

2 (a) Figure 3 shows a coil of wire called a solenoid.



Figure 3

Figure 4 gives information about the magnetic field of a solenoid.

description of the magnetic field	part of magnetic field	
	inside the coil	outside the coil
strong	✓	✗
weak	✗	✓
uniform	✓	✗
non-uniform	✗	✓

Figure 4

(i) Draw lines on Figure 5 to show the shape of the magnetic field **inside** the solenoid.

Use information from Figure 4.

(1)

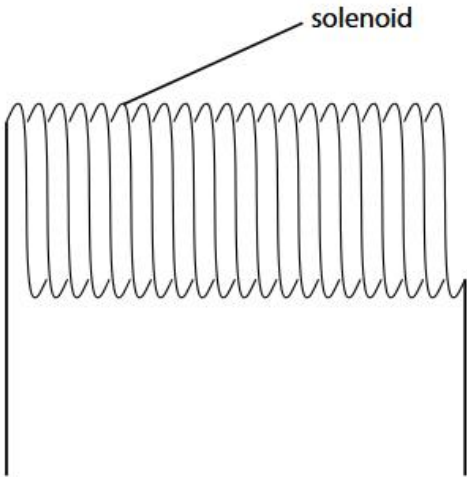


Figure 5

(ii) Describe how a student can determine the shape of the magnetic field around the solenoid.

(2)

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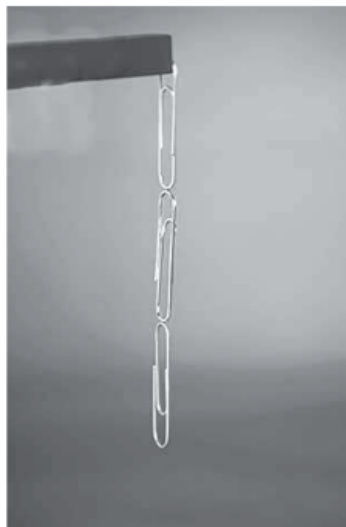
(b) A student investigates the magnetic properties of three rods. Each rod is made of one of the following materials:

- soft iron
- steel
- wood

The student places each rod in a solenoid that is connected to a direct current power supply.

The power supply is switched on for a short time.

The student tests the magnetic strength of each rod by seeing how many paper clips it can pick up as shown in Figure 6.



**Figure 6**

The student's results are shown in Figure 7.

rod	number of paper clips picked up by rod			
	before rod is placed in solenoid	when there is current in solenoid	1 minute after current is switched off	10 minutes after current is switched off
A	0	0	0	0
B	0	6	1	0
C	0	8	7	7

Figure 7

Complete the table below to show which material (soft iron, steel or wood) each rod is made from, with the reason why.

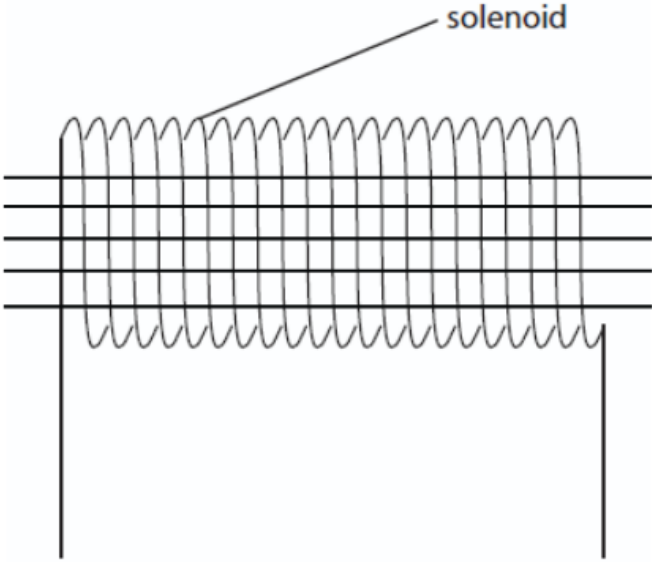
Part of the table has been done for you.

Use information from Figure 7.

(3)

rod	material	reason
A		It is not magnetic because it does not pick up paper clips whether there is a current or not.
B		
C		

(Total for Question 2 = 6 marks)

Question number	Answer	Additional guidance	Mark
2(a)(i)	magnetic lines of force closely packed AND (almost) parallel (1)	<p>ignore any arrows as direction of field is not required</p> <p>ignore any lines outside the coil</p> 	(1)

Question number	Answer	Additional guidance	Mark
2(a)(ii)	<p>An answer that combines the following points of understanding to provide a logical description:</p> <ul style="list-style-type: none"> <li>plotting compass placed on card near wire and pencil mark made near N pole of compass (1)</li> <li>move compass so S pole is above pencil mark and keep repeating this until arrive at starting point (1)</li> </ul>	<p>allow</p> <p>sprinkle iron filings on card</p> <p>tap card to allow filings to align with field</p>	(2)

Question number	Answer	Mark
2(b)	<p>All three materials correctly identified (1) (rod A – wood, rod B – soft iron, rod C – steel) One mark for each reason:</p> <ul style="list-style-type: none"> <li>rod B only attracts paper clips when there is a current in the coil (1)</li> <li>rod C attracts paper clips when there is a current in the coil and for some time after (1)</li> </ul>	(3)

