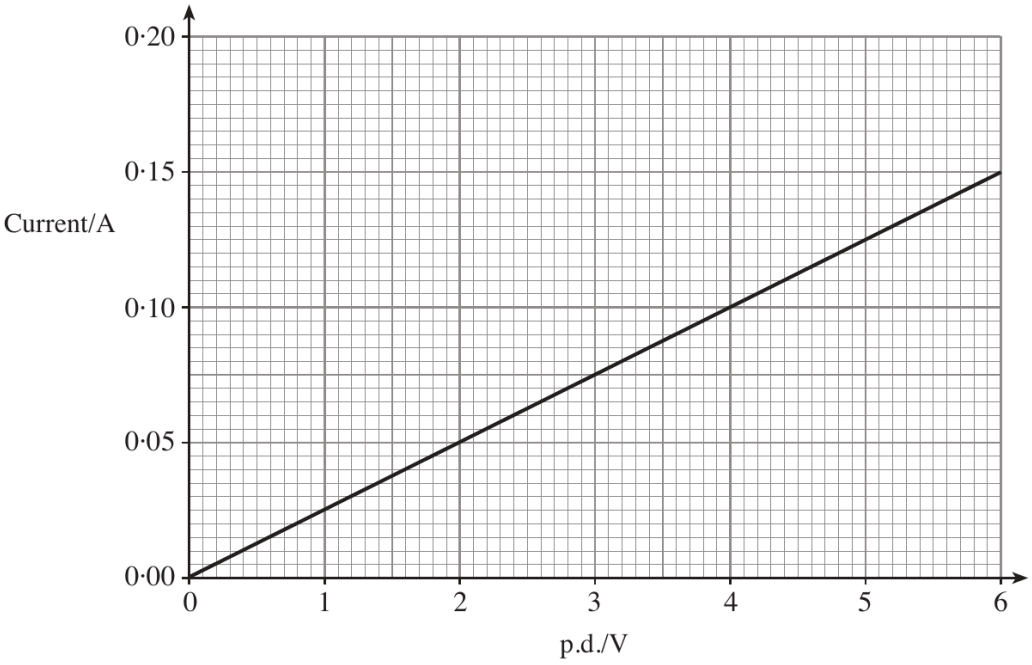
Use V = IR on each block.

Check: sum of p.d.s around any loop = $V_{supply}$.

# Section index

Use this index to jump straight to the section you need.

4. A graph of current against potential difference (p.d.) is given for a piece of metal wire.




(a) Calculate the resistance of the wire. [1]

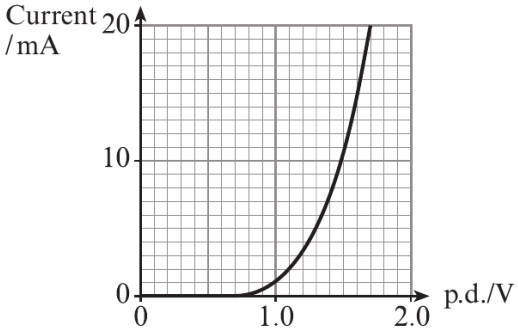
(b) What does the graph tell us about the temperature of the wire as the p.d. across it is increased? Explain your answer. [2]

(c) The wire has a length of 2·5 m and a diameter of $2{\cdot}0 \times 10^{-4}$ m. Calculate the resistivity of the metal. [3]

Examiner only

**2.** The current-voltage characteristics of a diode also apply to a light emitting diode (LED). A graph of current against potential difference for an LED is shown.

*(a)* (i) Calculate the resistance of the LED when the p.d. is 1.6 V. [2]

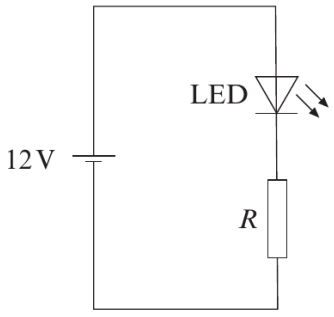



(ii) Comment on the resistance of the LED at voltages below 1.0 V. Calculations are not required. [1]

*(b)* (i) Explain how the graph shows that the LED does not obey Ohm's law. [1]

(ii) Name one other device, other than a diode, to which Ohm's law does not apply. [1]

*(c)* If the LED is connected across a supply of e.m.f. greater than 1.6 V, then the large current produced will destroy it. For this reason, LEDs usually have protective resistors in series with them to limit the current. The circuit shows this LED used as an indicator for a car alarm. The car battery supplies 12 V and the LED has an operating current of 15 mA. Determine the value, *R*, of the protective resistor needed. [3]



Examiner only

**2.** *(a)* Explain how electrical resistance arises in metal conductors. [3]

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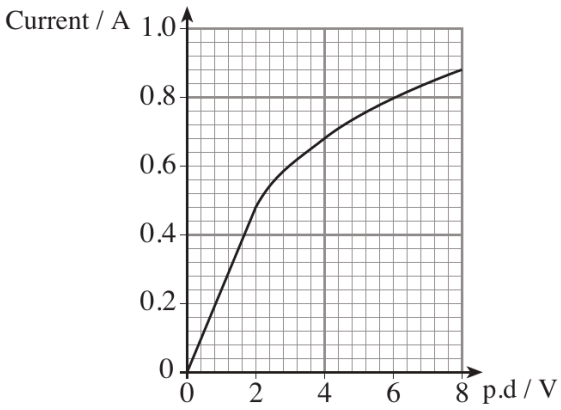
*(b)* A current-voltage graph for a filament lamp is shown.




