

EMF & Internal Resistance

Question Paper

Level	A Level
Subject	Physics
Exam Board	Edexcel
Topic	Electric Circuit
Sub Topic	EMF & Internal Resistance
Booklet	Question Paper
Paper Type	Open Response 2

Time Allowed: 35 minutes

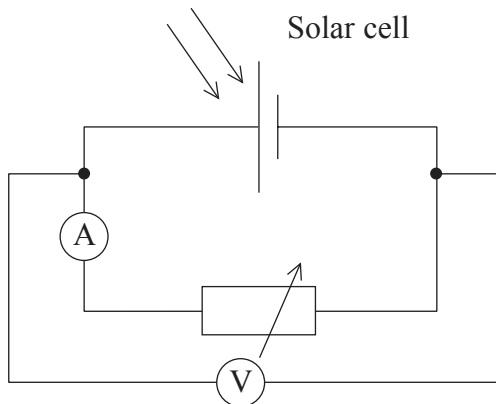
Score: /29

Percentage: /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

- 1 A solar cell generates an e.m.f. when certain wavelengths of light are incident on it. A student connects a solar cell in the following circuit.

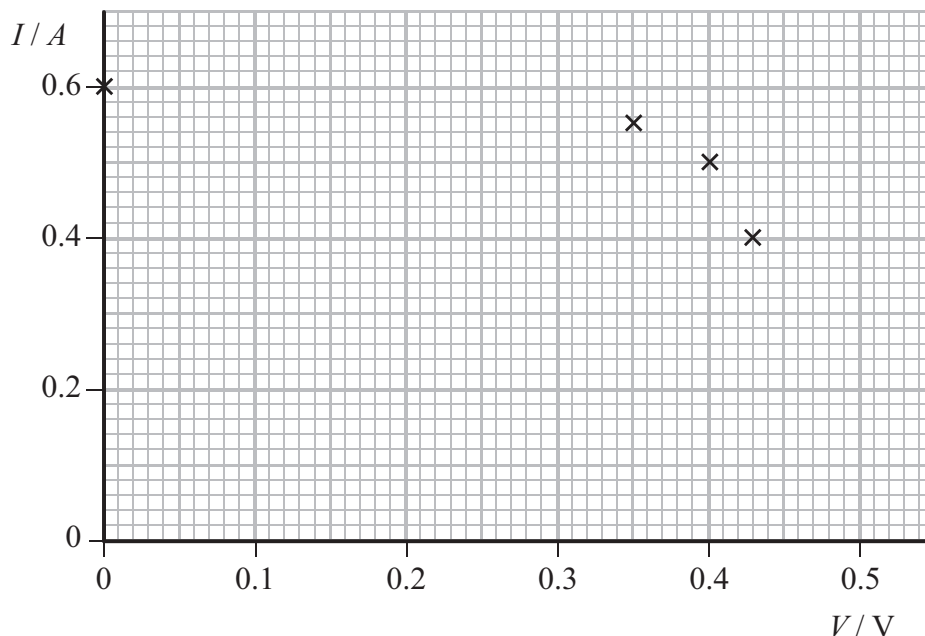


The student keeps the intensity and wavelength of the incident light constant and adjusts the variable resistor to obtain the following set of results.

Current I / A	Terminal potential difference V / V
0.60	0.00
0.55	0.35
0.50	0.40
0.40	0.43
0.30	0.46
0.20	0.48
0.10	0.50
0.00	0.52

- (a) On the grid opposite, plot these results and draw the line of best fit through all the points. The first four points have been plotted.

(3)



(b) (i) Calculate the power output of the solar cell when the current in the cell is 0.40 A.

(2)

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Power =

(ii) Explain why the e.m.f. of this cell is 0.52 V.

(2)

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(iii) Calculate the internal resistance of the cell when the potential difference across the cell is 0.40 V.

(3)

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Internal resistance =

(c) The e.m.f. of this particular cell is independent of the light intensity.
The current increases as the light intensity increases.

