Internal Resistance

Have a go at the following exam questions.

OCR, G482, JUNE 2009

2 **(a)** A battery of e.m.f. E and internal resistance r delivers a current I to a circuit of resistance R.

Write down an equation for E in terms of r, I and R.

..... **[1]**

(b) A 'flat' car battery of internal resistance 0.06 Ω is to be charged using a battery charger having an e.m.f. of 14 V and internal resistance of 0.74 Ω, as shown in Fig. 2.1.

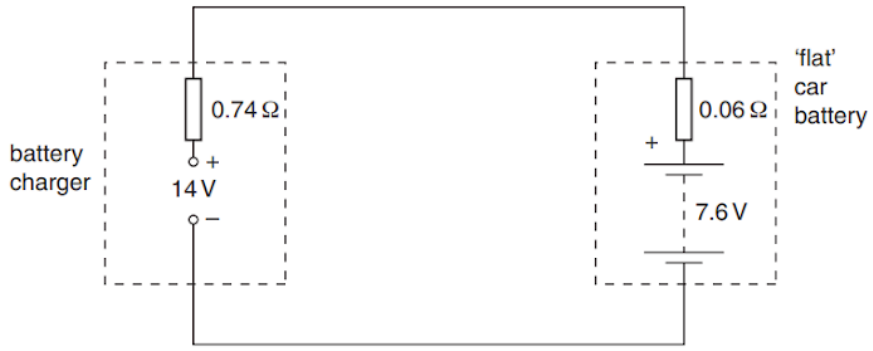

Fig. 2.1

You can see that the battery to be charged has its positive terminal connected to the positive terminal of the battery charger.

At the beginning of the charging process, the e.m.f. of the 'flat' car battery is 7.6 V.

(i) For the circuit of Fig. 2.1, determine

1 the total resistance

resistance = ... Ω **[1]**

2 the sum of the e.m.f.s in the circuit.

e.m.f. = ... V **[1]**

(ii) State Kirchhoff's second law.

.....

..... **[1]**

(iii) Apply the law to this circuit to calculate the initial charging current.

current = ... A **[2]**

(c) For the majority of the charging time of the car battery in the circuit of Fig. 2.1, the e.m.f. of the car battery is 12V and the charging current is 2.5 A. The battery is charged at this current for 6.0 hours. Calculate, for this charging time,

(i) the charge that passes through the battery

charge = ... C **[2]**

(ii) the energy supplied by the battery charger of e.m.f. 14V

energy = ... J **[2]**

(iii) the percentage of the energy supplied by the charger which is dissipated in the internal resistances of the battery charger and the car battery.

percentage of energy = ... % **[2]**

[Total: 12]

3. *(a)* Define the *e.m.f.* of a cell. [2]

.....

