Student Number								

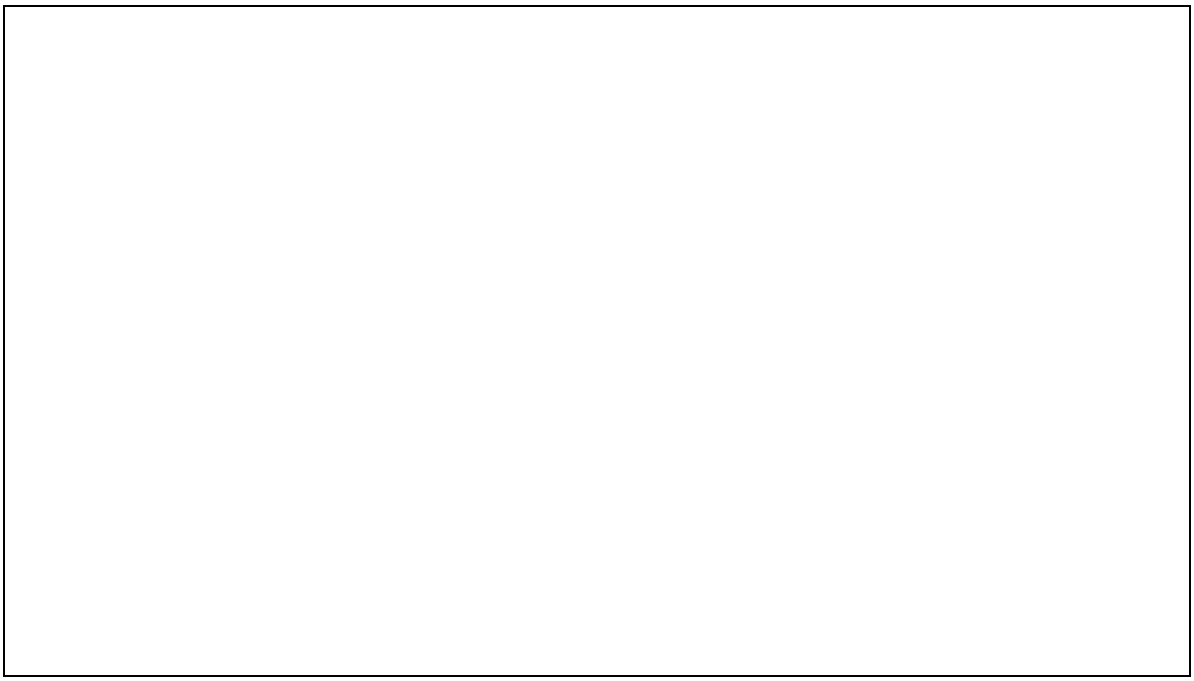
marks

Question 29 (9 marks). Q4160

A student used a magnetic probe and datalogger to measure the magnetic field strength inside a solenoid. The independent variable was the magnitude of the current flowing through the solenoid.

(a) Design a method for this investigation. Include a labelled diagram that clearly communicates the method and specific details. You do not need to repeat information conveyed in your diagram. Q4160a

3



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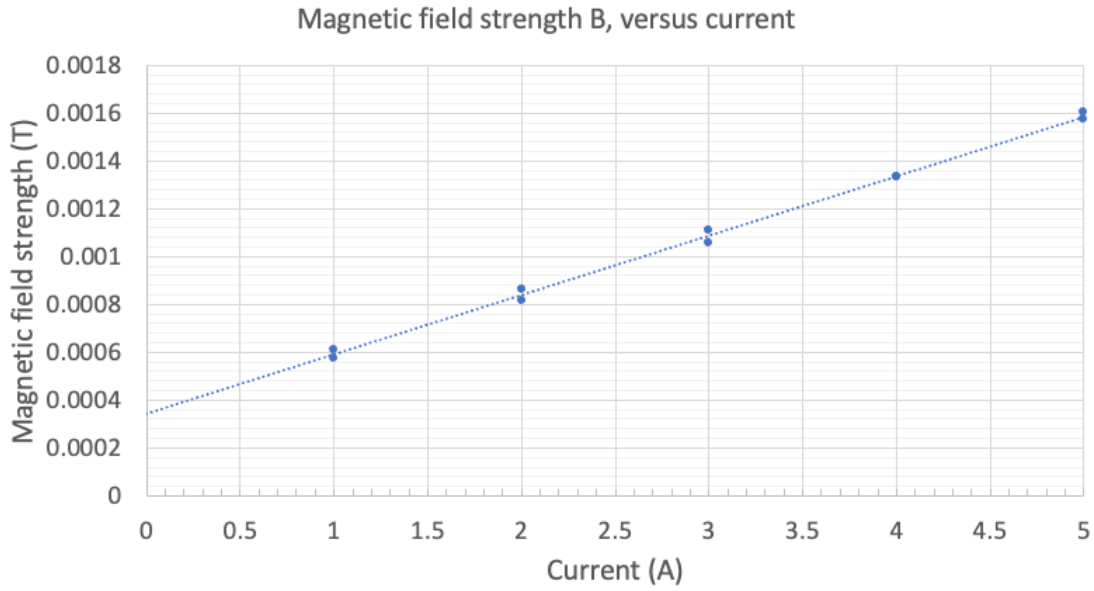
QUESTION CONTINUES

Student Number								

marks

The student collected and presented their data below.



(b) Use the graph to calculate the gradient, demonstrating your method by annotating the graph. Demonstrate how the gradient relates to a value for μ_0.

