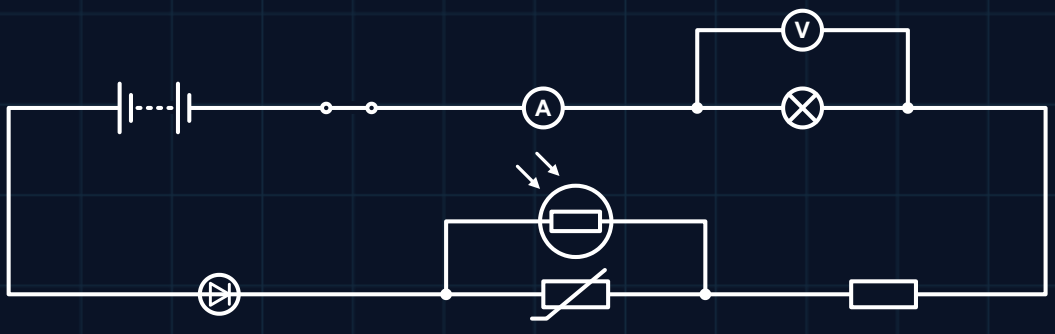
YEAR 10 PHYSICS, AQA GCSE, UNIT REVIEW

ELECTRIC CIRCUITS

UNIT REVIEW AFTER LESSON 12

Mixed exam practice from the whole unit, a fix-it log, and a static electricity page for GCSE Physics students.

ANSWER EDITION FOR TEACHERS AND SELF-MARKING



NAME _____ CLASS _____

TEACHER _____ TARGET GRADE _____

REFERENCE

EQUATION TOOLKIT

You will meet these one at a time. Learn each equation **in words** as well as symbols: AQA gives you an equation sheet in the exam (it does not include $R_{total} = R_1 + R_2$), but knowing the equations by heart makes every question faster.

$Q = I\,t$

Lesson 2

charge flow = current × time

C, A, s

Rearranged: I = Q ÷ t and t = Q ÷ I

$E = Q\,V$

Lesson 3

energy transferred = charge × p.d.

J, C, V

Rearranged: V = E ÷ Q and Q = E ÷ V

$V = I\,R$

Lesson 4

p.d. = current × resistance

V, A, Ω

Rearranged: I = V ÷ R and R = V ÷ I

$R_{total} = R_1 + R_2$

Lesson 6

total resistance in series

Ω

Rearranged: (series only)

$P = V\,I$

Lesson 11

power = p.d. × current

W, V, A

Rearranged: V = P ÷ I and I = P ÷ V

$P = I^2\,R$

Lesson 11

power = current² × resistance

W, A, Ω

Rearranged: R = P ÷ I² and I = √(P ÷ R)

$E = P\,t$

Lesson 11

energy transferred = power × time

J, W, s

Rearranged: P = E ÷ t and t = E ÷ P

$V_p\,I_p = V_s\,I_s$

Lesson 12

transformer: power in = power out

V, A

Rearranged: $I_s = V_p\,I_p \div V_s$

FOUR STEPS FOR EVERY CALCULATION

1
Write down what you know, with units. Convert units first (minutes → seconds, kW → W, mA → A).

2
Write the equation you will use, in symbols.

3
Substitute the numbers, then rearrange if needed.

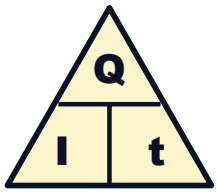
4
Give the answer with a unit. Ask: is it sensible?

CONVERT	HOW	EXAMPLE
minutes → seconds	× 60	3.0 min = 180 s
hours → seconds	× 3600	2.0 h = 7200 s
milliamps (mA) → amps (A)	÷ 1000	250 mA = 0.25 A
kilowatts (kW) → watts (W); kilohms (kΩ) → ohms (Ω)	× 1000	2.2 kW = 2200 W
kilovolts (kV) → volts (V)	× 1000	400 kV = 400 000 V

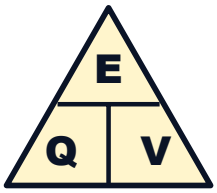
EQUATION TRIANGLES: HELP WITH REARRANGING

1. Cover the quantity you want to find.
2. The two left **side by side**? **Multiply** them.
3. One **above** the other? **Divide** the top by the bottom.

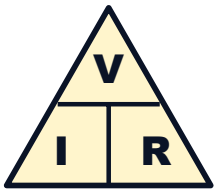
Example: to find I from Q = I t, cover I. Q is above t, so I = Q ÷ t. Triangles only help with rearranging: you still need to learn each equation. For P = I² R, the triangle gives I²; take the square root to find I.



