Exampro GCSE Physics

Name:

P3 Foundation - Transformers and Fields Self Study Questions

Class:

Author:

Date:

Time: 91

Marks: 91

Comments:

Q1. (a) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

There are two types of traditional transformer; step-up and step-down.

Describe the similarities and differences between a step-up transformer and a step-down transformer.

You should include details of:

- construction, including materials used
- the effect the transformer has on the input potential difference (p.d.).

You should **not** draw a diagram.

....

....

....

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....

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Extra space ....

....

....

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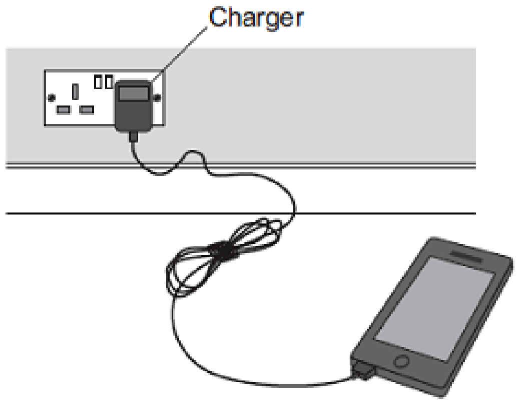
....

....

(6)

(b) The figure below shows a mobile phone and charger.



Mobile phone chargers use a different type of transformer, which is smaller and lighter than a traditional transformer.

What name is given to the type of transformer used in a mobile phone charger?

....

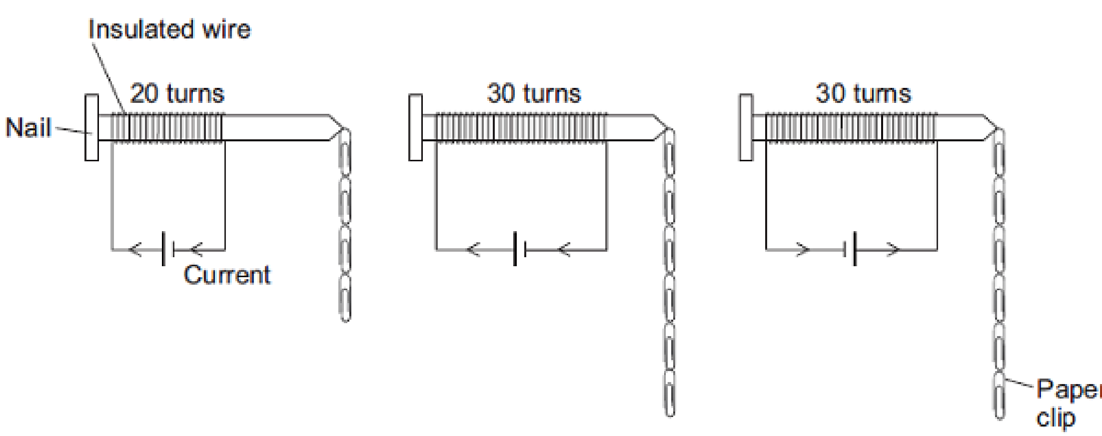
(1)
(Total 7 marks)

Q2. A student is investigating the strength of electromagnets.

Figure 1 shows three electromagnets.

The student hung a line of paper clips from each electromagnet.

Figure 1



Electromagnet **A** Electromagnet **B** Electromagnet **C**

No more paper clips can be hung from the bottom of each line of paper clips.

(a) (i) Complete the conclusion that the student should make from this investigation.

Increasing the number of turns of wire wrapped around the nail will ....

the strength of the electromagnet.

(1)

(ii) Which **two** pairs of electromagnets should be compared to make this conclusion?

Pair 1: Electromagnets .... and ....

Pair 2: Electromagnets .... and ....

(1)

(iii) Suggest **two** variables that the student should control in this investigation.

