

## Mark schemes

- 1.** (a) the magnets are not touching 1
- but (each) experiences a force  
*allow but there is a force of attraction between them* 1
- (b) place a (plotting) compass near the (north / south) pole of the magnet and mark the direction that the compass points 1
- move the (plotting) compass around the bar magnet (to the other pole) marking at (regular) intervals the direction the compass points 1
- join the points up and add an arrow pointing from the north pole to the south pole 1
- (c) (closing switch S) causes a current in the coil  
*allow switches on the electromagnet* 1
- a magnetic field is created 1
- a force of attraction acts on the ball bearing 1
- so the ball bearing accelerates (towards the iron rod) 1
- [9]**
- 2.** (a) top of each paper clip labelled N / north  
*both parts required*
- and**  
bottom of each paper clip labelled S / south 1
- (b) so the paper clips have the same weight / mass 1
- which allows the results for different numbers of turns to be compared (fairly)  
*allow fair test*  
*allow the control variable (is the weight / mass of a paper clip)*  
*allow to obtain valid results*  
*ignore accurate results* 1

(c) as the number of turns increases so does the number of paper clips (held)  
*allow positive correlation* 1

in a linear pattern

*directly proportional scores 2 marks*

*allow a correct description of directly proportional for 2 marks*

1

(d) some of the paper clips were already magnetised

1

(e) discount the result of 18

*ignore repeat experiment / measurements*

1

as the three new results are similar (and not close to 18)

1

and use 15 (the mean of the new results)

*allow find the mean of the remaining results (16, 14 and 15)*

*if no other marks have been awarded: calculate the mean (of all four results) (1)*

*round down to 15 (1) – this mark only scores if the mean of 15.75 has been calculated*

1

(f) keep number of turns constant

*allow a specific number of turns*

1

(use the variable resistor to) change the current (several times)

*change the p.d. is insufficient*

1

(for each current value) count how many paper clips the electromagnet will hold

1

[12]

3.

(a) induced

1

(b) bar 2

1

(the same end) of bar 1 attracts both ends of bar 2

**or**

only two magnets can repel so cannot be bar 1 or bar 3

1

(c) so the results for each magnet can be compared

or

so there is only one independent variable

*fair test is insufficient*

*allow different thickness of paper would affect number of sheets  
each magnet could hold*

*accept it is a control variable*

1

(d) because the magnet with the biggest area was not the strongest

*accept any correct reason that confirms the hypothesis is wrong eg  
smallest magnet holds more sheets than the largest*

1

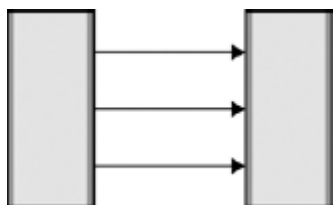
[5]

5.

(a) (i) field pattern shows:  
some straight lines in the gap

1

direction N to S



1

(ii) north poles repel

1

(so) box will not close

1

(b) (i) as paper increases (rapid) decrease in force needed

1

force levels off (after 50 sheets)

1

(ii) the newtonmeter will show the weight of the top magnet

1

(iii) (top) magnet and newtonmeter separate before magnets separate

*accept reverse argument*

1

(because) force between magnets is greater than force between magnet and  
hook of newtonmeter

1

(iv) any **three** from:

- means of reading value of force at instant the magnets are pulled apart
  - increase the pulling force gently
- or**
- use a mechanical device to apply the pulling force
  - clamp the bottom magnet
  - use smaller sheets of paper
  - fewer sheets of papers between readings (smaller intervals)
  - ensure magnets remain vertical
  - ensure ends of magnet completely overlap
  - repeat the procedure several times for each number of sheets and take a mean
  - make sure all sheets of paper are the same thickness

3

(v) 3 (mm)

*30 × 0.1 ecf gains 2 marks*

*2.1 N corresponds to 30 sheets gains 1 mark*

3

**[15]**

<b>6.</b>	(a) (i) increase	1
	(ii) A and B and B and C  <i>both required for the mark either order</i>	1
	(iii) any <b>two</b> from:	
	• size of nail <b>or</b> nail material <i>allow (same) nail</i>	
	• current <i>allow (same) cell allow p.d. same amount of electricity is insufficient</i>	
	• (size of) paper clip	
	• length of wire <i>accept type / thickness of wire</i>	2
	(b) 4	1
	B picks up the same number as C, so this electromagnet would pick up the same number as A <b>or</b> direction of current does not affect the strength of the electromagnet <i>allow it has got the same number of turns as A</i>	1
	(c) 2  <i>allow 1 or 3</i>	1
		<b>[7]</b>
<b>7.</b>	(i) relay  <i>accept solenoid do <b>not</b> accept magnetic switch</i>	1

- (ii) a current flows through the coil (of the electromagnet)  
**or** a current flows through the electromagnet  
**or** a (magnetic) field is produced  
*accept 'electricity' for 'current'*  
*accept the electromagnet is activated **or** magnetised **or** turned on*  
*do **not** accept answer in terms of magnetic charge* 1
- the (iron) arm is attracted to the electromagnet  
*accept the arm pivots **or** moves towards the electromagnet* 1
- the contacts are pushed together  
*do **not** accept contacts attract* 1

**[4]**