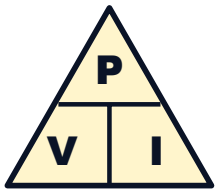
Q = I t
Q = I × t
I = Q ÷ t
t = Q ÷ I



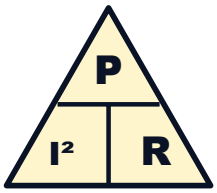
E = Q V
E = Q × V
Q = E ÷ V
V = E ÷ Q



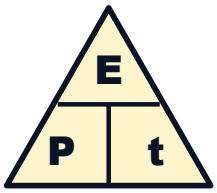
V = I R
V = I × R
I = V ÷ R
R = V ÷ I



P = V I
P = V × I
V = P ÷ I
I = P ÷ V



P = I² R
P = I² × R
R = P ÷ I²
I² = P ÷ R,
so I = √(P ÷ R)



E = P t
E = P × t
P = E ÷ t
t = E ÷ P

AFTER LESSON 12, AT HOME OR IN CLASS

UNIT REVIEW

Mixed questions from the whole unit, like a real exam. Try each question without looking back. Then mark it with your teacher's answers and fill in the “fix it” log.

RETRIEVE

EQUATION RECALL CHALLENGE

Cover the toolkit page first.

1 Write each equation in symbols. Then give the unit of every quantity in it.

Equation in words	In symbols	Units
charge flow = current × time	Q = I t	C, A, s
energy transferred = charge × p.d.	E = Q V	J, C, V
p.d. = current × resistance	V = I R	V, A, Ω
total resistance in series	$R_{total} = R_1 + R_2$	Ω
power = p.d. × current	P = V I	W, V, A
power = current² × resistance	P = I² R	W, A, Ω
energy transferred = power × time	E = P t	J, W, s

AQA-STYLE

MIXED EXAM PRACTICE

41 marks, about 50 minutes

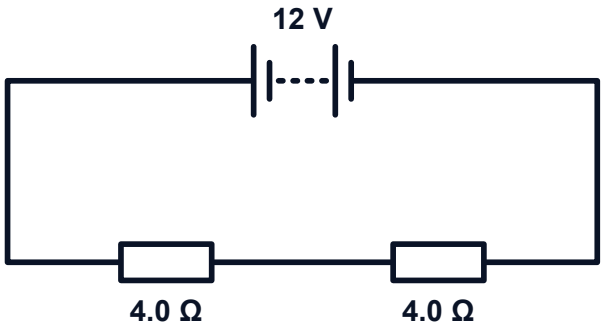
2 A current of 0.80 A flows through a lamp for 2.5 minutes. Calculate the charge that flows. **[3 marks]**

t = 2.5 × 60 = 150 s (1); Q = I t = 0.80 × 150 (1) = 120 C (1)

3 A component transfers 48 J of energy when 8.0 C of charge passes through it. (a) Calculate the p.d. across it. (b) State what this p.d. means. **[3 marks]**

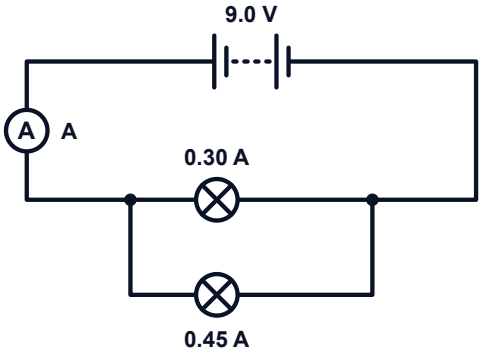
(a) V = E ÷ Q = 48 ÷ 8.0 (1) = 6.0 V (1). (b) 6.0 J is transferred per coulomb of charge (1).

4 Calculate the total resistance, the current, and the p.d. across one resistor. **[4 marks]**



R = 4.0 + 4.0 = 8.0 Ω (1); I = V ÷ R = 12 ÷ 8.0 (1) = 1.5 A (1); p.d. = 1.5 × 4.0 = 6.0 V (1)

5 The lamps are in parallel. State the p.d. across each lamp and the reading on ammeter A. Give reasons. **[3 marks]**

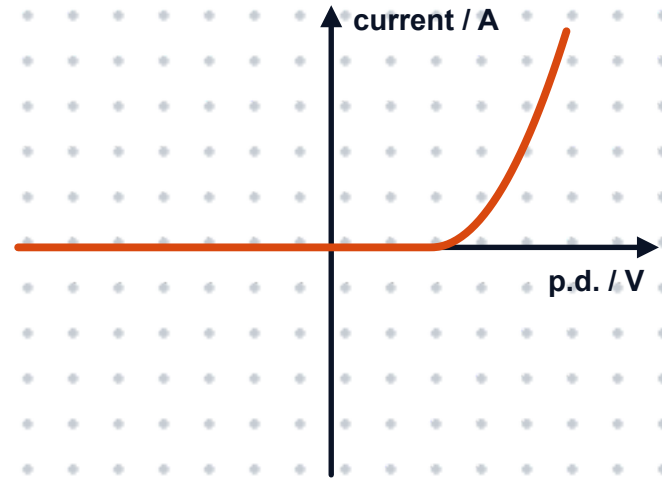


9.0 V across each lamp: in parallel each branch has the supply p.d. (1). A = 0.30 + 0.45 = 0.75 A (1), because branch currents add up to the supply current (1).