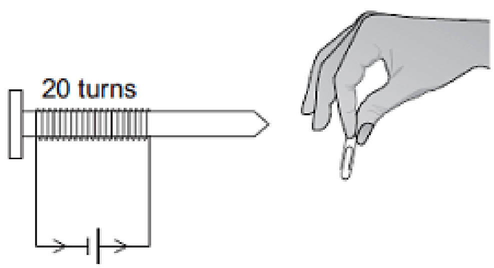
1 ....

2 ....

(2)

(b) The cell in electromagnet **A** is swapped around to make the current flow in the opposite direction. This is shown in **Figure 2**.

Figure 2



What is the maximum number of paper clips that can now be hung in a line from this electromagnet?

Draw a ring around the correct answer.

fewer than 4 **4** **more than 4**

Give **one** reason for your answer.

....

....

....

(2)

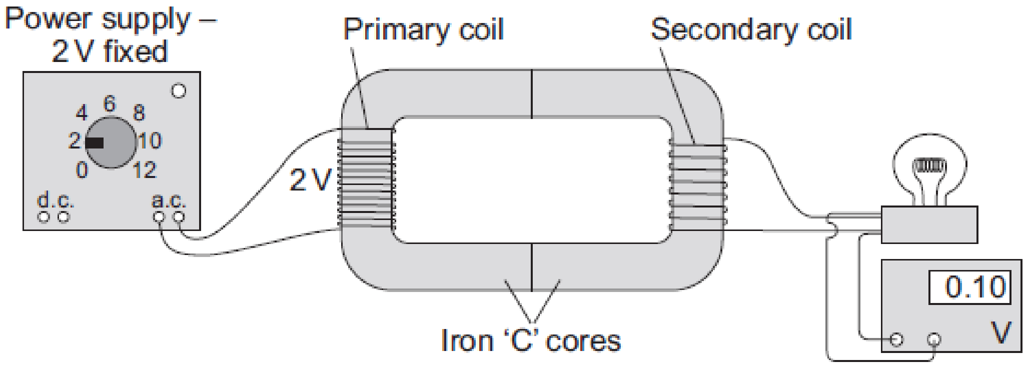
(c) Electromagnet **A** is changed to have only 10 turns of wire wrapped around the nail.

Suggest the maximum number of paper clips that could be hung in a line from the end of this electromagnet.

Maximum number of paper clips = ...

(1)
(Total 7 marks)

Q3. The diagram shows the apparatus used by a student to investigate a transformer.



(a) The transformer made by the student would not have worked if the core had been made from aluminium and not iron.

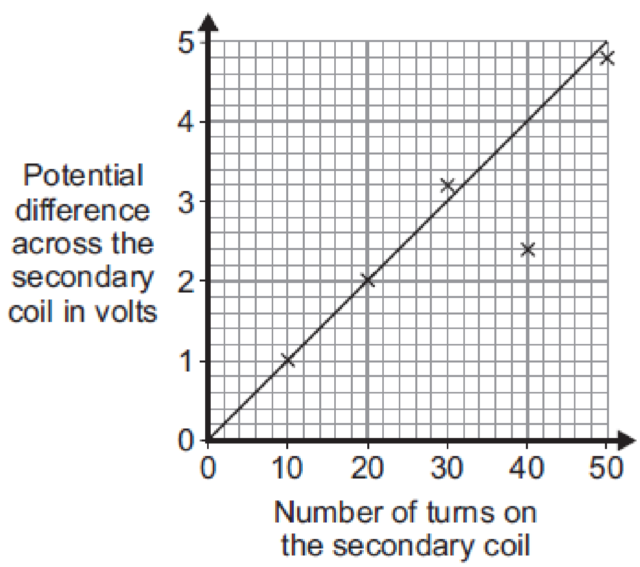
Why?

....

....

(1)

(b) The student made changes to the number of turns used to make the secondary coil. He then measured the potential difference across the secondary coil after each change. The graph shows the student's results.



(i) What range of values was used for the number of turns on the secondary coil?

From .... to ....

(1)

(ii) When he drew the line of best fit, the student ignored one of the data points.

Why?

....

....

(1)

(iii) What is the minimum number of turns needed on the secondary coil for the transformer to act as a step-up transformer?