Add to the grid above a line showing a set of results that might be obtained if the intensity of the incident light was increased.

(2)

(Total for Question = 12 marks)

2 When a cell of e.m.f. 1.5 V is connected across a resistance of 6.6 Ω the current is 0.21 A.

Calculate the internal resistance of the cell.

(3)

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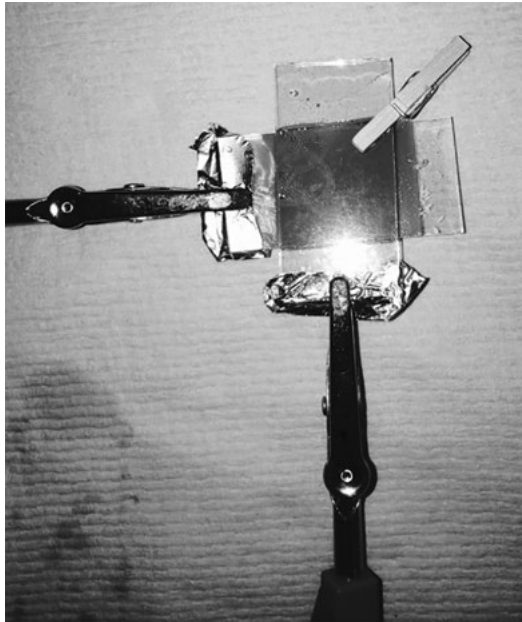
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Internal resistance =

(Total for Question = 3 marks)

- 3 Many plants obtain energy from sunlight using a green pigment called chlorophyll. Other plant pigments can also absorb sunlight, for example the red pigment in raspberries. The photograph shows a solar cell that uses a pigment from raspberries to absorb light in order to generate an e.m.f.



When measured with a high resistance voltmeter, the e.m.f. is found to be 400 mV.
When the solar cell is connected across a 4700Ω resistor, the potential difference across the resistor is 18 mV.

- (a) Calculate the internal resistance of the solar cell.

(3)

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Internal resistance =

(b) The absorbing area of the solar cell is $3.9 \times 10^{-4} \text{ m}^2$ and the radiation flux is 1.5 mW m^{-2} . Calculate the efficiency of the solar cell in transferring energy from sunlight to the resistor.

(4)

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Efficiency =

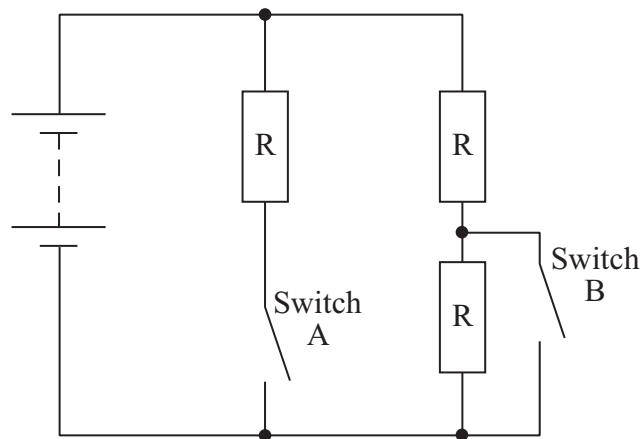
(Total for Question = 7 marks)

- 4 The photograph shows a convector heater designed for use in a home. It operates by air flowing through the heater and passing over its heating elements.



The heater contains three identical heating elements and two switches.

- (a) A student models the heater using the circuit below. The power supply has a negligible internal resistance.



The table gives the four possible combinations of the two switches.
Complete the table to show the total circuit resistance for each switch combination.

(3)

Switch combinations	Total circuit resistance
A open. B closed	R
A open. B open	
A closed. B closed	
A closed. B open	

(b) Explain which switch combination dissipates the most energy in a given time.

(2)

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(c) The power supply is replaced by one with an internal resistance.

Explain what effect this change will have on the thermal energy output of the heater.

(2)

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(Total for Question = 7 marks)