



Province of the
EASTERN CAPE
DEPARTMENT OF EDUCATION

AMATHOLE WEST DISTRICT

GRADE 12

2023

LEARNER GUIDE - EXPERIMENT 2 PART 1: INTERNAL RESISTANCE OF A BATTERY

1. TOPIC

Write the topic as given by the educator.

2. AIM

To determine the internal resistance of a battery

3. APPARATUS

List the relevant apparatus.

[2]

4. PRECAUTIONS, PROCEDURE / METHOD

4.1 Mention the special precaution for this experiment. (1)

4.2 Set up the apparatus as shown in the circuit diagram on the worksheet (2)

4.3 Follow the procedure/method as given on the worksheet

4.4 Conduct the experiment. (Your teacher will evaluate your performance) (3)

[6]

5. OBSERVATIONS AND DATA COLLECTION

Take the ammeter and voltmeter readings for FIVE different rheostat settings and complete the table given.

[2]

6. DATA ANALYSIS AND INTERPRETATION

6.1 Draw the graph of voltmeter readings against ammeter readings. (3)

6.2 Interpretation - Using the graph/table find the internal resistance. (7)

[10]

7. CONCLUSION

Write a relevant conclusion based on the experiment.

[2]

[22]



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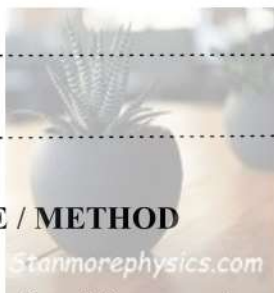
WORKSHEET

EXPERIMENT 2: PART 1

1. AIM

Determining the internal resistance of a battery.

2. APPARATUS



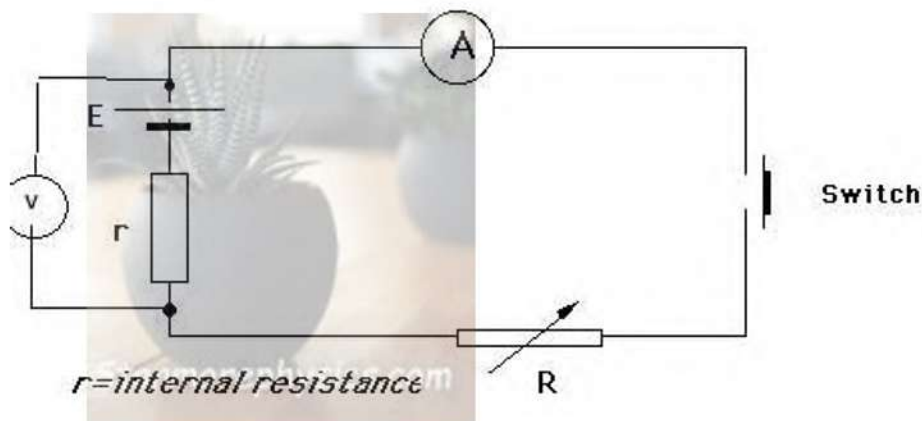
(2)

3. PRECAUTIONS, PROCEDURE / METHOD

3.1 Mention the special precaution for this experiment.

(1)

3.2 Set up the apparatus as shown in the circuit diagram.



CRITERIA	MARK	
Voltmeter & Ammeter connected correctly in the circuit	1	
Complete circuit	1	

4.3 PROCEDURE/ METHOD

1. Connect the apparatus as shown in the above diagram.
2. Set **Rheostat** at a position and close the switch. Take the Ammeter and voltmeter readings as accurately as possible. Release switch after each reading.
3. Repeat the experiment by changing the setting of **R** and record the readings.

4.4 Conduct the experiment.

(3)

Criteria	1	2	3
The way in which the experiment is conducted.	1 mark	2 mark	3 marks
	Maximum help is given to enable the learner to go on with the experiment.	Help is given regularly to enable the learner to go on with the experiment.	No help is given to enable the learner to complete the experiment.

[6]

5. OBSERVATIONS and DATA COLLECTION

Take all the readings and complete the table given.

[2]

	I (A)	V _{load} (V)
1		
2		
3		
4		
5		

6. DATA ANALYSIS AND INTERPRETATION

- 6.1 Draw the graph of V against I. (on a graph paper provided). (3)
- Draw the best possible straight line through the points - they will be quite scattered.

