Name: _____

Edexcel_EMF_Old

Questions

Date:

Time:

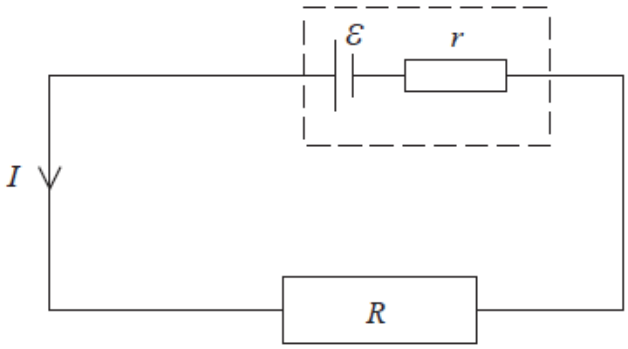
Total marks available:

Total marks achieved: _____

Questions

Q1.

The diagram shows a resistor of resistance R across a cell of e.m.f. ε and internal resistance r.



Which of the following is a correct expression for the current I?

☒ **A** $I = \varepsilon / r$

☒ **B** $I = \varepsilon / R$

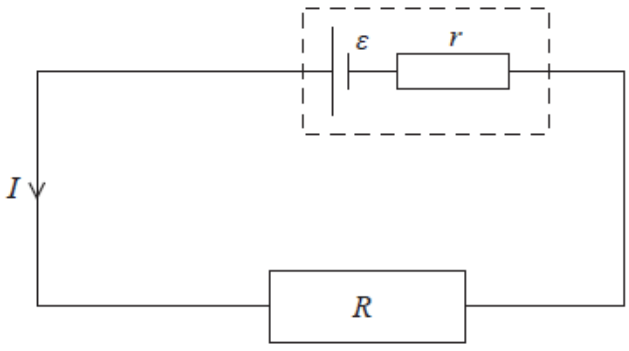
☒ **C** $I = \varepsilon / (R + r)$

☒ **D** $I = \varepsilon / (R - r)$

(Total for question = 1 mark)

Q2.

The diagram represents a resistor of resistance R in a series circuit with a cell of e.m.f. ε and internal resistance r.



Which of the following correctly gives the potential difference V across the internal resistance?

☒ **A** $V = \frac{\varepsilon(R+r)}{r}$

☒ **B** $V = \frac{\varepsilon R}{R+r}$

☒ **C** $V = \frac{\varepsilon(R+r)}{R}$

☒ **D** $V = \frac{\varepsilon r}{(R+r)}$

(Total for question = 1 mark)

Q3.

Explain, in terms of energy, the difference between potential difference (p.d.) and electromotive force (e.m.f.).

(2)

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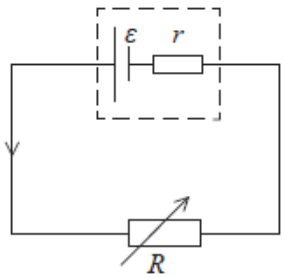
(Total for Question = 2 marks)

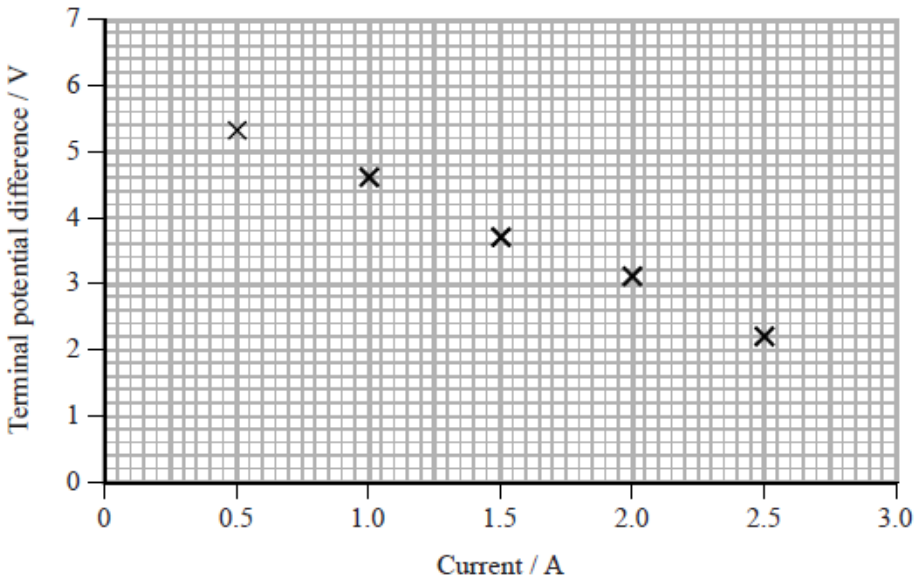
Q4.