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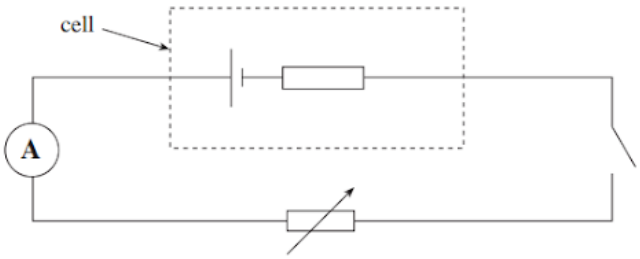
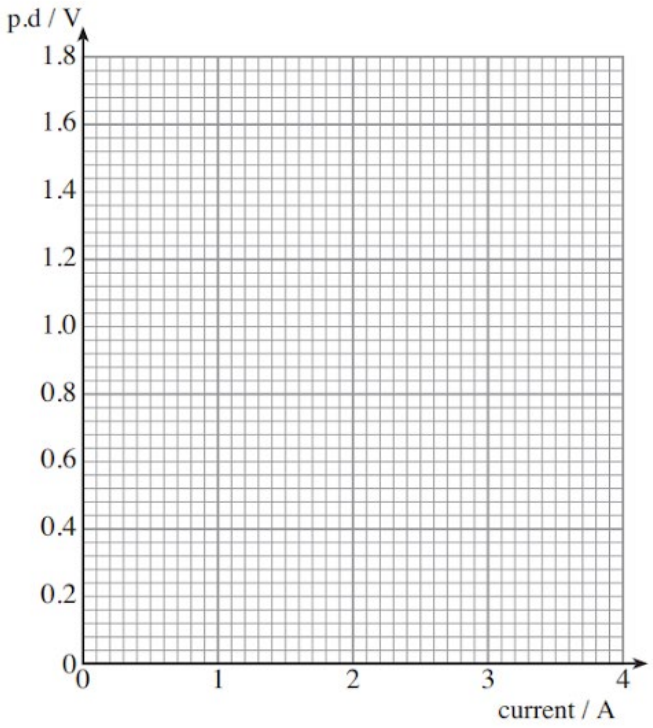
(b) A student sets up the following circuit to find the e.m.f. and internal resistance of a cell. Complete the circuit diagram by adding a voltmeter. [1]



(c) With the circuit complete the student obtains the following results. Plot these results on the grid and draw a line through your points. [3]

p.d. across cell terminals /V	Current /A
1.4	0.6
1.2	1.2
1.0	1.8
0.8	2.4
0.6	3.0



(d) Use your graph to determine

(i) the e.m.f of the cell; [1]

.....

(ii) the internal resistance of the cell. [2]

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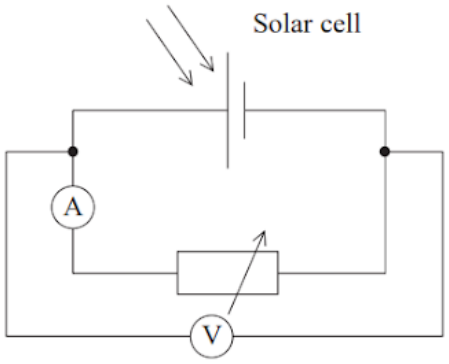
.....

22 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.

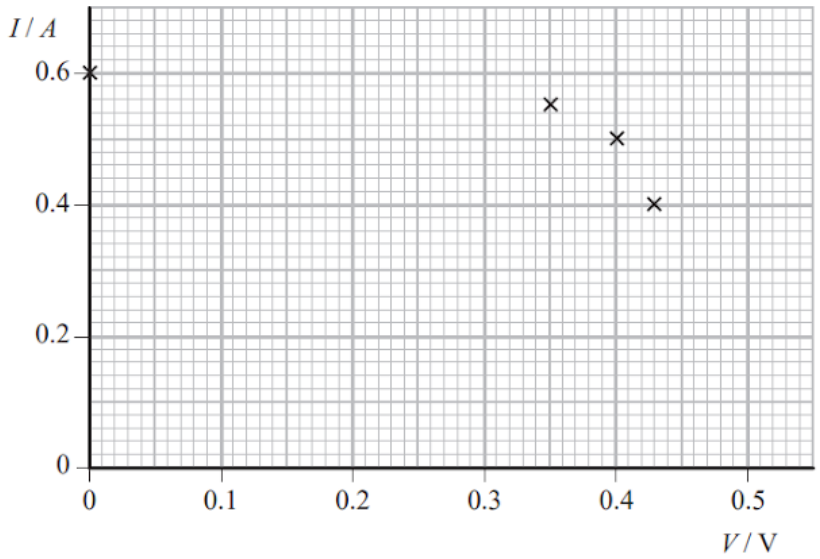


The student keeps the intensity and wavelength of the incident light constant and adjusts the variable resistor to obtain the following set of results.

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)

.....

.....

Power = ...

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

(2)

.....

.....

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

(3)

.....

.....

.....

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 22 = 12 marks)