6.2 Interpretation

6.2.1 The formula $E = V_{\text{load}} + Ir$ is given.

Write the formula in $y = mx + c$ form with V as the subject of the formula.

$V_{\text{load}} =$

where $m =$

(1)

6.2.2 What is the purpose of including rheostat in the circuit?

(1)

.....

.....

6.2.3 Use the graph to determine the internal resistance of the battery

(3)

.....

.....

.....

6.2.4 From the graph determine the emf of the battery. Explain

(2)

.....

.....

[10]

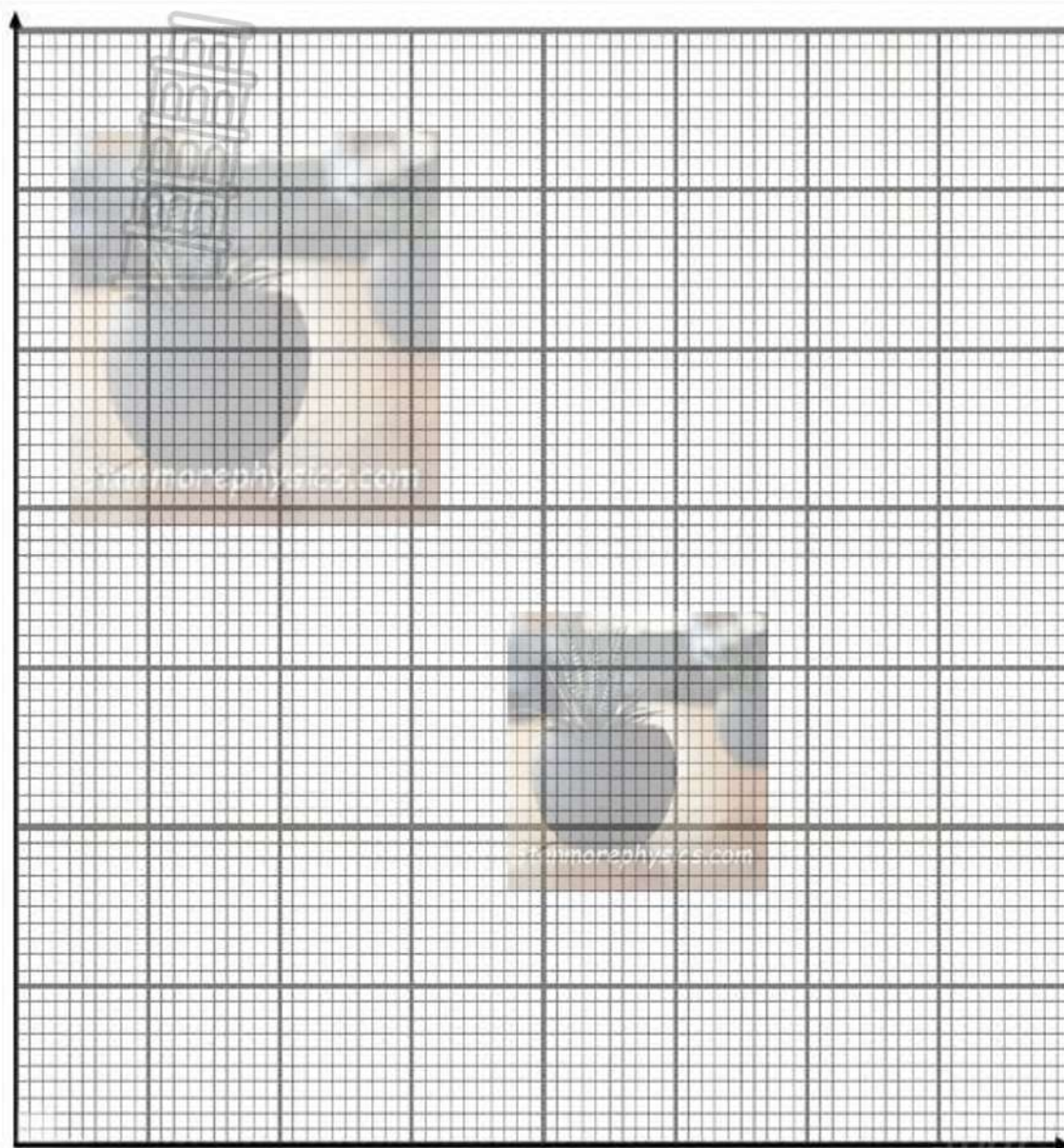
7. CONCLUSION

[2]

.....

