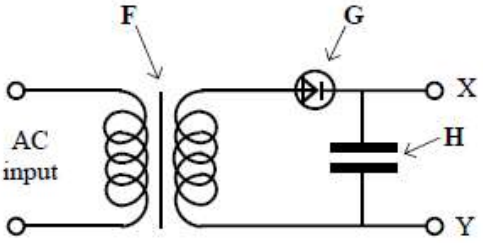
Physics
Leaving Certificate
Higher Level

Past Exam Questions on
Resistance

Q8 Section B 2013

8. (*a*) The diagram shows a circuit used in a charger for a mobile phone.



Name the parts labelled **F**, **G** and **H**. (9)

Describe the function of **G** in this circuit. (6)

Sketch graphs to show how voltage varies with time for

(i) the input voltage

(ii) the output voltage, V_{XY}. (12)

The photograph shows the device **H** used in the circuit. Use the data printed on the device to calculate the maximum energy that it can store. (9)

(*b*) Electricity generating companies transmit electricity over large distances at high voltage. Explain why high voltage is used. (6)

A 3 km length of aluminium wire is used to carry a current of 250 A. The wire has a circular cross-section of diameter 18 mm.

(i) Calculate the resistance of the aluminium wire.

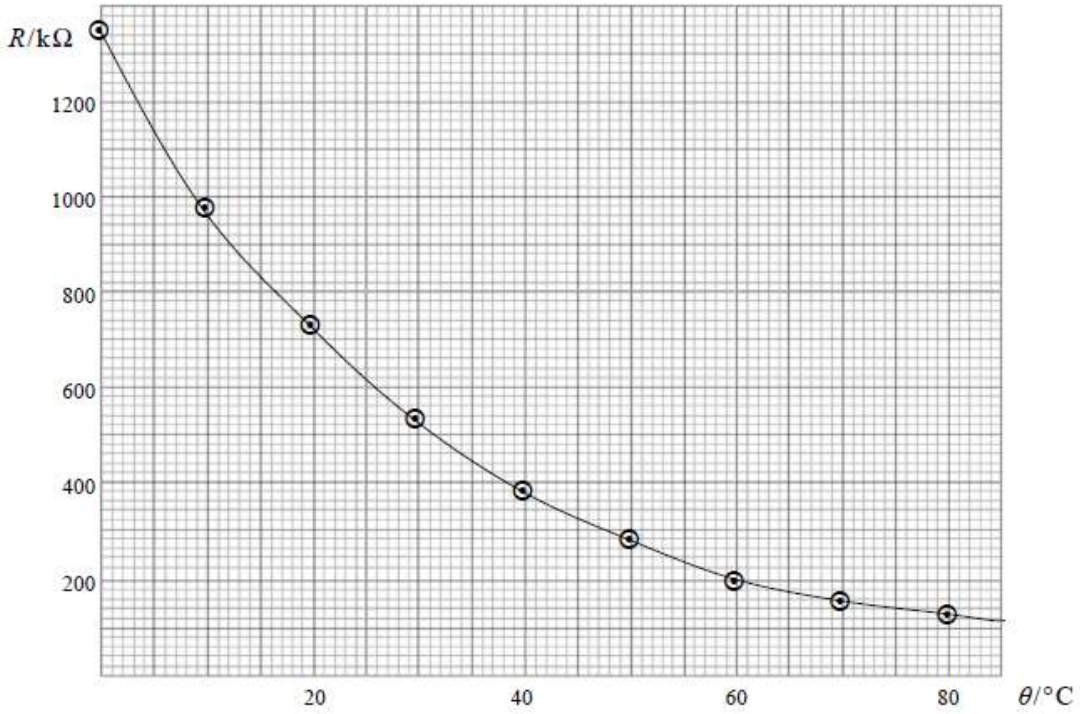
(ii) Calculate how much electrical energy is converted to heat energy in the wire in ten minutes. (14)

(resistivity of aluminium = $2.8 \times 10^{-8}\ \Omega\,\text{m}$)

Q12 Part (d) Section B 2012

(*d*) What is meant by the term thermometric property? (6)

This graph was obtained during an experiment where the resistance R of a thermistor was measured as its temperature θ was raised from 0 °C to 100 °C (as measured by a mercury-in-glass thermometer).



