

Mark schemes

- 1** (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]**
- 2** (a) in a longitudinal wave the oscillations / vibrations are parallel to the direction of energy transfer.
- accept wave travel for energy transfer throughout* 1
- in a transverse wave the oscillations / vibrations are perpendicular to the direction of energy transfer. 1
- (b) accept any sensible suggestion eg a vibrating drum skin does not move the air away to create a vacuum (around the drum) 1

(c) **Level 3 (5–6 marks):**
 A detailed explanation linking variations in current to the pressure variations of a sound wave, with a logical sequence.

Level 2 (3–4 marks):
 A number of relevant points made, but not precisely. A link between the loudspeaker and a sound wave is made.

Level 1 (1–2 marks):
 Some relevant points but fragmented with no logical structure.

0 marks:
 No relevant content.

Indicative content

the current in the electrical circuit is varying

the current passes through the coil

the coil experiences a force (inwards or outwards)

reversing the current reverses the force

the size of the current affects the size of the force

the varying current causes the coil to vibrate

the (vibrating) coil causes the cone to vibrate

the vibrating cone causes the air molecules to move

the movement of the air molecules produces the pressure variations in the air needed for a sound wave

the air molecules bunch together forming compressions and spread apart forming rarefactions

6

[9]

3

(a) motor effect

1

(b) increase the strength of the magnet

or

increase the current

1

(c) $4.8 \times 10^{-4} = F \times 8 \times 10^{-2}$

1

$F = 6 \times 10^{-3} \text{ (N)}$

1

$$6 \times 10^{-3} = B \times 1.5 \times 5 \times 10^{-2}$$

1

$$B = \frac{6 \times 10^{-3}}{7.5 \times 10^{-2}}$$

1

$$B = 8 \times 10^{-2} \text{ or } 0.08$$

1

allow 8×10^{-2} or 0.08 with no working shown for 5 marks
a correct method with correct calculation using an incorrect value of F gains 3 marks

Tesla

accept T

1

do not accept t

[8]

4

(a) an electromagnet can be switched off

accept a permanent magnet cannot be switched off

or

an electromagnet is stronger

accept control the strength

1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a 'best-fit' approach to the marking.

Level 3 (5 – 6 marks):

there is a description of how the electromagnet is made

and

there is a description of how the strength of the electromagnet can be varied

and

there is a description of how the strength of the electromagnet can be tested

Level 2 (3 – 4 marks):

there is a description of how the electromagnet is made

and either

there is a description of how the strength of the electromagnet can be varied

or

there is a description of how the electromagnet can be tested

Level 1 (1 – 2 marks):

there is a basic description of how to make an electromagnet

or

there is a basic description of how the strength of the electromagnet can be varied

or

there is a basic description of how the electromagnet can be tested

Level 0 (0 marks):

No relevant / correct content

examples of the points made in the response

Details of how to make an electromagnet

- wrap the wire around the nail
- connect the wire to the power supply (with connecting leads and croc clips)
- switch on the power supply

accept a current should be sent along the wire

Details of how to vary the strength of the electromagnet

- change the number of turns (on the coil)
- change the current (through the coil)
- change the separation of the turns

allow change the potential difference (across the coil)

accept wrap the coil more tightly

Details of how to test the electromagnet

- suspend paperclips from the electromagnet
- the more paperclips suspended, the stronger the electromagnet is
- clamp the electromagnet at different distances from the paperclip(s)
- the further the distance from which paperclips can be attracted the stronger the electromagnet is
- test before and after making alterations to change the strength
- compare the results from before and after making alterations
- use de-magnetised paper clips

accept count the number of paperclips

*with different current **or** p.d. **or** no. of turns*

***or** core and see if the number changes/increases*

6

[7]

5

(a) induced

1

(b) any **two** from:

- use the same (strength) magnet

same size magnet is insufficient

- the speed that the magnet is moved

accept movement of the magnet

- the area of the turns

same type / length of wire is insufficient

- the magnetic pole being moved towards the coil (of wire).

use the same voltmeter is insufficient

2

- (c) (i) voltmeter misread
or
 number of turns miscounted
result misread is insufficient
human error is insufficient
allow the magnet was moved at a (slightly) different speed (into the coil) than for the other readings
allow spacing between the turns had changed 1
- (ii) line of best fit passing through all points except (100, 0.034)
line does not need to go back to origin 1
- (d) any **one** from:
- can re-check data / readings.
accept can go back to data
 - can take more readings (in a given time)
can store data is insufficient
 - easier to identify maximum value.
automatically records data is insufficient
accept is more accurate
accept eliminates human error 1

[6]

6

- (a) (i) field pattern shows:
 some straight lines in the gap
 direction N to S
-
- (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]

7	(a) (i) increase	1
	(ii) A and B and B and C <i>both required for the mark either order</i>	1
	(iii) any two from:	
	• size of nail or 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 or 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
		[7]

8	(a) plastic or rubber <i>accept any named plastic do not accept wood</i>	1
	it is a (good) insulator or it is a poor conductor <i>ignore mention of heat if in conjunction with electricity</i>	1

- (b) *The answer to this question requires ideas in good English in a sensible order with correct use of scientific terms. Quality of written communication should be considered in crediting points in the mark scheme.*
Maximum of 2 marks if ideas not well expressed.

pulls iron bolt down **or** attracts the iron bolt **or** moves bolt out of plunger

*answers in terms of charges attracting
 or repelling gain no credit*

1

plunger pushed / moved to the right (by spring) **or** plunger released

1

push switch opens / goes to off / goes to right

*accept circuit is broken
 for maximum credit the points must follow a logical sequence
 3 correct points but incorrect sequence scores 2 marks only
 ignore reset action*

1

[5]

9 (i) relay

*accept solenoid
 do **not** accept magnetic switch*

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]

10 (a) current flows

coil / core magnetised / electromagnet activated / energised / turned on
 attracts iron bar causing bolt to be pulled out

each for 1 mark

4

- (b) more turns
bigger current / e.m.f
softer iron core
any two for 1 mark each 2
- (c) to relock door / return iron bar / to lock door
for 1 mark 1
- (d) iron bar would still be attracted / coil still magnetised so still works
for 1 mark each
- yes + wrong answer
0 marks
- yes + current still flows
1 mark
- yes + still magnetised / iron bar still attracted
2 marks 2

[9]

- 11** electromagnet becomes stronger (*not* becomes magnetic) iron moves left – implied OK
plunger goes up push switch goes to off or circuit broken unless plunger moves down
for 1 mark each [4]

- 12** Quality of written communication: One mark for correct sequencing.
bolt out ® plunger up ® switch off / circuit broken 1

any **five** from

- high current flows
 - electromagnet is stronger
 - the iron bolt is pulled out
 - the plastic plunger moves up
 - the switch is lifted / open / off
accept circuit is broken
 - no current flowing
 - to re-set the plunger must be pushed down
- 5

[6]