.....

[22]





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MARKING GUIDELINE

GRADE 12

EXPERIMENT 2: PART 1

2023

1. TOPIC

2. AIM

To determine the internal resistance of a battery.

3. APPARATUS

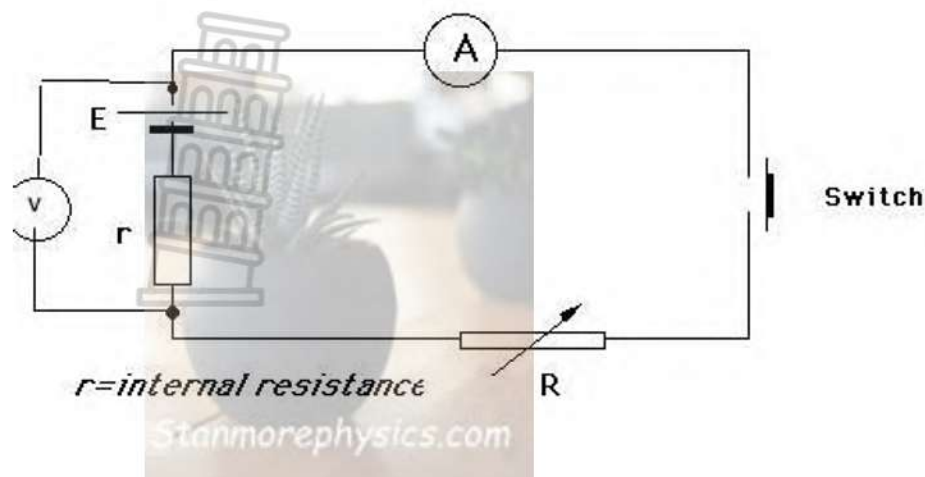
Battery, connecting wires, rheostat, voltmeter, ammeter and switch ✓✓ (2)
(If all are given 2, otherwise 1)

4. PRECAUTIONS, PROCEDURE / METHOD

4.1 Mention the special precaution for this experiment. (1)

Release the switch after each reading (so that the cell does not run down) ✓

4.2 Set up the apparatus as shown in the circuit diagram (2)



checklist

CRITERIA	MARK	
Voltmeter & Ammeter connected correctly in the circuit	1	✓
Complete circuit	1	✓

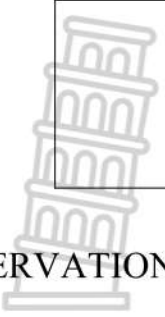
4.3 PROCEDURE/ METHOD

1. Connect the apparatus as shown in the above diagram.
2. Set **Rheostat** at a position and close the switch. Take the Ammeter and voltmeter readings as accurately as possible. Release switch after each reading. 3. Repeat the experiment by changing the setting of **R** and record the readings.

4.4 Conduct the experiment.

(3)

Criteria	1	2	4
The way in which the experiment is conducted.	1 mark	2 mark	3 marks
	Maximum help is given to enable the learner to go	Help is given regularly to enable the learner to go	No help is given to enable the learner to

	on with the experiment.	on with the experiment.	complete the experiment.
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[6]

5. OBSERVATIONS and DATA COLLECTION

Take all the readings and complete the table given.

[2]

	Electric current $I(\text{A}) \checkmark$	Potential difference $V_{\text{load}}(\text{V}) \checkmark$
1		
2		
3		
4		
5		



6. DATA ANALYSIS AND INTERPRETATION

- 6.1 Draw the graph of V against I . (on a graph paper provided) (3)
 Draw the best possible straight line through the points - they will be quite scattered.