(i) Describe how the **resistance** of the lamp changes as the voltage across it increases over the range

(I) 0 V – 2 V; [1]

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(II) 2 V – 8 V. [1]

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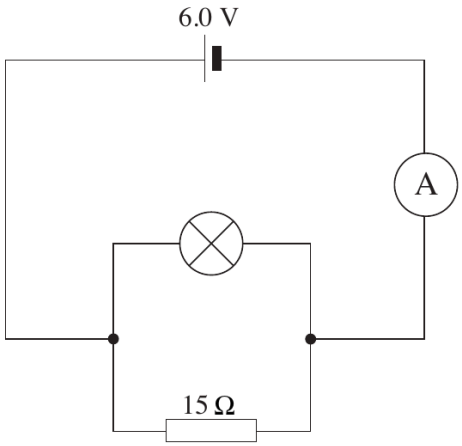
(ii) The lamp is connected in parallel to a 15 Ω resistor and to a 6 V supply as shown. Calculate the current through the ammeter. [4]

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(iii) Calculate the power dissipated in the circuit. [2]

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Examiner only

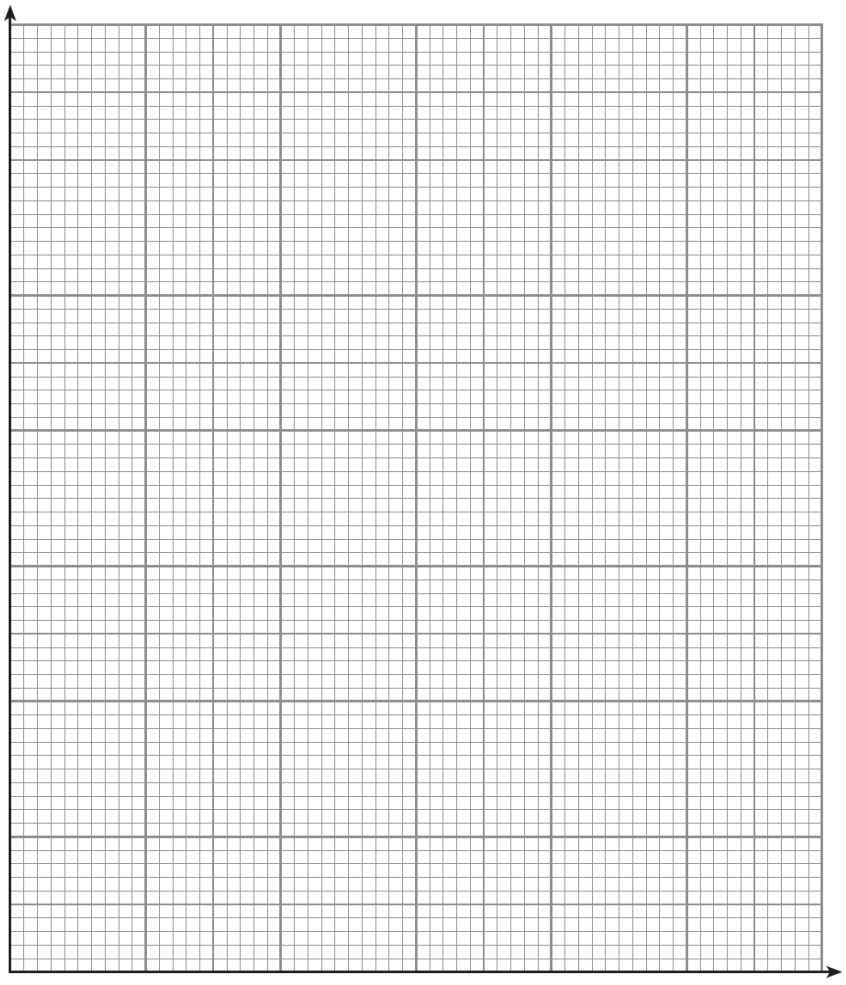
**4.** A student measures the potential difference across a metal wire for a range of current values.

