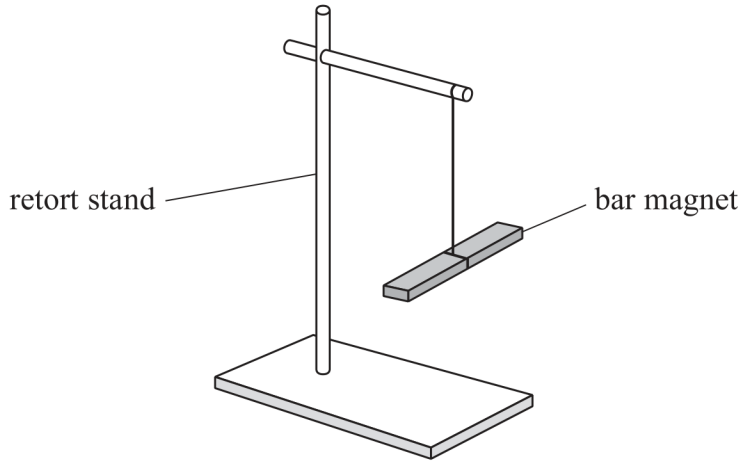
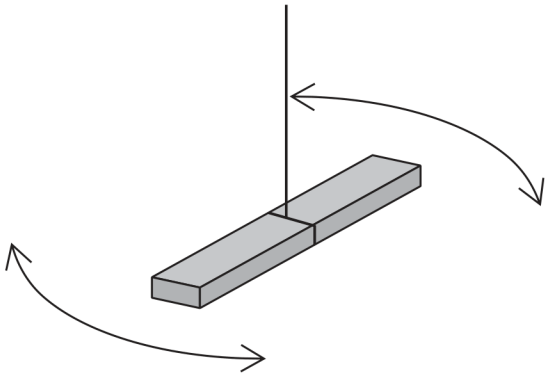
3 A bar magnet was suspended from a wooden retort stand as shown.



The magnet lined up with the magnetic field of the Earth.

The magnet was given a small angular displacement from its equilibrium position and oscillated in a horizontal plane about the string as shown.



(a) Describe how the time period of these oscillations should be measured to make the readings as accurate as possible.

(3)

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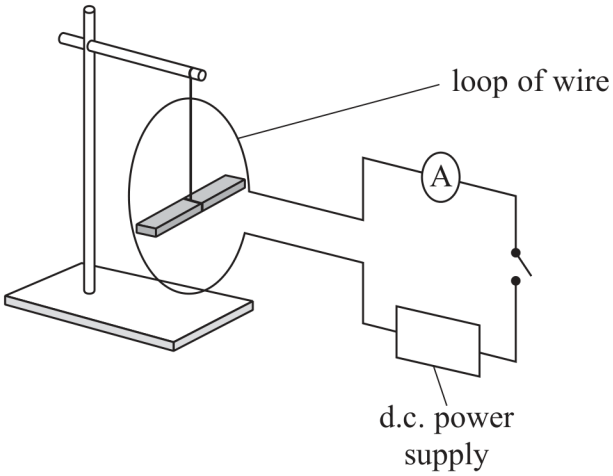
(b) A loop of wire was placed vertically around the centre of the oscillating magnet as shown.



When the switch was closed, there was a current I in the loop of wire and the time period T of the oscillations decreased.

A student predicted that the relationship between T and I is

$$T = I^n$$

where n is a constant.

(i) State an additional component required in the circuit that would allow this relationship to be investigated.

(1)

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(ii) Explain why plotting a graph of log T against log I would test the validity of this relationship.

(2)

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(c) The student processed his results and produced the table below.

T/s	I/A		
0.813	1.20		
0.754	1.40		
0.706	1.60		
0.663	1.80		
0.631	2.00		
0.593	2.20		

(i) Plot a graph of log T against log I on the grid opposite.
Use the additional columns in the table to record your processed data.

(6)

(ii) Use your graph to determine a value for n.

(3)

.....

.....

.....

.....

n = ...

(iii) After plotting the graph, the student modified his prediction. He suggested that the relationship between T and I is

$$T = kI^n$$

where k is a constant.

Justify this suggestion.

(4)

(Total for Question 3 = 19 marks)

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