	Criteria	Mark
1	Heading, Scale, Axes	✓
2	Plotting of points	✓
3	Best fitting line	✓

6.2 Interpretation

6.2.1 The formula $E = V_{\text{load}} + Ir$ is given.

Write the formula in $y = mx + c$ form with V as the subject of the formula.

$$V_{\text{load}} = -Ir + E \dots\dots\dots$$

$$\text{where } m = -r \quad \checkmark$$

(1)

6.2.2 What is the purpose of including rheostat in the circuit?

To change current and voltage in the circuit by changing the resistance. $\checkmark$

(1)

6.2.3 Use the graph to determine the internal resistance of the battery

(3)

$$\text{Gradient} = \Delta V / \Delta I \quad \checkmark$$

$$= \quad \checkmark$$

$$r = -\text{gradient}$$

$$= \quad \checkmark$$

6.2.4 From the graph determine the emf of the battery. Explain

(2)

$$\text{Emf} = \quad \checkmark$$

The y intercept

When current is zero, the terminal potential difference is equal to emf. $\checkmark$

[10]

7. CONCLUSION

The negative gradient of the graph is the internal resistance. $\checkmark\checkmark$ OR

The stronger the current the greater the drop in terminal potential difference.

[2]

therefore the higher the internal resistance of the battery. $\checkmark\checkmark$ OR

The y intercept of this graph is the emf of the cell. $\checkmark\checkmark$

[22]



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TEST GRADE 12

2023

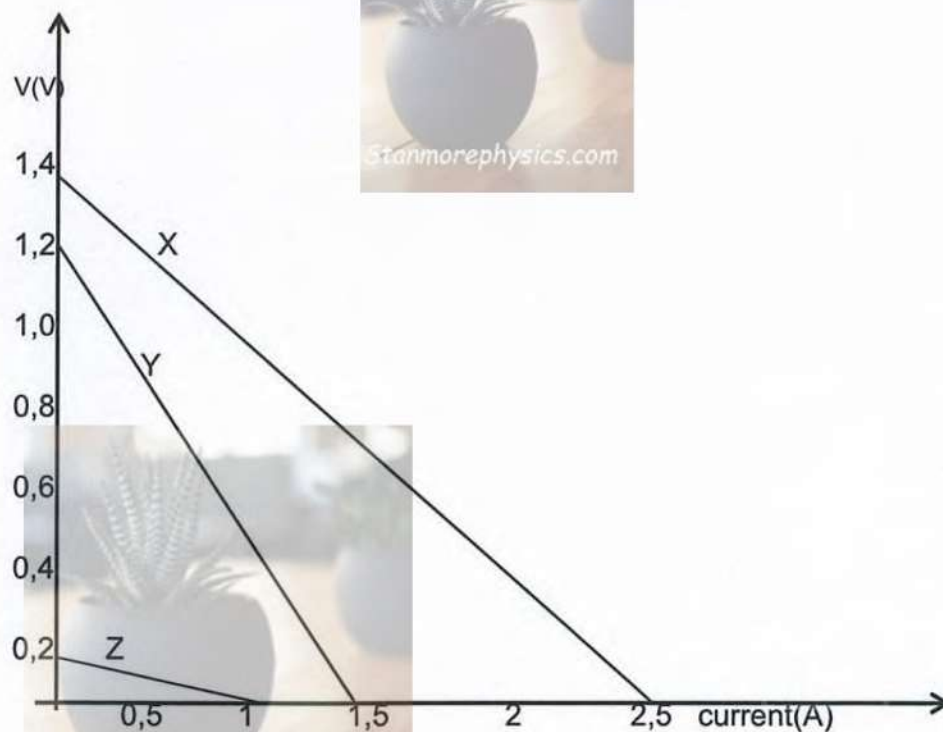
20 MINUTES

EXPERIMENT 2 - INTERNAL RESISTANCE

QUESTION 1

A group of learners conducted some experiments to determine the emf and internal resistance of some batteries.

- 1.1 They conducted the experiment using 3 different batteries (X, Y and Z). The graphs below represent the relationship between the terminal potential difference and current through each battery. Study the graph and answer the following questions:



1.1.1 Which battery (X, Y or Z) has the highest emf? (1)

1.1.2 Explain your answer to the above question.

.....