6 In the wire-length practical, one point on the graph of resistance against length is well above the line. (a) Suggest two possible causes. (b) What should the student do? **[4 marks]**

(a) Any two: the wire heated up; poor contact at a clip; the length or a meter was misread (2). (b) Repeat that reading (1) and leave it out of the line of best fit if it is still anomalous (1).

7 Sketch the I–V graph of a diode. Explain how it differs from the graph of a fixed resistor. **[4 marks]**



Almost zero current for negative p.d. (1), then a steep rise above a small positive p.d. (1). A fixed resistor is a straight line through the origin in both directions (1): the diode only conducts one way / its resistance is very high in reverse (1).

8 A thermistor is connected in series with an ammeter and a battery. Explain how the ammeter reading changes as the thermistor cools down. **[3 marks]**

As it cools, the thermistor's resistance increases (1), so the total resistance increases (1) and the current decreases (1).

9 A kettle has a metal case connected to the earth wire. Explain why the earth wire is needed, including the role of the fuse. **[5 marks]**

If the live wire touches the case (1), the earth wire gives a low-resistance path to earth (1); a very large current flows (1), which melts the fuse (1) and disconnects the live wire, so the case is safe to touch (1).

10 A 1.5 kW heater runs on the 230 V mains for 4.0 minutes. Calculate (a) the energy transferred and (b) the current. **[5 marks]**

(a) P = 1500 W, t = 240 s (1); E = P t = 1500 × 240 (1) = 360 000 J (1). (b) I = P ÷ V = 1500 ÷ 230 (1) = 6.5 A (1).

11 Use the equations P = V I and P = I² R to explain why the National Grid transmits electricity at a very high p.d. **[4 marks]**

For a fixed power, P = V I, so a higher p.d. means a smaller current (2). P = I² R, so a smaller current means much less heating in the cables and less energy wasted (2).

12 An ideal step-up transformer has 25 kV and 1200 A in the primary coil. The secondary p.d. is 400 kV. Calculate the secondary current. **[3 marks]**

$V_p I_p = V_s I_s$ (1); I_s = 25 000 × 1200 ÷ 400 000 (1) = 75 A (1)

REVIEW LATER

FIX-IT LOG

Turn every lost mark into a target.

Q	What went wrong?	The correct physics (or method) is…	Lesson to revisit

TRIPLE SCIENCE ONLY (AQA 4.2.5)

EXTENSION: STATIC ELECTRICITY

Only for students taking GCSE Physics (separate science). Combined Science students can skip this page.

When two insulating materials are rubbed together, **electrons** are transferred from one to the other. The one that **gains electrons** becomes **negatively** charged; the one that **loses electrons** is left **positively** charged. Only electrons move, never positive charge.

Like charges repel; unlike charges attract. These are non-contact forces: they act without the objects touching.

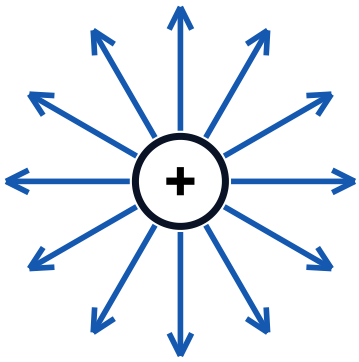
A charged object creates an **electric field** around it. Another charged object in the field feels a force. The field is **strongest close to the object** and gets weaker further away.

If enough charge builds up, the p.d. between the object and the earthed conductor nearby becomes large enough for charge to jump across the air: a **spark**.

1 A plastic rod becomes negatively charged when it is rubbed with a cloth. Which way did the electrons move? What charge is left on the cloth? **[2 marks]**

Electrons moved from the cloth to the rod (1). The cloth is left positively charged (1).

2 Draw the electric field around an isolated, positively charged sphere. Add arrows, and show where the field is strongest. **[3 marks]**



Radial lines pointing outwards; closer together (stronger) near the sphere.

3 A small negatively charged sphere is moved towards a large positively charged sphere. Explain what happens to the force on the small sphere, without the spheres touching. **[4 marks]**

The small sphere is in the electric field of the large sphere (1). Unlike charges attract, so the force is attractive (1), and it is a non-contact force (1). The field is stronger closer to the sphere, so the force increases as they get closer (1).

REFERENCE

KEY WORDS

Learn the meaning and spelling. In exams, precise words earn marks: say “p.d. across” and “current through”.

