Magnetism

Mark Scheme

Name: _____

Class: _____

Date: _____

Time: **103 minutes**

Marks: **99 marks**

Comments:

1

(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]

2

(a) The movement of liquid iron in the Earth's outer core

1

(b) will attract

1

will repel

1

(c) **Level 2 (3–4 marks):**
A detailed explanation is provided that includes a coherent comparison of the properties of the types of magnet and presents a clear argument to support the use of electromagnets. Logical links are made between relevant points and use in a scrapyard

Level 1 (1–2 marks):
Relevant points made about the properties of the magnets. An attempt at comparison may be made, but logic is unclear and unstructured and links to use in scrapyard may not be present

0 marks:
No relevant content.

Allow steel or iron for car body throughout

Indicative content

- an electromagnet can be switched on and off
- so it can be used to lift a car body
- and release a car body
- so it can easily be used to move car bodies from one place to another in the scrapyard
- a permanent magnet cannot be switched off to release a car body
- so would not be as useful in the scrapyard
- the strength of the magnetic field of an electromagnet can be varied
- so an electromagnet can lift different masses
- so can deal with different vehicles
- but the strength of the magnetic field of a permanent magnet cannot be varied or is fixed
- so a permanent magnet can only lift up to a certain mass

4

[7]

3 (a) (i) increase

1

(ii) A and B
and
B and C

both required for the mark

either order

1

(iii) any **two** from:

- size of nail
  or
  nail material

  allow (same) nail
- current

  allow (same) cell

  allow p.d.

  same amount of electricity is insufficient
- (size of) paper clip
- length of wire

  accept type / thickness of wire

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

allow it has got the same number of turns as A

1

(c) 2

allow 1 or 3

1

[7]

4 (a) S – top, N – bottom

1

(b) touch / attracted to magnet **A**

1

(c) the magnetic needles point to the north pole

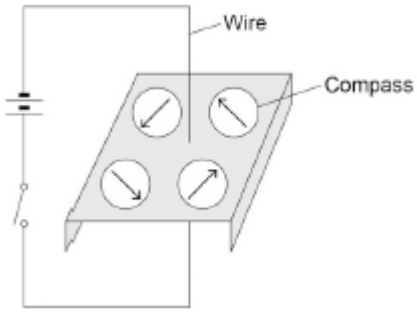
1

because The Earth has a magnetic field

1

*accept the needles align to the Earth's magnetic field for **2** marks*

(d)



1

(e) point in the opposite direction

change direction is insufficient

1

(f) uniform field lines through the wire coil.

1

field lines curving round the top and bottom of the wire coil.

1

arrows indicating direction from N to S

*do **not** accept conflicting arrows*

1

[9]

5

(a) correct plotting of all points

*allow **1** mark for three or four correctly plotted points*
allow ± ½ a square

2

line of best fit

1

(b) as (number of) turns increases, number of paperclips increases

allow positive correlation

1

(c) no paperclips would be picked up

1

(electro)magnet would not have been strong enough
or
magnetic field would not have been strong enough

1

(d) take repeat readings (1)

to allow a mean to be calculated (1)

allow to identify / exclude anomalies
allow to reduce the effect of random errors
allow to assess the repeatability of the data

or

extend range of data (1)

to see if pattern continues (1)

allow to identify / exclude anomalies

or

use smaller intervals for number of turns (1)

to be able to see the pattern in the data more clearly (1)

allow to identify / exclude anomalies

or

use smaller paperclips (1)

to be able to detect smaller changes in strength of magnetic field
or so fewer turns required to pick up one paperclip (1)

or

increase strength of electromagnet (1)

allow increase current

so fewer turns required to pick up one paperclip (1)

Max 2 marks

(e) the distance from the electromagnet

1

the size of the current through the wire

1

[10]

6 (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]

7 (a) 1st box ticked

1

(b) (permanent magnet) has no effect on the aluminium

1

iron is attracted (to the permanent magnet)

1

(only) the (permanent) magnet can be repelled (by the permanent magnet)

1

(c) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to give a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logically linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

- completing the circuit
- turns the electromagnet on

- there is a current in the coil
- a magnetic field is produced around the coil
- the iron core becomes magnetised

- move electromagnet towards the blocks
- the block is attracted to the electromagnet
- moving the crane moves the block

- switching off the current switches off the electromagnet
- releasing the block

[10]

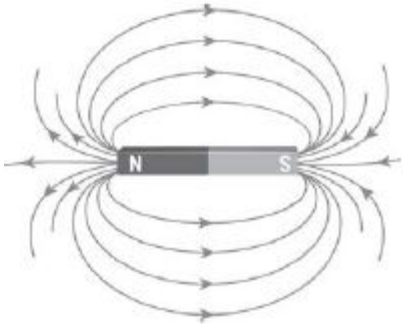
8 (a) continuous field lines that start and finish on the poles

1

direction of arrow from North to South

1

the diagram:



*scores **2** marks*

(b) **Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

- place the magnet on a piece of paper
- draw around the magnet
- mark north and south poles
- place the compass by a pole of the magnet
- make a dot at the tip of the compass needle
- move the compass tail to the new dot
- make a dot at the tip
- repeat until the compass reaches the other pole of the magnet
- draw a line through the dots
- add arrow to show direction of field line (from north to south)
- repeat for different starting positions at the poles

(c) compass needle is a (small bar) magnet

1

(so) the compass / needle and bar magnet exert a force on each other

1

or

(so) the compass / needle is attracted / repelled by the bar magnet

(d) cobalt

1

(e) (magnetic north / south) poles are changing position

allow reference to compass needle changing direction (over time)

1

direction of magnetic field has reversed

allow magnetic patterns in rocks (at constructive plate boundaries)

allow changing migration patterns of birds / animals

1

(f) (molten) iron moving

1

in (Earth's outer) core

1

[13]

9 (a) $Fe_2O_3 + 3\,CO \rightarrow 2Fe + 3\,CO_2$

correct formulae of reactants

1

correct formulae of products

1

correct balancing

1

(b) iron loses oxygen – reduction

1

carbon gains oxygen – oxidation

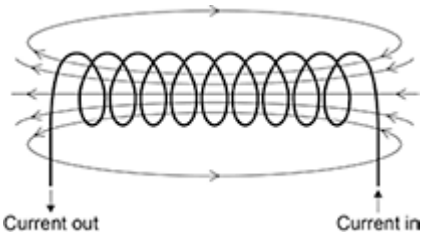
1

(c) any **four** from:

- resources for manufacture are limited
- recycling reduces the use of resources
- reduces energy consumption in extraction / manufacture
- reduces waste from processing and extraction
- reduces environmental impact of extraction

4

(d)



field lines going through and around coil

1

correct directional arrows

1

(e) any **two** from:

***1** mark for suggestion, **1** mark for correctly linked explanation*

- use many coils **or** tight coils **or** long wire (1)
- to give a strong magnetic field for lifting heavy objects (1)

explanation must be correctly linked to the suggestion to gain the mark

or

- add an iron core
- to increase field circuit for lifting

or

- include a switch in circuit
- so can drop / pick up cars

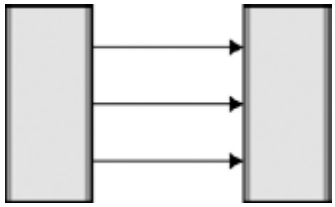
max. 4

[15]

10 (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]