..... (2)

1.1.3 Which battery (X, Y or Z) has the highest internal resistance? (1)

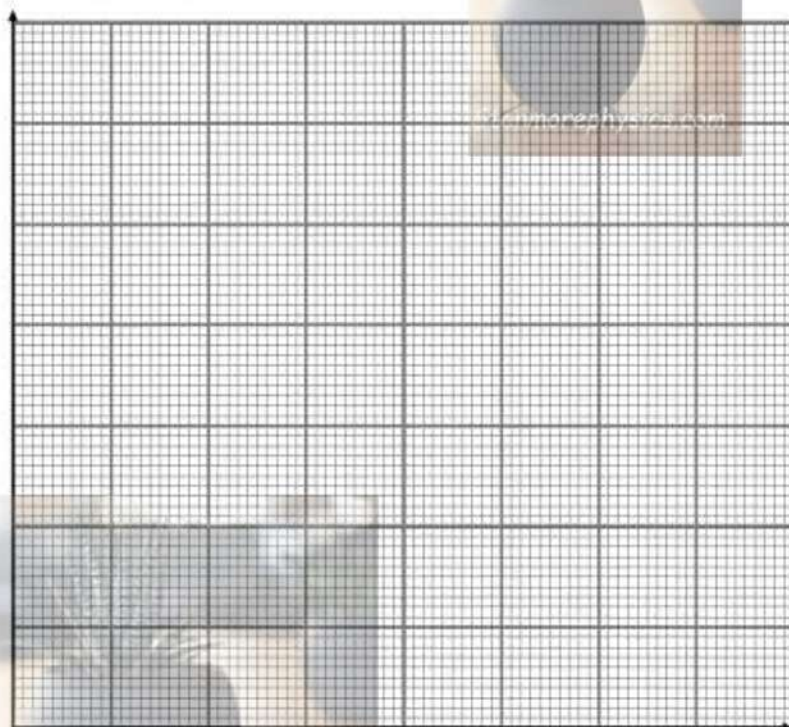
1.1.4 Explain your answer to the above question.

..... (2)

1.2 They connected a battery to a rheostat (variable resistor), ammeter and a voltmeter. The following data was obtained for a battery.

Reading on ammeter (I)	Reading on voltmeter (V)
1,6	4
0,94	6
0,72	8
0,46	10
0,28	12

Using the information in the table, draw a graph (current on the X axis and potential difference on the Y axis) and determine the internal resistance of the battery. (5)



.....

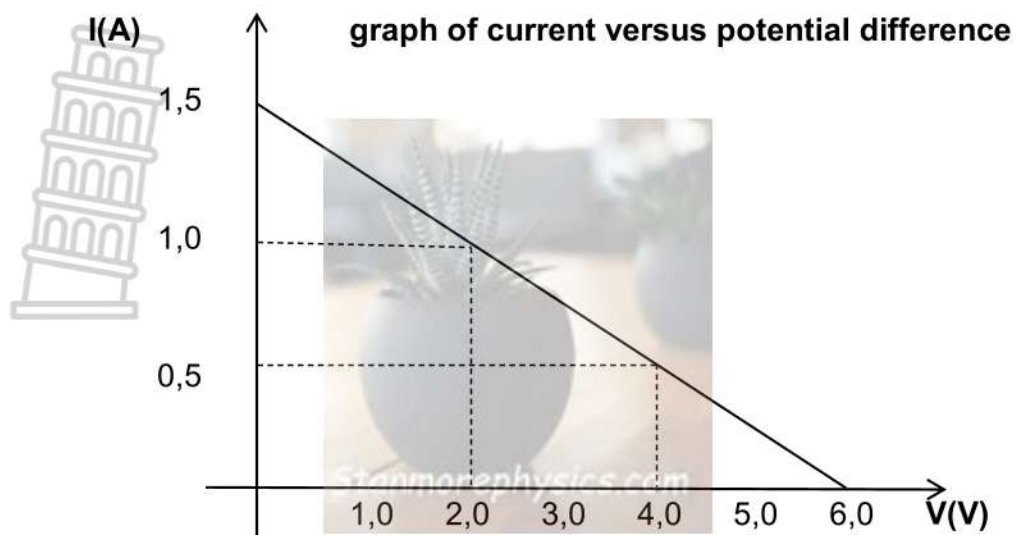
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.....