The diagram shows a circuit that can be used to determine the e.m.f. ε and internal resistance r of a power supply.



The resistance R is varied and corresponding values of terminal potential difference and current are recorded.

A graph of terminal potential difference against current is plotted.



ε is given by the equation

$$\varepsilon = I(r + R)$$

Power supplies used in schools are designed to have a very large value of r.
Use the equation to explain how this keeps students safer.

(2)

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(Total for question = 2 marks)

Q5. When a cell of e.m.f. 1.5 V is connected across a resistance of 6.6 Ω the current is Ω.21 A.

Calculate the internal resistance of the cell.

(3)

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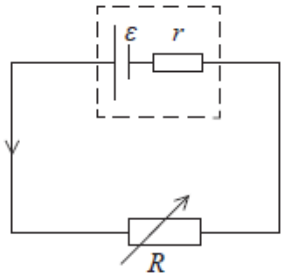
Internal resistance = ...

(Total for Question = 3 marks)

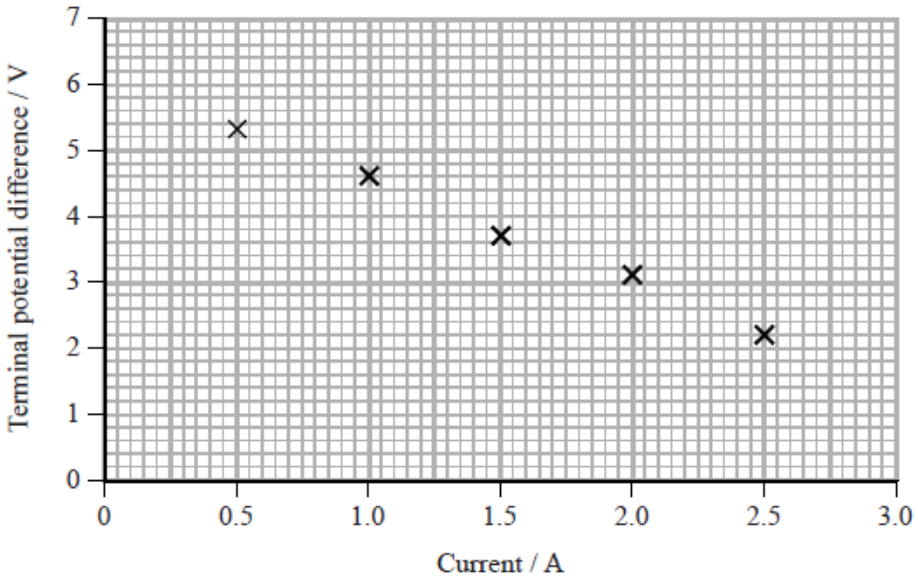
Q6.

The diagram shows a circuit that can be used to determine the e.m.f. ε and internal resistance r of a power supply.



The resistance R is varied and corresponding values of terminal potential difference and current are recorded.

A graph of terminal potential difference against current is plotted.



(i) Use the graph to determine a value for ε.

(2)

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ε = ...

(ii) Use the graph to determine a value for *r*.

(2)

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r = ...

(Total for question = 4 marks)

Q7.

A car battery has an e.m.f. of 12 V and an internal resistance of $3.0 \times 10^{-3}\Omega$. For the starter motor to turn the engine, the battery must provide a current of 400 A.

(a) Calculate the terminal potential difference across the terminals of the battery when the current through the battery is 400 A.

(3)

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Terminal potential difference = ...

(b) The copper wires between the battery and the motor have a diameter of 1 cm.

Explain why such a thick wire is needed.