Q4160b

3

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QUESTION CONTINUES

Student Number								

marks

After collecting their results, the student realised that they had not zeroed the magnetic field probe at the start of the experiment.

(c) How this is evident in the graph above? Q4160c

1

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(d) Does this affect the estimation of μ_0? Justify your answer. Q4160d

2

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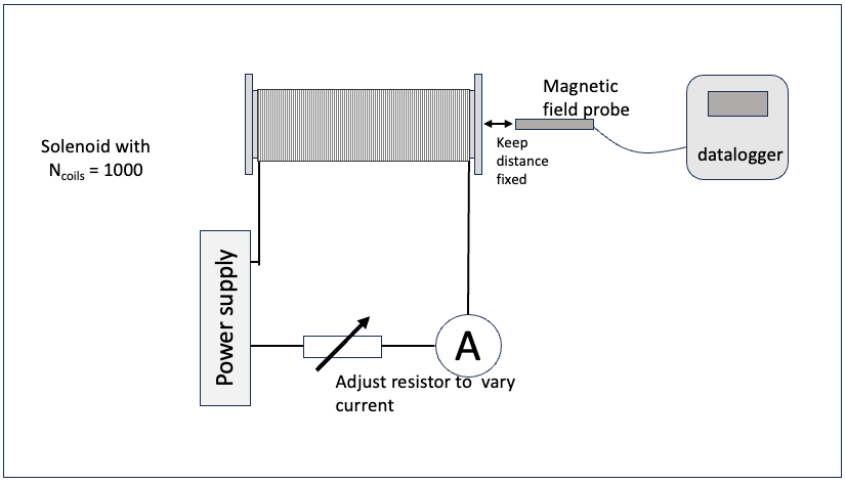
Q4160 Question 29 QR

a)

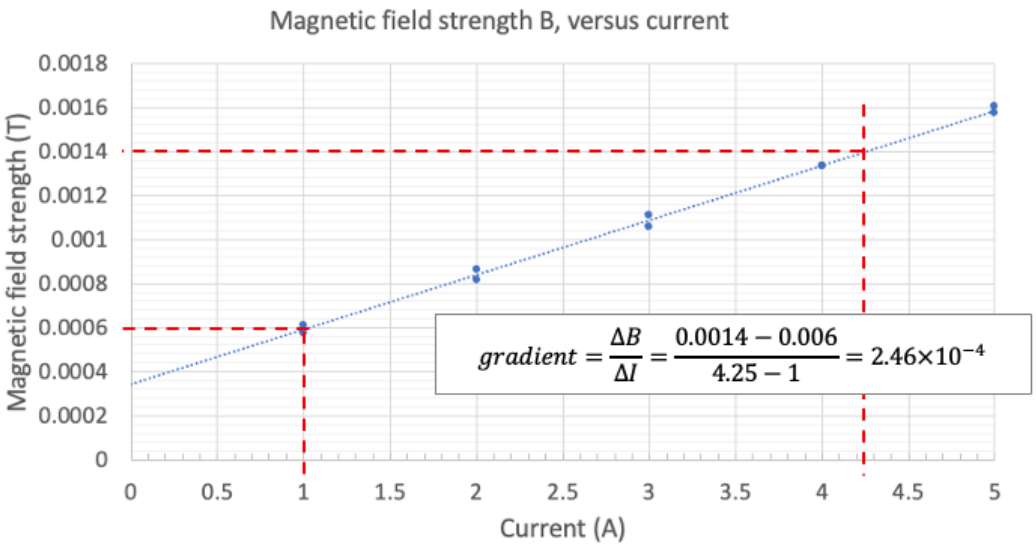
Suggested Response:
The apparatus was set as shown.
Must include a practical way to vary current (variable resistor or change voltage settings on power supply for instance)
An air-filled solenoid (Solenoid law not valid for an iron-filled core), varying current passing through (0, 1, 2, 3, 4, 5)
Each reading was repeated 8 times.



Marking Guide	
Includes diagram. Clearly communicates a valid method that includes at several repeats	3
No repeats included OR poor communication OR not valid method	2
Any non-trivial attempt	1

Note: past/present tense or numbering for method irrelevant. Nothing in diagram needs to be repeated in prose.

b)
Suggested response



"using the graph" and "demonstrate… by annotating". Even without these instructions the best responses will contain construction lines on the graph and use the trend line (the model) rather than individual points as shown above.

The solenoid law can be re-arranged in the form of the equation for a straight line.

$$B = \frac{\mu_0 N}{L} I + 0$$

Hence the gradient is the x co-efficient of the above graph (B vs I)

$$gradient = \frac{\mu_0 N}{L}$$

$$\mu_0 = \frac{gradient \times L}{N}$$

Students may continue to find μ_0 although this is not required

Marking Guide	
Demonstrates finding gradient (construction lines for suitable points ON LINE) are annotated, relates gradient to μ_0 from solenoid law and graph	3
Mostly achieves above accurately	2
Any non-trivial attempt	1

c)
Suggested response:

It is evident by the y intercept (on graph) not equal to zero.

Marking guide: or any correct response

d)

Suggested response

Since μ_0 is related to the gradient of the straight line and not the y-intercept, the failure to tare (or zero) the magnetic probe does NOT affect the estimation of μ_0.

Marking Guide	
Identifies does not affect μ_0 and provides a justification	2
Any non-trivial attempt	1