The thermistor is used in a circuit to keep the water in a tank at a constant temperature. What is the temperature of the water when the resistance of the thermistor is 420 kΩ? (6)

A thermocouple thermometer has emf values of 0 μV at 0 °C and 815 μV at 100 °C. When the thermocouple thermometer was placed in the tank of water, its emf was found to be 319 μV. What is the temperature of the water in the tank as measured by the thermocouple thermometer? (9)

Why do the thermistor and the thermocouple thermometer give different temperature readings for the water in the tank? (7)

Q9 Section B 2012

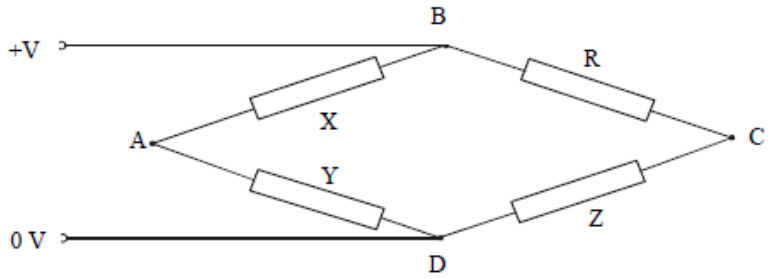
9. Define resistance.

(i) Two resistors of resistance R_1 and R_2 are connected in series. Derive an expression for the effective resistance of the two resistors in terms of R_1 and R_2. (18)

(ii) Two 4 Ω resistors are connected in parallel.
Draw a circuit diagram to show how another 4 Ω resistor could be arranged with these two resistors to give an effective resistance of 6 Ω. (9)

(iii) A fuse is a resistor used as a safety device in a circuit. How does a fuse operate? (11)

A Wheatstone bridge circuit is used to measure the resistance of an unknown resistor R.
The bridge ABCD is balanced when X = 2.2 kΩ, Y = 1.0 kΩ and Z = 440 Ω.



(iv) What test would you use to determine that the bridge is balanced? (6)

(v) What is the resistance of the unknown resistor R? (6)

(vi) When the unknown resistor R is covered by a piece of black paper, the bridge goes out of balance. What type of resistor is it? Give a use for this type of resistor. (6)

Q4 Section A 2010

4. In an experiment to investigate the variation of the resistance R of a thermistor with its temperature θ, a student measured its resistance at different temperatures.

The table shows the measurements recorded.

θ/°C	20	30	40	50	60	70	80
R/Ω	2000	1300	800	400	200	90	40

Draw a labelled diagram of the apparatus used. (9)

How was the resistance measured? (6)

Describe how the temperature was varied. (6)

Using the recorded data, plot a graph to show the variation of the resistance of a thermistor with its temperature.

Use your graph to estimate the average variation of resistance per kelvin in the range 45 °C – 55 °C. (15)

In this investigation, why is the thermistor usually immersed in oil rather than in water? (4)

Q4 Section A 2009

4. In an experiment to measure the resistivity of nichrome, the resistance, the diameter and appropriate length of a sample of nichrome wire were measured.

The following data were recorded:

resistance of wire	= 7.9 Ω
length of wire	= 54.6 cm
average diameter of wire	= 0.31 mm

Describe the procedure used in measuring the length of the sample of wire. (6)

Describe the steps involved in finding the average diameter of the wire. (15)

Use the data to calculate the resistivity of nichrome. (15)

The experiment was repeated on a warmer day. What effect did this have on the measurements? (4)

Q4 Section A 2008

4. A student investigated the variation of the resistance R of a metallic conductor with its temperature θ.

The student recorded the following data.

