



Additional Assessment Materials
Summer 2021

Pearson Edexcel GCE AS Physics

Topic 3: Electric Circuits
Test 1

(Public release version)

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Additional Assessment Materials, Summer 2021

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General guidance to Additional Assessment Materials for use in 2021

Context

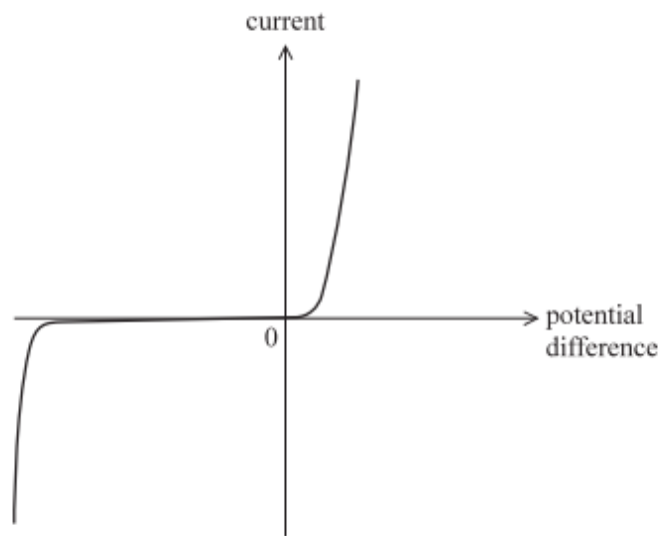
- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource is to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1

9 The graph shows how current varies with potential difference for a component in a circuit.



Explain how the graph shows what the component is.

(3)

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(Total for Question 9 = 3 marks)

2

(b) A filament bulb contains a tungsten filament of diameter 3.8×10^{-5} m and uncoiled length 1.6 m. As the temperature of the filament increases, the resistance of the filament increases to a maximum which is 14 times greater than the initial resistance at room temperature.

(i) Determine the power of the filament at maximum brightness.

p.d. across filament = 240 V

resistivity of tungsten at room temperature = $5.6 \times 10^{-8} \Omega \text{ m}$

(5)

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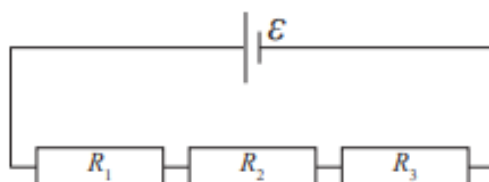
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Power =

3

9 (a) Three resistors, of resistance R_1 , R_2 and R_3 , are connected in series across a cell. The cell has electromotive force (e.m.f.) \mathcal{E} with negligible internal resistance. The current through the cell is I .



Derive the formula for the total resistance R_T of the circuit in terms of R_1 , R_2 and R_3 .

(3)

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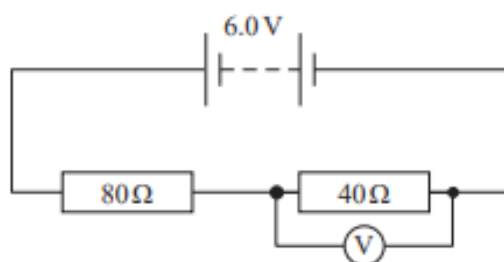
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- (b) The circuit diagram shows two resistors in series across a battery of e.m.f. 6.0 V and negligible internal resistance. A voltmeter with low resistance is connected across the $40\ \Omega$ resistor.



The reading on the voltmeter is 1.8 V .

Calculate the resistance of the voltmeter.

(3)

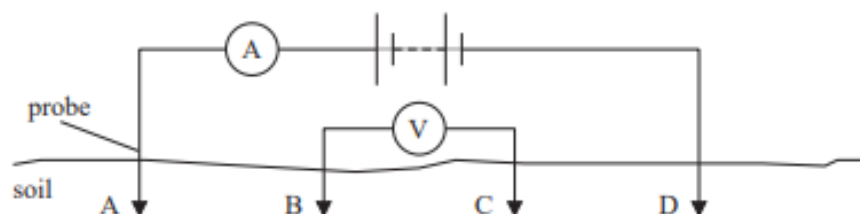
Resistance of voltmeter =

(Total for Question 9 = 6 marks)

4

13 Archaeologists use resistivity surveying of soil to search for the remains of buildings and settlements under the ground.

A basic arrangement that can be used to determine the resistivity of a region of soil is shown.



Probes are placed at positions A and D so that the length AD of soil forms part of the circuit. The ammeter measures the current through the soil.

A second pair of probes connected to a voltmeter is placed at positions B and C. This measures the potential difference between positions B and C in the soil.

(a) Explain how the reading on the voltmeter will change if the length BC increases.

(2)

(b) The table gives the resistivity of some different materials.

Material	Resistivity / $\Omega \text{ m}$
Undisturbed clay	4–20
Compacted clay	100–200
Limestone	500–1000
Sandstone	1500–10 000

The probes connected to the voltmeter are kept at a constant separation of 0.75 m and are moved along the soil between positions A and D.

The current is constant at 9.5 mA. The voltmeter reading varies between 1.8 V and 8.0 V.

It can be assumed that the sample of soil under investigation has a cross-sectional area of 0.65 m^2 .

Deduce two possible materials that could be present in the soil between positions A and D.