(3)

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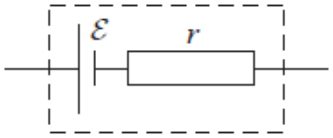
(Total for Question = 6 marks)

Q8.

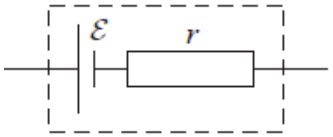
A cell may be represented as an e.m.f. ε in series with an internal resistance r.



A student used the relationship $V = \varepsilon - Ir$ and a graphical method to determine ε and r.
She connected a cell in a circuit and took a series of measurements of the current I in the cell and the potential difference V across the terminals of the cell.

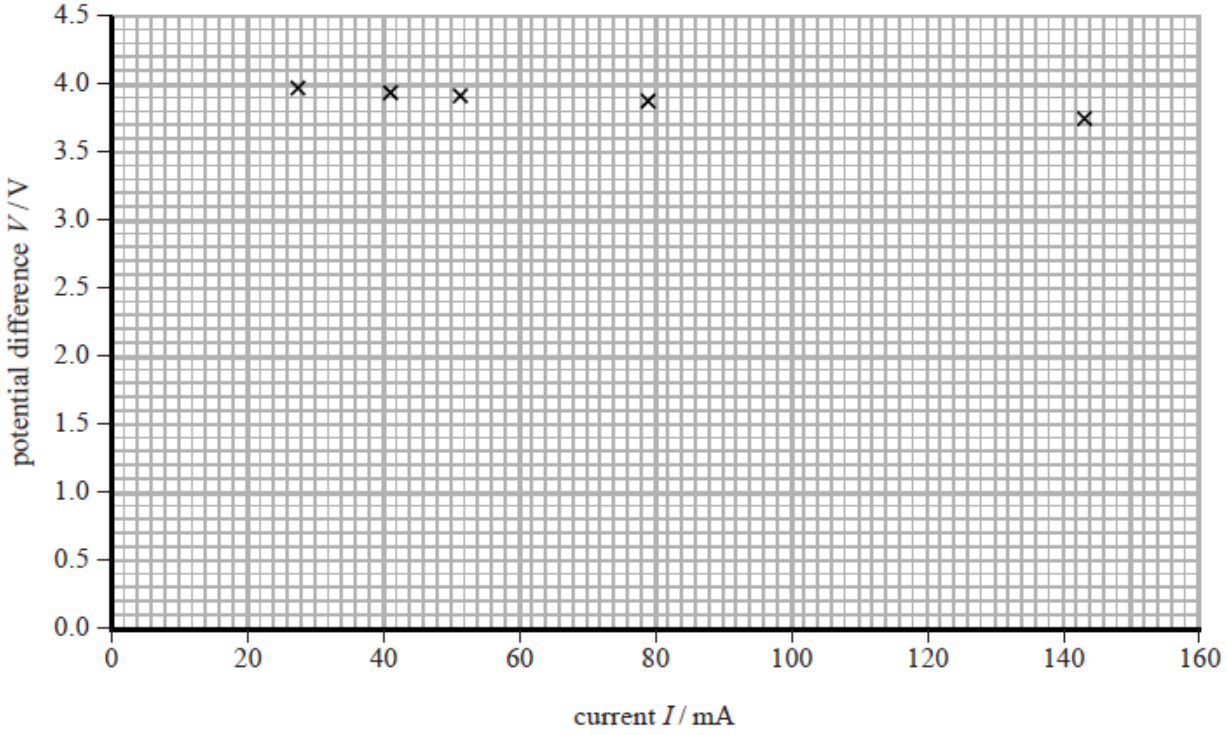
(a) Complete a circuit diagram of a circuit she could have used.

(2)



(b) The student's measurements are shown in the table and plotted on the graph.

I / mA	V / V
27.5	3.97
41.0	3.94
51.6	3.90
78.6	3.88
143.0	3.75



Determine values for ε and r from the graph and show how you obtained your answers.

(4)

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ε = ...

r = ...

(c) Explain how the graph could be constructed to obtain better values for ε and r.