θ/°C	20	30	40	50	60	70	80
R/Ω	4.6	4.9	5.1	5.4	5.6	5.9	6.1

Describe, with the aid of a labelled diagram, how the data was obtained. (9)

Draw a suitable graph to show the relationship between the resistance of the metal conductor and its temperature. (12)

Use your graph to:

(i) estimate the resistance of the metal conductor at a temperature of −20 °C;

(ii) estimate the change in resistance for a temperature increase of 80 °C;

(iii) explain why the relationship between the resistance of a metallic conductor and its temperature is **not** linear. (19)

Q7 Section B 2008

7. Define resistivity and give its unit of measurement. (9)

An electric toaster heats bread by convection and radiation.
What is the difference between convection and radiation as a means of heat transfer? (8)

A toaster has a power rating of 1050 W when it is connected to the mains supply.
Its heating coil is made of nichrome and it has a resistance of 12 Ω.
The coil is 40 m long and it has a circular cross-section of diameter 2.2 mm.

Calculate:

(i) the resistivity of nichrome;

(ii) the heat generated by the toaster in 2 minutes if it has an efficiency of 96%. (18)

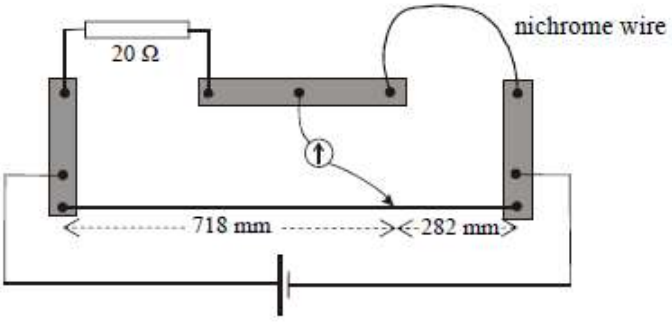
The toaster has exposed metal parts. How is the risk of electrocution minimised? (9)

When the toaster is on, the coil emits red light.
Explain, in terms of movement of electrons, why light is emitted when a metal is heated. (12)

Q9 Section B 2007

9. Define (i) resistance, (ii) resistivity. (12)

A metre bridge was used to measure the resistance of a sample of nichrome wire.
The diagram indicates the readings taken when the metre bridge was balanced.
The nichrome wire has a length of 220 mm and a radius of 0.11 mm.



Calculate:

(i) the resistance of the nichrome wire
(ii) the resistivity of nichrome. (18)

Sketch a graph to show the relationship between the temperature and the resistance of the nichrome wire as its temperature is increased. (6)

What happens to the resistance of the wire:

(i) as its temperature falls below 0°C?
(ii) as its length is increased?
(iii) if its diameter is increased? (11)

Name another device, apart from a metre bridge, that can be used to measure resistance.
Give one advantage and one disadvantage of using this device instead of a metre bridge. (9)

Q9 Section B 2006

9. What is an electric current? Define the ampere, the SI unit of current. (12)

Describe an experiment to demonstrate the principle on which the definition of the ampere is based. (15)

Sketch a graph to show the relationship between current and time for

(i) alternating current;
(ii) direct current. (9)

The peak voltage of the mains electricity is 325 V. Calculate the rms voltage of the mains? (6)

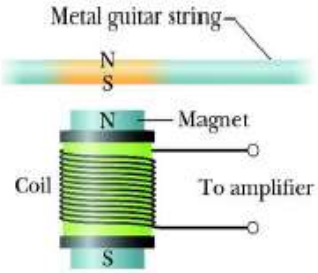
What is the resistance of the filament of a light bulb, rated 40 W, when it is connected to the mains? (9)

Explain why the resistance of the bulb is different when it is **not** connected to the mains. (5)

Q11 Section B 2006

11. Read the following passage and answer the accompanying questions.

The growth of rock music in the 1960s was accompanied by a switch from acoustic guitars to electric guitars. The operation of each of these guitars is radically different.



