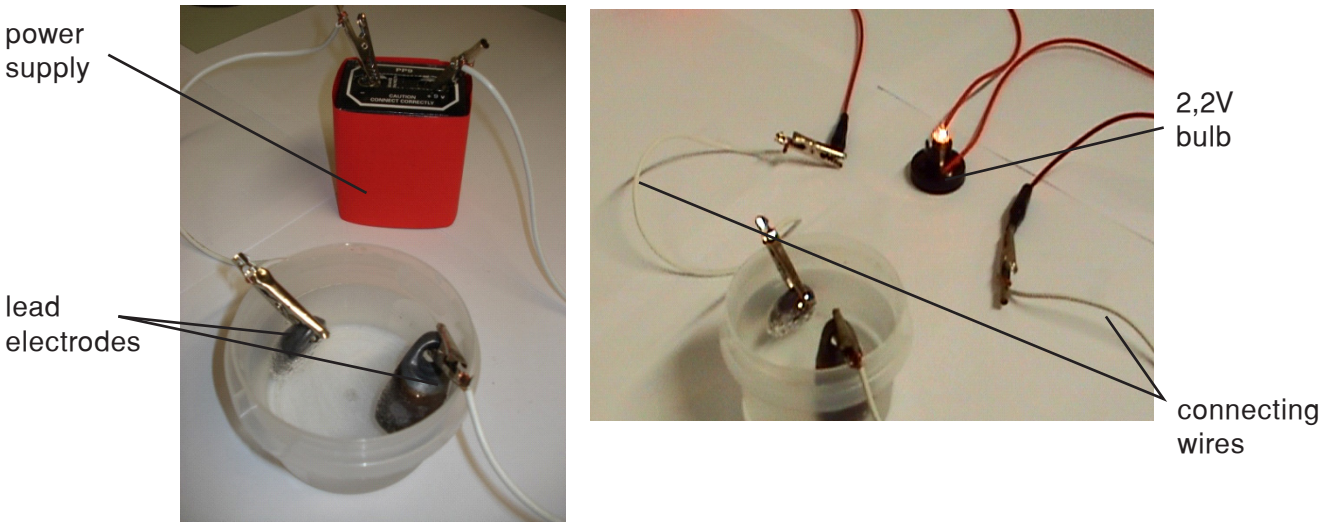
CELL CHARGE AND DISCHARGE

Instructions

- Read these investigation instructions, results and theory.
- Watch the accompanying movie.
- Answer the questions.
- Perform the investigation yourself for enrichment.

Investigation instructions and results

Apparatus



Charging cell

Discharging cell

Method

- **Charging**. Charge the cell for various times.
  Treatments differ in charge time:
  A: 1 minute B: 2 minutes C: 3 minutes
  D: 4 minutes E: 5 minutes F: 6 minutes
- **Discharging**. After each charge period, connect a 2,2V bulb to allow for discharge. Measure the time period for which the bulb shines.

Background theory

A secondary cell is rechargeable. While it is discharging it behaves as a voltaic cell. Chemical energy is converted into electrical energy. This happens as a spontaneous redox reaction occurs at the electrodes, causing a potential difference to develop across them.

While the cell is being charged it behaves as an electrolytic cell. Electrical energy is converted into chemical energy. For this to happen, the cell must be connected to an external power supply. This causes a potential difference to form across the electrodes. This forces a non-spontaneous chemical reaction to occur. This chemical reaction is the reverse of the spontaneous discharge reaction. In this way the chemicals are restored to their original state, ready to react spontaneously during the next discharge.

Questions

Variables

Complete / Give the:

1 **Independent** variable. _____

(Cause. What the investigator made different between the treatments.)

2 **Indicator** of the **dependent** variable. _____

(Measurement of effect. What the investigator measures to show the investigation outcome.)

3 _____ variable. **A cell's discharge time.**

(Effect. Different between the treatments because they had been treated differently from the start.)

4 **Controlled** variables (list at least three). (Must be kept the same between treatments for a fair test.)

_____

_____

Focus question

Complete:

5 How does _____ affect _____?

[independent variable] [dependent variable]

Hypothesis

6 Guess what the answer to the focus question might be. _____

_____

7 Justify your hypothesis, referring to the background theory. _____

_____

_____

Table

8 Circle the correct options to complete general rules for drawing a table.

Optional ↓ *Headings* ↙ ↘

	Dependent variable / **Independent variable** / Indicator of dependent variable	Dependent variable / Independent variable / **Indicator of dependent variable**
A	**Values showing how investigator treated**	Values showing how investigator treated treat-
B	**treatments differently** / Measurements	ments differently / **Measurements**
C	made to show investigation outcome	**made to show investigation outcome**
D		

↖ *Body* ↗

9 Units (e.g. min or s) should be given only in the [heading / body] of the table.

10 The abbreviation for the unit seconds is [sec / s].

11 Calculate the averages for each treatment.

The effect of a cell's charge time on its discharge time

	Charge time (min)	Time bulb shines (s)	
		Raw data (3 repetitions)	Average
A	1	4,5 ; 4,7 ; 4,6	
B	2	6,0 ; 5,9 ; 5,5	
C	3	6,4 ; 6,4 ; 6,7	
D	4	6,9 ; 6,9 ; 6,9	
E	5	7,3 ; 7,9 ; 7,0	
F	6	8,1 ; 8,4 ; 7,5	

Graph

12 Represent the findings graphically.

Check. Have you: Tick if done:

- given a suitable graph heading? ☐
- plotted the independent variable on the x (—) axis? ☐
- plotted the indicator of the dependent variable on the y (|) axis? ☐
- labelled each axis and given units where appropriate? ☐
- accurately plotted data points with small circled dots? ☐
- drawn a smooth trend line? ☐

Conclusion

13 Answer the focus question in your own words. _____

_____

14 Complete for a shorter way of writing the conclusion.

Increasing _____ [increases / decreases / doesn't affect]
[independent variable]

_____ [dependent variable]

Discussion

15 Was your hypothesis shown to be correct or incorrect? _____

16 Suggest a reason for your findings, referring to the background theory.

_____

_____

_____

Further investigation

Design another investigation of your own, using the guidance given below.
It must have a different focus question to the previous investigation.

Variables

Complete / Give the:

17 **Independent** variable. _____

Dependent variable. **A cell's discharge time.**

18 **Controlled** variables. (Must be kept the same between treatments for a fair test.)
Compared to the previous investigation, give one variable which:

a must be constant between treatments here, but not previously

_____

b must not be constant between treatments here, but must be previously

_____

Focus question

Complete:

19 How does _____ affect _____?
[independent variable] [dependent variable]

Method

20 Treatments differ in : _____:

A: _____ C: _____

B: _____ D: _____

21 Explain what you would do in this investigation.

_____

_____

_____

_____

Table

22 Fill in headings and values showing how you will treat the treatments differently.
Include units in headings where appropriate.
Leave empty spaces where you could fill data in after taking measurements.

A		
B		
C		
D		