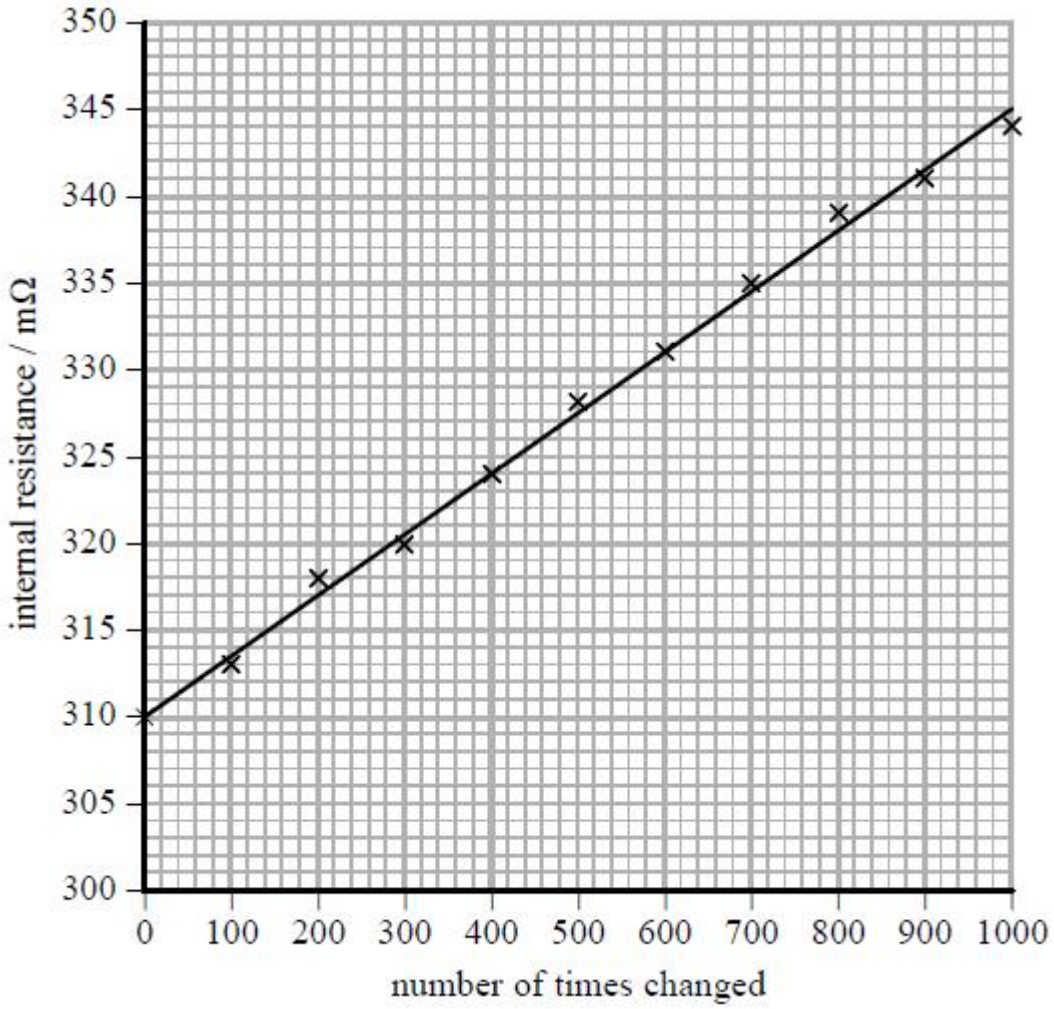
Name of the Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

The cells used in a camera to charge the flash unit are 3.6 V lithium ion rechargeable cells. The data sheet supplied with such a cell includes a graph which shows how the internal resistance of the cell varies with the number of times it has been charged and discharged.



The cell is recommended for use in a camera flash charger which typically draws a supply current of 800 mA. The manufacturer claims that even after 500 charging cycles the cell terminal potential difference (p.d.) will be more than 99% of the terminal p.d. when new and supplying the same current.

Analyse the data from this graph to explain whether it supports the claim, supporting your answer with a calculation.

(4)

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(Total for question = 4 marks)

Q2.

(a) A magnetic field can be measured with a device called a Hall probe. The probe is connected to a voltmeter. When the probe is placed at right angles to a magnetic field, a potential difference is recorded on the voltmeter. The potential difference increases with increasing magnetic flux density.

A wire carries a constant current. A Hall probe is used to investigate how the magnetic flux density produced by the wire varies with distance from the wire.
The potential difference *V* was recorded for a range of distances *r*.

r/cm	*V*/V
1.0	0.725
1.5	0.483
2.0	0.363
2.5	0.29
3.0	0.242
3.5	0.21

(i) Criticise these results.

(2)

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(ii) It is suggested that *V* and *r* are related by the equation

$$V = \frac{k}{r}$$

where *k* is a constant.
(1) Determine by calculation whether this suggestion is valid.

(2)

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(2) A graph of $\frac{1}{V}$ is plotted against r.
State how the graph would indicate that the equation is correct.

(1)

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(b) The Hall probe can be replaced with a small coil of wire which is connected to a sensitive voltmeter. The plane of the coil is at right angles to the magnetic field produced by the current-carrying wire.

(i) Explain, with reference to Faraday's law, why the voltmeter reading would be zero.

(2)

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(ii) State **three** different ways in which an e.m.f. could be induced in this coil.

(3)

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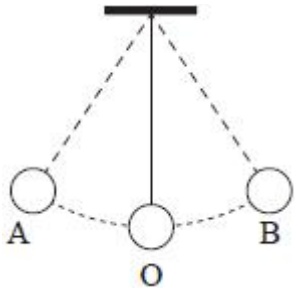
(Total for question = 10 marks)

Q3.

A student is using a simple pendulum to determine a value for the acceleration of free fall *g*.

She sets the pendulum into oscillations with small amplitude and uses a stopwatch to determine the time period.



The student releases the pendulum at A and simultaneously starts the stopwatch. She measures the time taken for 5 oscillations and divides the value by 5. She repeats the procedure twice and calculates a mean time period.

Explain **two** modifications to the student's method that would improve the value obtained for the time period.

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(Total for question = 4 marks)