*(a)* Draw a diagram of a circuit which could be used. [2]

*(b)* (i) The table below shows the results obtained. Complete the column labelled 'Resistance'. [1]

| Current/A | p.d./V | Resistance / Ω |
|---|---|---|
| 0.10 | 0.40 | |
| 0.20 | 0.80 | |
| 0.30 | 1.30 | |
| 0.40 | 1.90 | |
| 0.50 | 3.00 | |

(ii) Draw a graph of **resistance** ($y$-axis) against **current** ($x$-axis). [3]



Examiner only

*(c)* (i) Describe how the resistance of the wire varies with current. [2]

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(ii) Give the range of currents over which Ohm's law applies to the wire. [1]

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(iii) Explain why Ohm's law does not apply outside this range. [1]

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*(d)* In an electric fire current flows through a wire called an element. An ammeter is placed in series with the element. Predict what would happen to the ammeter reading from the time the fire is switched on until it reaches a steady operating temperature. [2]

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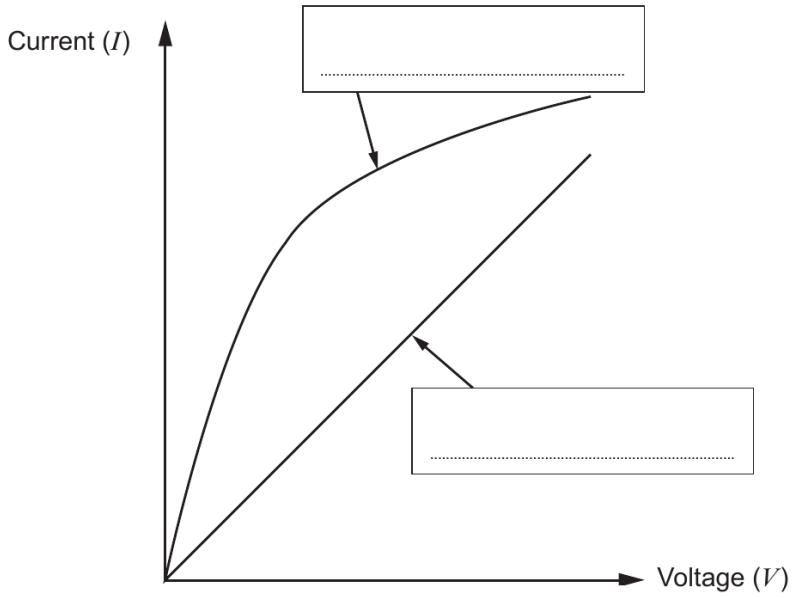
**4.** *(a)* Graphs are drawn for a metal wire at constant temperature and for the filament of a lamp. Examiner only




(i) Complete the boxes, labelling the graphs with the component they represent. [1]

(ii) Suggest reasons for the different shapes of the two graphs. [5]

Examiner only

*(b)* X and Y are two lamps.

(i) Lamp X is labelled at 12 V, 24 W. Calculate the current in the lamp when it operates at its rated voltage. [1]

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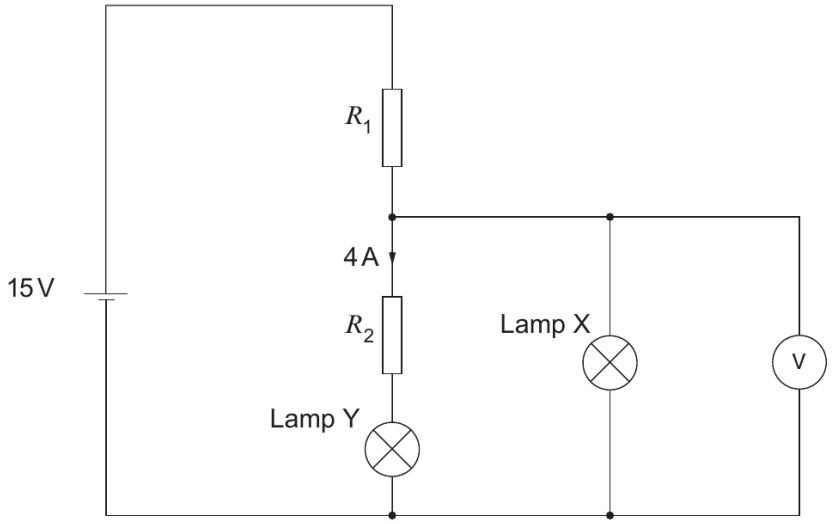
(ii) Lamp Y is labelled at 6 V, 4 A. In the following circuit, the values of $R_1$ and $R_2$ are chosen so that **both lamps operate at their rated voltages**.




(I) State the reading on the voltmeter. ..... [1]

(II) Calculate the pd across $R_2$. [1]

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(III) Calculate $R_2$. [1]

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(IV) Calculate $R_1$. [3]

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**END OF QUESTION PACK**

5 questions · 52 marks · ~1 h 13 min
Source: WJEC PH1 (2008 modular spec)
Curated for WJEC Physics 2015 spec AS Unit 2 — Topic 2a (2.2)