....

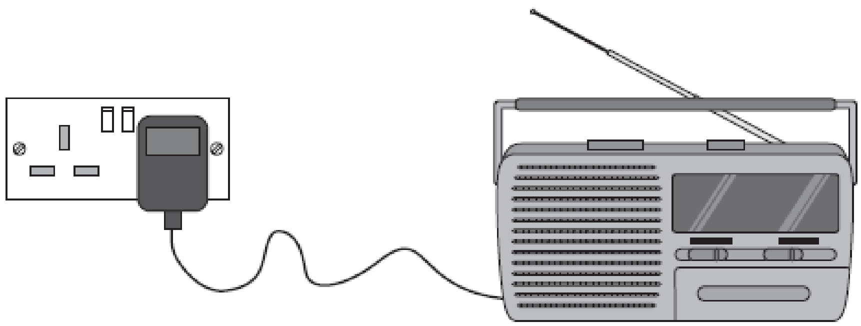
Give a reason for your answer.

....

....

(2)

(c) A radio can be used with a 9 V battery or it can be plugged into the 230 V mains electricity supply using an adapter. The mains adapter contains a transformer.



Why must the mains adapter contain a transformer?

....

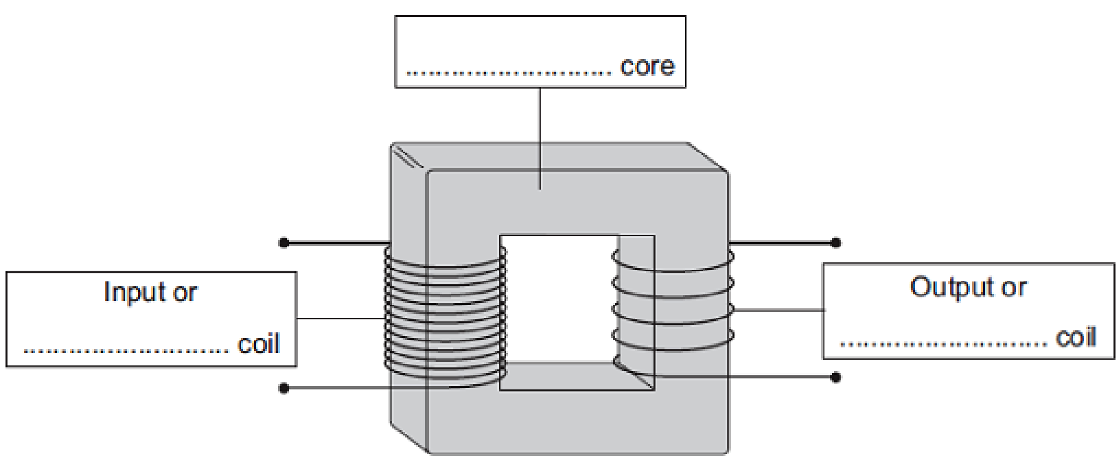
....

(1)
(Total 6 marks)

Q4. (a) The diagram shows the structure of a traditional transformer.

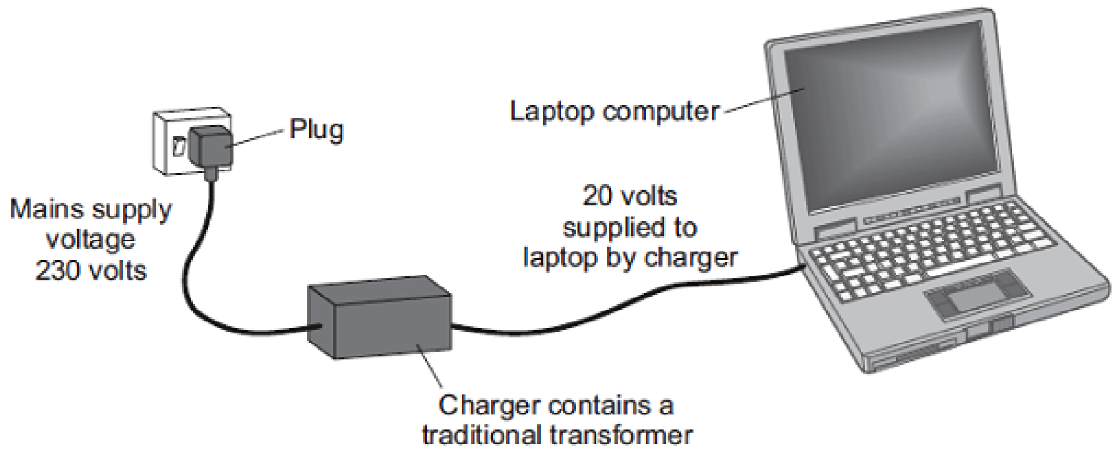
Use words from the box to label the diagram.