(4)

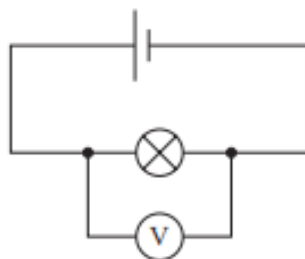
(Total for Question 13 = 6 marks)

5

5

9 A torch uses a 1.5 V dry cell. Over time, the light intensity produced by the torch decreases as the cell 'goes flat'.

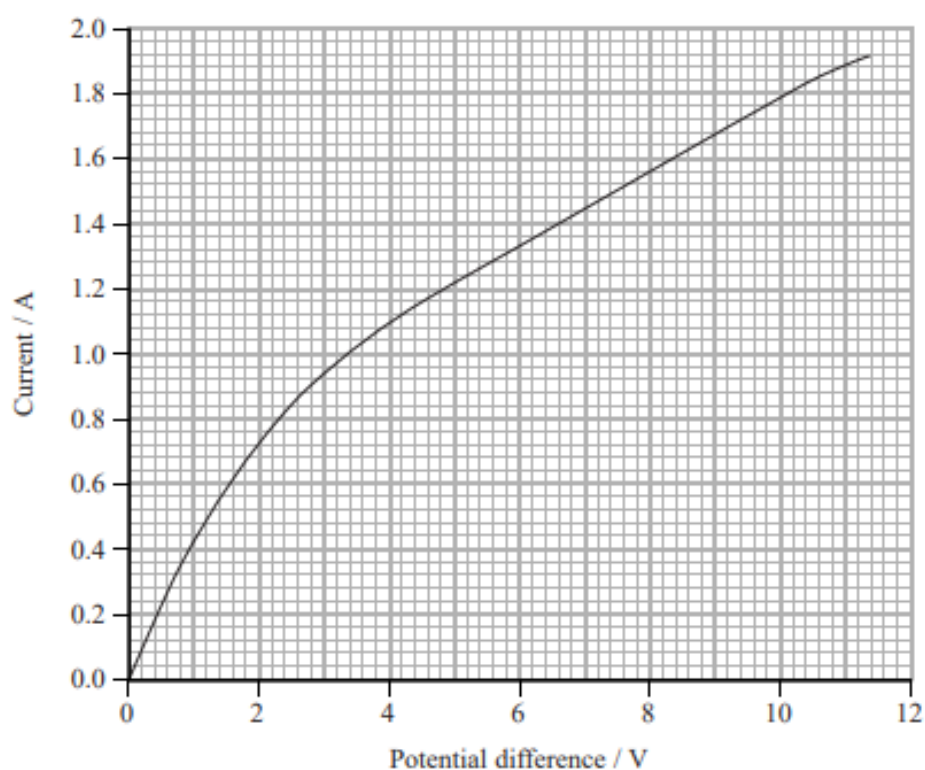
(a) Student A sets up the following circuit in an attempt to measure the e.m.f. of a cell.



Explain why the voltmeter reading will **not** be the e.m.f. of the cell.

(2)

- 14 The graph shows how the current through a filament bulb varies with the potential difference across the bulb.



- (a) Determine the resistance of the filament bulb when the potential difference is 7.0 V.

(2)

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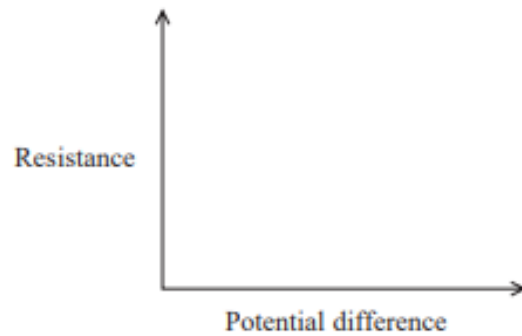
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Resistance =

(b) Sketch a graph of resistance against potential difference for the filament bulb over the range 0 V to 7 V.

(3)



*(c) Explain the variation of resistance with potential difference for the filament bulb in terms of particle behaviour.

(6)

A series of horizontal dotted lines provided for writing the answer to part (c).

(Total for Question 14 = 11 marks)

7

16 In 2010, Andre Geim and Konstantin Novoselov were awarded the Nobel Prize in Physics for producing, identifying and studying graphene.

Graphene is a form of carbon which exists only as a single atomic layer of graphite. It has a breaking stress of 130 GPa compared to 0.5 GPa for steel. Some scientists claim that graphene is the strongest material ever measured.

(a) Explain why graphene, despite its greater strength, is unlikely to replace steel in many applications.

(2)

- (b) Graphite used in pencils consists of many layers of carbon. It can be assumed that a pencil deposits approximately 100 layers of carbon atoms when drawn across a piece of paper.

A student carried out an experiment to determine the resistivity of the graphite in a pencil.

A line of length 0.200m and width 0.50mm was drawn on a piece of paper. An ohmmeter was then used to measure the resistance of the graphite line.



Calculate the resistivity of graphite.

$$\text{resistance} = 1.029 \times 10^6 \Omega$$

$$\text{diameter of carbon atom} = 1.4 \times 10^{-10} \text{ m}$$

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Resistivity of graphite =

(c) Photocells traditionally use silicon to generate electricity using visible light. Research demonstrates that unlike silicon, graphene is able to respond at all wavelengths and releases multiple electrons as it absorbs one photon.

Deduce why it would be an advantage to use graphene in photocells to generate electricity.

(3)

(Total for Question 16 = 9 marks)

TOTAL FOR PAPER IS 42 MARKS