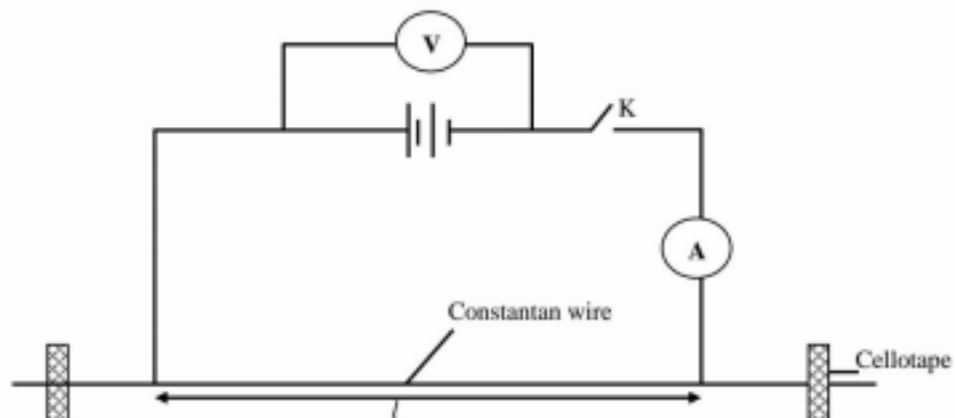


A battery manufacturing company has received complaints of its products overheating, and having low life span. This made the company director to have a consultation with its team of experts' in-charge of quality assurance; they predicted that this could be as result of internal resistance of the batteries exceeding $1.8\ \Omega$ and proved it right. In a bid to improve on the quality and life span of the batteries, the company's executive director decided that all the newly manufactured batteries should be tested before putting them into the

market. Unfortunately after the commencing the process of testing, the machine broke down. This forced them to seek for alternative approach which they are not familiar with, they seek for your expertise.

Task: Carryout scientific investigation to determine whether their newly manufactured batteries meet the minimum standards.

Hint: $E = V + Ir$ where E is e.m.f of the cells, V is p.d drop and I is current



12.	Precautions:	<ul style="list-style-type: none"> ✓ Repeating the experiment ✓ taking reading at right angles 		Any two 1 score
13.	Advice:	<ul style="list-style-type: none"> ✓ The experiment must be repeat for a number of times so as to minimize errors. 		1 score
TOTAL				33 Scores

Item 4

S/No	Items 1	Expected responses	code	Scores
1.	Aim.	<ul style="list-style-type: none"> ✓ To determine the internal resistance r of the sample cells provided to ascertain whether they now meet the minimum standards. 		2 scores
2.	Variables	<ul style="list-style-type: none"> ✓ Independent Variable; the length l of constant wire W ✓ Dependent variable; the p.d drop V and current I 		2 scores <ul style="list-style-type: none"> • Stating any 2 variable score
3.	Hypothesis	<ul style="list-style-type: none"> ✓ The internal resistance of a cell is less than 1.8Ω 		1 score <ul style="list-style-type: none"> • for stating the hypothesis
4.	List of apparatus	<ul style="list-style-type: none"> ✓ Ammeter ✓ Voltmeter ✓ Switch ✓ Connecting wires ✓ Doubles cells in a cell holder ✓ Constantine wire SWG 28 ✓ Crocodile clips ✓ Metre rule. 		1score <ul style="list-style-type: none"> • for listing the apparatus
5.	Procedure:	<ul style="list-style-type: none"> ✓ The apparatus are connected as shown in the diagram above. ✓ When the switch k is still open, the voltmeter reading, V_0 is read and recorded. ✓ The length l of wire between the crocodile clips is adjusted such that $l = 10.0$ cm and switch k closed. ✓ The voltmeter reading V_1 and ammeter reading I are read and recorded. ✓ The switch k is then opened. ✓ The above procedures are repeated with at least four values of l i.e $l = 20.0, 30.0, 40.0, 50.0$ and 60.0 cm ✓ The results recorded in a suitable including the values of $(V_0 - V_1)$ 		8 scores <ul style="list-style-type: none"> ✓ For each correct step 1 score

		<ul style="list-style-type: none">✓ A graph ($V_0 - V_1$) against ($x \pm y$) plotted and slope r calculated.																														
6.	Presentation of data:	<ul style="list-style-type: none">✓ Table of results.✓ $V_0 = V$ <table><tr><td>$l(\text{cm})$</td><td>$V_1(\text{V})$</td><td>$I(\text{A})$</td><td>$(V_0 - V_1) (\text{V})$</td></tr><tr><td>10.0</td><td></td><td></td><td></td></tr><tr><td>20.0</td><td></td><td></td><td></td></tr><tr><td>30.0</td><td></td><td></td><td></td></tr><tr><td>40.0</td><td></td><td></td><td></td></tr><tr><td>50.0</td><td></td><td></td><td></td></tr><tr><td>60.0</td><td></td><td></td><td></td></tr></table>	$l(\text{cm})$	$V_1(\text{V})$	$I(\text{A})$	$(V_0 - V_1) (\text{V})$	10.0				20.0				30.0				40.0				50.0				60.0					3 scores @ column
$l(\text{cm})$	$V_1(\text{V})$	$I(\text{A})$	$(V_0 - V_1) (\text{V})$																													
10.0																																
20.0																																
30.0																																
40.0																																
50.0																																
60.0																																
8.	Accuracy:	<ul style="list-style-type: none">✓ Appropriate number of decimal points		3 scores @ correctly recorded value half																												
9	Data analysis and interpretation;	Graph work on the graph paper. <ul style="list-style-type: none">✓ Title of the graph i.e A graph ($V_0 - V_1$) against I✓ Axes labeled with quantities units in bracket✓ Suitable and convenient scale covering at least half graph page✓ Correct plots✓ Line of best fit✓ Slope $S = \frac{\Delta(V_0 - V_1)}{\Delta I}$ and calculating r from $r = \frac{s}{2}$		8 scores: <ul style="list-style-type: none">✓ Title 1✓ Drawing and labeling 1✓ Scale 1✓ Correct plots 1✓ Line fit 1✓ Slope S 1✓ Calculating $r = \frac{s}{2}$																												
10.	Conclusion:	<ul style="list-style-type: none">✓ The resistance of the cell less 1.8Ω, the hypothesis is valid. The new cells manufactured now meet the minimum standards		2 scores																												
11.	Possible error:	<ul style="list-style-type: none">✓ Error due to parallax✓ Insensitivity of instruments✓ Over drained cells and stayed cells		Any two 1 score																												
12.	Precautions:	<ul style="list-style-type: none">✓ Repeating the experiment✓ taking reading at right angles		Any two 1 score																												
13.	Advice:	<ul style="list-style-type: none">✓ use of depolarizing agent to improve on the efficiency		1 score																												
TOTAL				33 Scores																												