.....

.....

1.3 The graph below is obtained by the learners from an experiment to calculate the internal resistance of a battery.



1.3.1 What is the value of emf of the battery? (1)

1.3.2 Calculate V_{internal} if current in the circuit is equal to 0,5A.

.....
.....
.....
.....
.....

(1)

1.3.3 What does the gradient of the graph represent?

.....

(1)

1.3.4 Calculate the internal resistance of the battery.

.....
.....
.....
.....

(2)

TOTAL: 16



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EXPERIMENT 3 - INTERNAL RESISTANCE

QUESTION 1

1.1.1 X ✓ (1)

1.1.2 Y intercept of X is the highest value ✓

When current is zero, V is emf (Y intercept) ✓ (2)

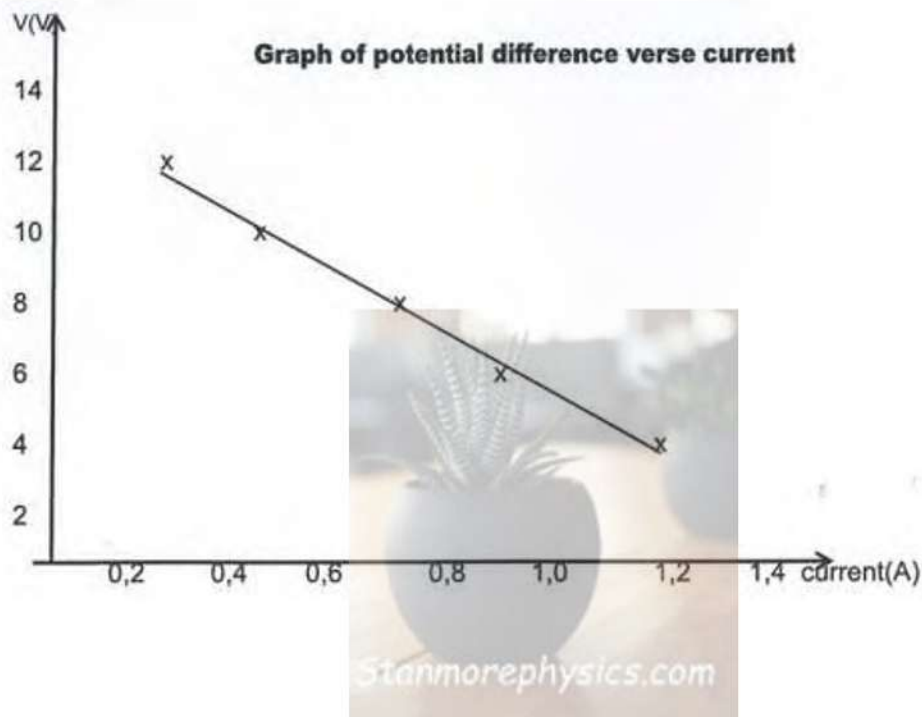
1.1.3 Y ✓ (1)

1.1.4 Internal resistance is obtained from the gradient ✓

Y has the steepest (highest) gradient ✓ (2)

1.2 Criteria for marking

- Name, Scale and labelling axes ✓
- Plotting points ✓
- Best fit line ✓



$$\text{Gradient} = -r$$

$$r = -\text{gradient}$$

$$= -\frac{(12-4)}{(0,28-1,16)} \checkmark$$

$$= 9,09 \Omega \checkmark$$

(5)

Or any two points on the graph can be chosen to calculate the gradient

$$1.3.1 \quad 6V \checkmark$$

(1)

$$1.3.2 \quad V_{\text{internal}} = \text{emf} - V_{\text{external}}$$

$$= 6 - 4$$

$$= 2V \checkmark$$

(1)

$$1.3.3 \quad \text{gradient} = -1/r \checkmark$$

(1)

$$1.3.4$$

(2)

$$r = -1/\text{gradient}$$

$$= -\frac{1}{0,5}$$

$$(0-1,5/6-0) \checkmark$$

$$= 4\Omega \checkmark$$

Or

$$V_{\text{internal}} = Ir$$

$$2 = 0,5 \times r \checkmark$$

$$r = 4\Omega \checkmark$$

[16]