aluminium	brass	iron	large	primary	secondary



(3)

(b) Batteries inside laptop computers are charged using laptop chargers. The laptop charger contains a traditional transformer.



The laptop charger contains a step-down transformer.

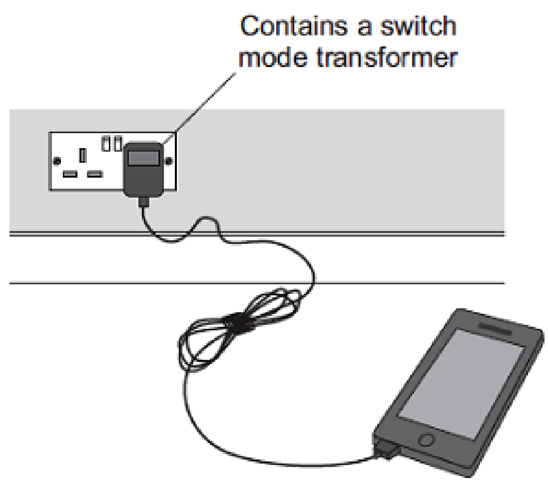
What does a step-down transformer do?

....

....

(1)

(c) The transformer used in a modern mobile phone charger is a switch mode transformer. This is different to the traditional transformer used in the laptop charger.



Give **one** advantage of using a switch mode transformer, rather than a traditional transformer.

....

....

(1)

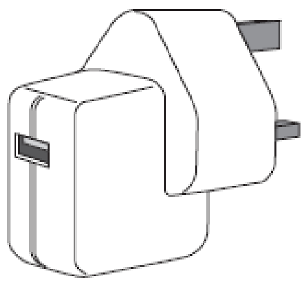
(d) Laptop batteries and mobile phone batteries can only be recharged a limited number of times. When a battery cannot be recharged, it is better to recycle the battery than to throw it away.

Draw a ring around the correct answer to complete the sentence.

(iii) The batteries are recycled mainly due to [an environmental / a political / a social] consideration.

(1)
(Total 6 marks)

Q5. The diagram shows a USB power adapter which plugs into a 230 V a.c. mains socket.



The adapter contains a small step-down transformer.

(a) The core of the transformer is made of laminated soft iron.

Why is iron used?

....

....

(1)

(b) The coils of the transformers are made of insulated copper wire.

Why is the wire insulated?

....

....

(1)

(c) There are 500 turns on one coil of the transformer and 20 000 turns on the other coil.

Use the equation in the box to calculate the p.d. across the secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer and give the unit.

....

....

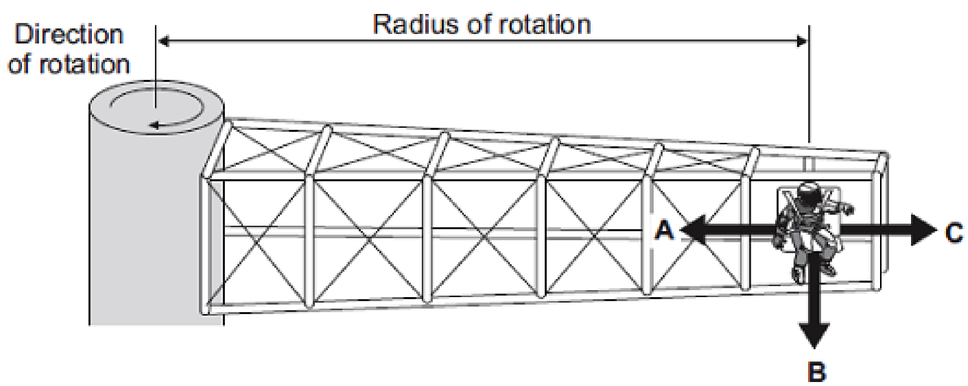
....