(2)

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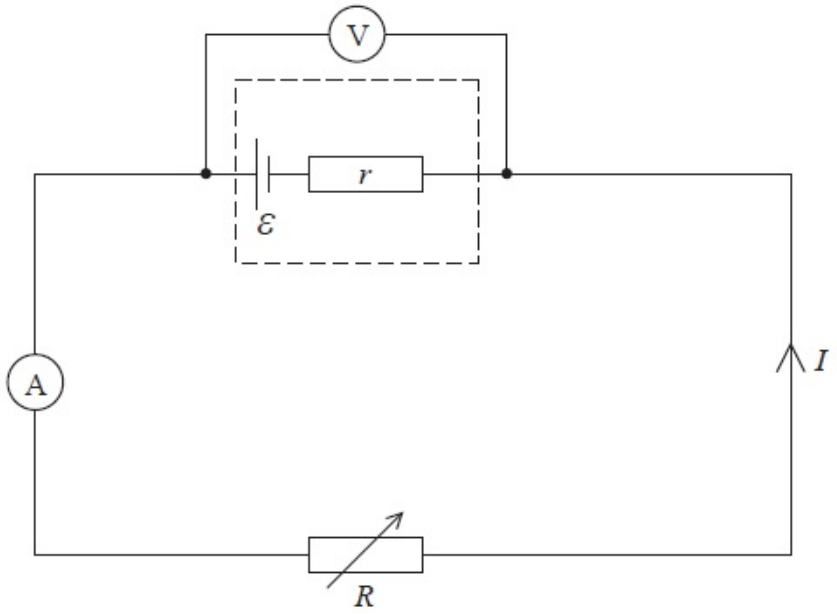
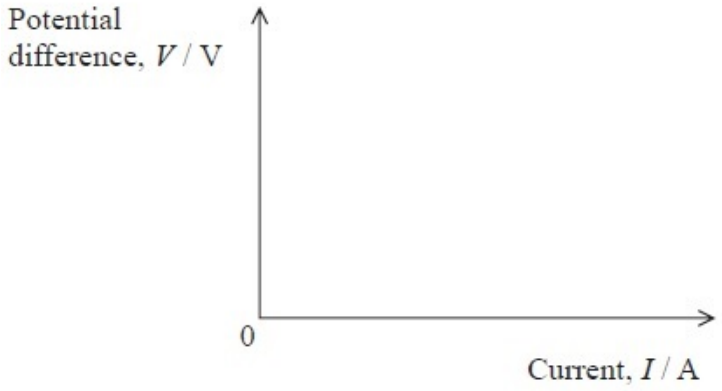
Q9. The diagram shows a circuit which may be used to find the emf ε and internal resistance r of a cell.



(a) As the resistance R of the variable resistor is varied, values of the current I in the circuit and the terminal potential difference V across the cell are recorded.

Sketch the graph of V against I and explain how it may be used to determine ε and r.

(5)



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*(b) We usually assume that ammeters have negligible resistance and voltmeters have infinite resistance.

The determination of ε and r is not affected by using an ammeter with non-negligible resistance but is affected by using a voltmeter with a low resistance.

Explain why.

(4)

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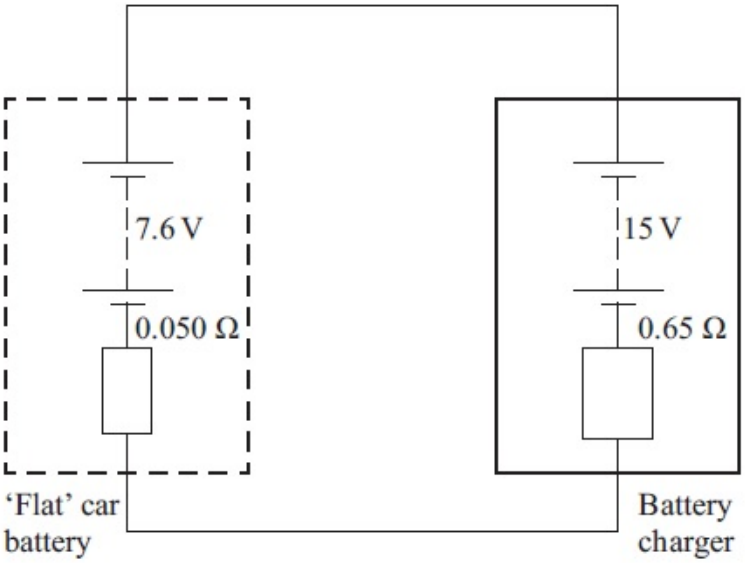
(Total for Question = 9 marks)

Q10.