Alternating current (ac): Current that keeps changing direction. UK mains is ac at 50 Hz.

Ammeter: Measures current. Connected in series.

Ampere (A): Unit of current. 1 A = 1 C per second.

Anomaly: A result that does not fit the pattern of the others.

Battery: Two or more cells joined together.

Charge (Q): Carried by particles such as electrons. Unit: coulomb (C).

Circuit breaker: A safety switch that cuts off the current if it gets too large.

Conventional current: The agreed direction of current: from + to −.

Current (I): The rate of flow of charge.

Diode: Lets current flow in one direction only.

Direct current (dc): Current that flows in one direction only, e.g. from a cell.

Directly proportional: If one quantity doubles, the other doubles. The graph is a straight line through the origin.

Earth wire: Green and yellow safety wire; carries a current only if there is a fault.

Electron: A tiny negatively charged particle. Free electrons carry the current in metals.

Filament lamp: A lamp with a thin metal filament; its resistance increases as it heats up.

Fuse: A thin wire that melts and breaks the circuit if the current is too large.

I–V characteristic: A graph of current against p.d. for a component.

LDR: Light-dependent resistor: resistance decreases as light intensity increases.

LED: Light-emitting diode: a diode that gives out light.

Live wire: Brown wire at about 230 V; dangerous to touch.

National Grid: The system of cables and transformers linking power stations to consumers.

Neutral wire: Blue wire that completes the circuit; at or close to 0 V.

Ohm (Ω): Unit of resistance.

Ohmic conductor: Current is directly proportional to p.d. at constant temperature.

Parallel: Components on separate branches. A voltmeter is connected in parallel.

Potential difference (V): Energy transferred per unit charge between two points. Unit: volt (V).

Power (P): Energy transferred per second. Unit: watt (W).

Resistance (R): How much a component opposes the current. Unit: ohm (Ω).

Series: Components connected one after another in a single loop.

Thermistor: Resistance decreases as temperature increases.

Transformer: Changes the size of an alternating p.d. (step-up or step-down).

Volt (V): Unit of p.d. 1 V = 1 J per C.

Voltmeter: Measures p.d. Connected in parallel, across a component.

FINISH

PROGRESS TRACKER

Colour one circle for each statement: **red** = not yet, **amber** = getting there, **green** = I can do this without help. Revisit your reds first.

I CAN…	R / A / G
01: Complete circuits and symbols	
explain why a circuit must be a complete loop	
recognise and draw the symbols for a cell, battery, switch, lamp, resistor and ammeter	
draw a neat circuit diagram using the rules	
connect an ammeter in series	
02: Current and charge	
describe current as the rate of flow of charge	
calculate charge, current or time using Q = I t	
convert minutes to seconds before calculating	
explain why current is not used up in a loop	
03: Potential difference	
explain p.d. as energy transferred per coulomb	
connect a voltmeter in parallel	
use E = Q V and its rearrangements	
use ‘p.d.s add up’ in a series loop	
04: Resistance and V = I R	
describe resistance and state its unit	
use V = I R and its rearrangements	
convert mA and kΩ	
decide from data or a graph whether a component is ohmic	
explain why heating increases resistance	
05: Resistance of a wire	
draw and set up the circuit to find a resistance	
name the independent, dependent and control variables	
plot a graph and draw a line of best fit	

I CAN…	R / A / G
spot an anomaly and suggest a cause	
06: Series and parallel circuits	
tell series and parallel circuits apart	
use the current and p.d. rules in series and parallel	
calculate total resistance, current and p.d.s in a series circuit	
explain why parallel branches reduce the total resistance	
07: Resistors in series and parallel	
set up series and parallel combinations with the meters in the right places	
calculate total resistance from V and I	
explain why series adds and parallel lowers resistance	
suggest a specific improvement to a practical	
08: I–V graphs	
read values from an I–V graph, including negative values	
sketch the I–V graphs for a fixed resistor, lamp and diode	
calculate resistance at a point	
explain why the lamp graph curves	
09: Investigating I–V characteristics	
set up the I–V circuit and explain each part	
take and record readings in both directions	
plot an I–V graph with the origin in the middle	
describe the extra steps for a diode	
10: Thermistors, LDRs and sensors	
describe how a thermistor responds to temperature	
describe how an LDR responds to light	
explain how the current in a sensor circuit changes	
choose and justify a sensor for a job	
11: Power and energy transfer	
describe power as energy transferred per second	

I CAN…	R / A / G
use E = P t with unit conversions	
use P = V I and P = I² R	
choose the right equation from the data given	
12: Mains, safety and the National Grid	
describe the difference between ac and dc	
state the UK mains p.d. and frequency	
name the three wires and their colours and jobs	
explain how the earth wire and fuse protect a user	
explain why the grid uses step-up and step-down transformers	