The frequency of oscillation of the strings in both guitars can be adjusted by changing their tension. In the acoustic guitar the sound depends on the resonance produced in the hollow body of the instrument by the vibrations of the string. The electric guitar is a solid instrument and resonance does not occur.

Small bar magnets are placed under the steel strings of an electric guitar, as shown. Each magnet is placed inside a coil and it magnetises the steel guitar string immediately above it. When the string vibrates the magnetic flux cutting the coil changes, an emf is induced causing a varying current to flow in the coil. The signal is amplified and sent to a set of speakers.

Jimi Hendrix refined the electric guitar as an electronic instrument. He showed that further control over the music could be achieved by having coils of different turns.

(Adapted from Europhysics News (2001) Vol. 32 No. 4)

(a) How does resonance occur in an acoustic guitar? (7)

(b) What is the relationship between frequency and tension for a stretched string? (7)

(c) A stretched string of length 80 cm has a fundamental frequency of vibration of 400 Hz. What is the speed of the sound wave in the stretched string? (7)

(d) Why must the strings in the electric guitar be made of steel? (7)

(e) Define magnetic flux. (7)

(f) Why does the current produced in a coil of the electric guitar vary? (7)

(g) What is the effect on the sound produced when the number of turns in a coil is increased? (7)

(h) A coil has 5000 turns. What is the emf induced in the coil when the magnetic flux cutting the coil changes by 8×10^{-4} Wb in 0.1 s? (7)

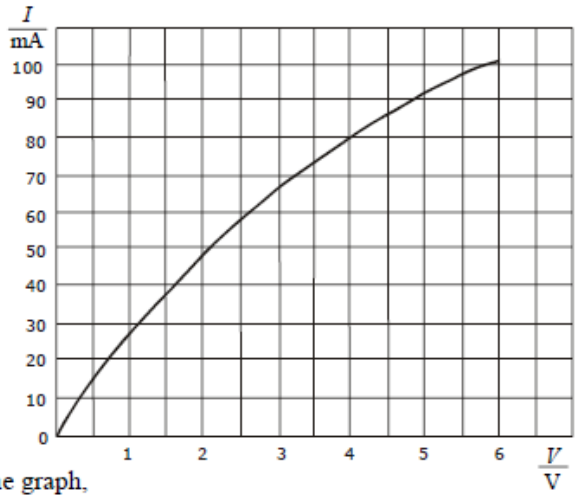
Q4 Section A 2005

4. A student investigated the variation of the current I flowing through a filament bulb for a range of different values of potential difference V.

Draw a suitable circuit diagram used by the student.

Describe how the student varied the potential difference. (16)

The student drew a graph, as shown, using data recorded in the experiment.



With reference to the graph,

(i) explain why the current is not proportional to the potential difference;

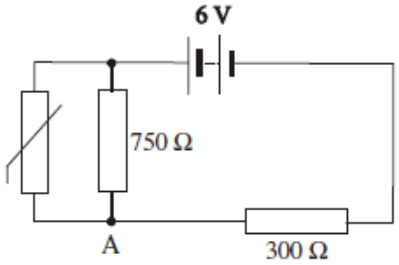
(ii) calculate the change in resistance of the filament bulb as the potential difference increases from 1 V to 5 V. (18)

Give a reason why the resistance of the filament bulb changes. (6)

Q9 Section B 2005

9. Define (i) potential difference, (ii) resistance. (12)

Two resistors, of resistance R_1 and R_2 respectively, are connected in parallel. Derive an expression for the effective resistance of the two resistors in terms of R_1 and R_2. (12)



In the circuit diagram, the resistance of the thermistor at room temperature is 500 Ω.
At room temperature, calculate

(i) the total resistance of the circuit;
(ii) the current flowing through the 750 Ω resistor. (18)

As the temperature of the room increases, explain why

(iii) the resistance of the thermistor decreases;
(iv) the potential at A increases. (14)