A 'flat' car battery of internal resistance 0.050 Ω is charged with a battery charger. The battery charger consists of a power supply (with negligible internal resistance) of e.m.f. 15 V in series with a resistor of resistance 0.65 Ω.



The positive terminal of the car battery is connected to the positive terminal of the battery charger.

(a) (i) Determine the resultant e.m.f. of the circuit.

(1)

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Resultant e.m.f. = ...

(ii) Determine the total resistance of the circuit.

(1)

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Total resistance = ...

(iii) Calculate the initial charging current.

(2)

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Charging current = ...

(b) The e.m.f. of the car battery quickly increases to 12.0 V and the charging current becomes 4.30 A.

(i) Show that the terminal potential difference across the battery charger is now about 12 V.

(3)

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(ii) Calculate the rate at which electrical energy is now being supplied by the 15V power supply.

(2)

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Rate of energy supply = ...

(iii) The wasted energy in this process is the energy dissipated in the internal resistance of the car battery and the series resistor in the battery charger.

Calculate the efficiency of the charging process when the current is 4.30 A.

(3)

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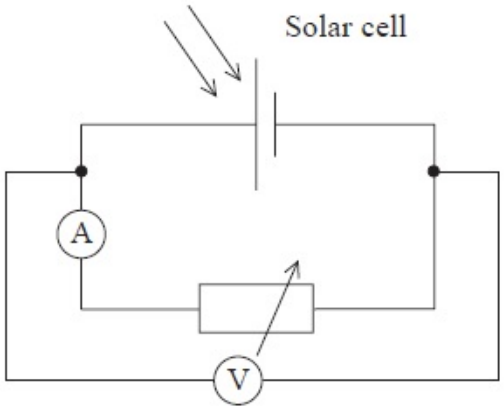
Efficiency = ...

(Total for Question = 12 marks)

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.

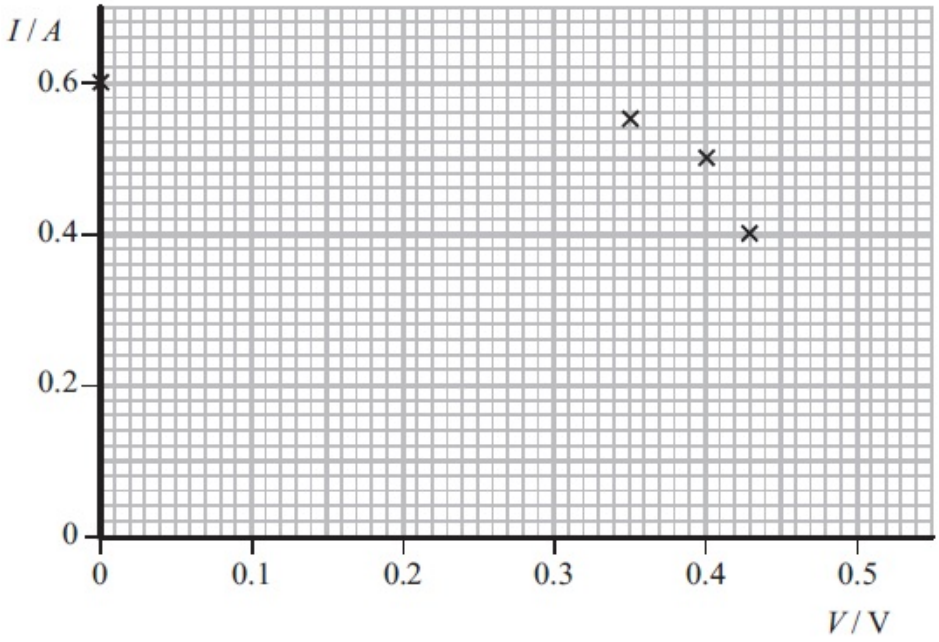


The student keeps the intensity and wavelength of the incident light constant and adjusts the variable resistor to obtain the following set of results.

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)