p.d. across the secondary = ...

(3)

(Total 5 marks)

Q6. The diagram shows a 'G-machine'. The G-machine is used in astronaut training.



The G-machine moves the astronaut in a horizontal circle.

(a) In which direction, **A**, **B** or **C**, does the centripetal force on the astronaut act?

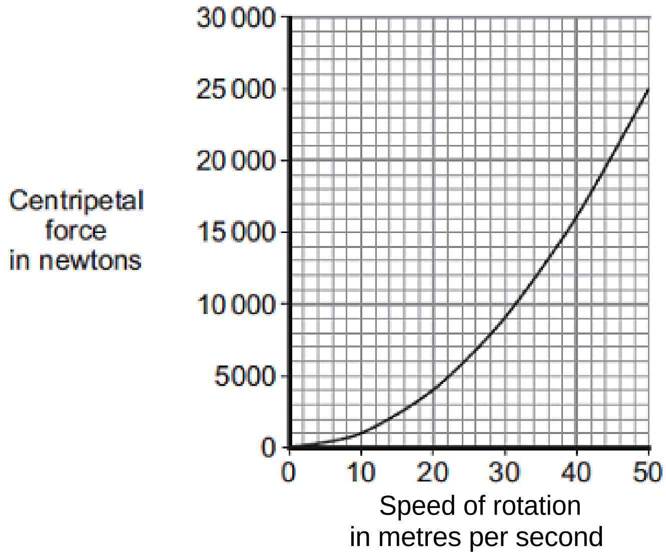
Write your answer in the box. ☐

(1)

(b) The centripetal force on the astronaut is measured.

Graph X shows how the centripetal force is affected by the speed of rotation.
The radius of rotation is kept the same.

Graph X



(i) Use **Graph X** to determine the centripetal force on the astronaut when rotating at a speed of 30 metres per second.

Centripetal force = ... newtons

(1)

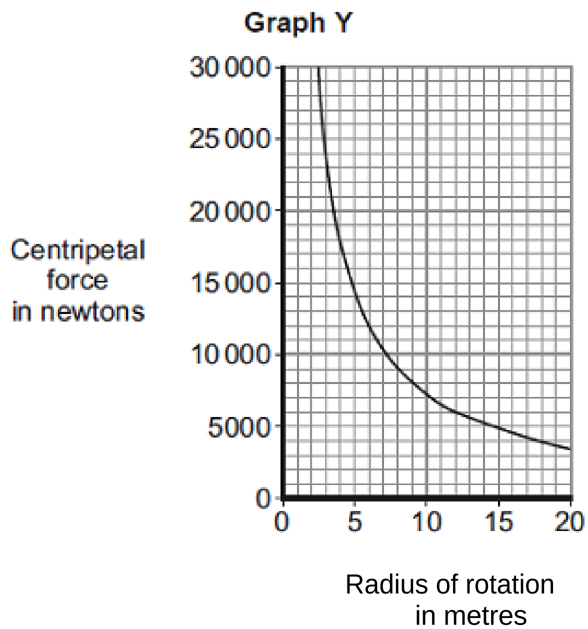
(ii) Complete the following sentence to give the conclusion that can be made from **Graph X**.

Increasing the speed of rotation of a G-machine will ....

the centripetal force on the astronaut.

(1)

(iii) **Graph Y** shows how the centripetal force is affected by the radius of rotation, when the speed of rotation is kept the same.



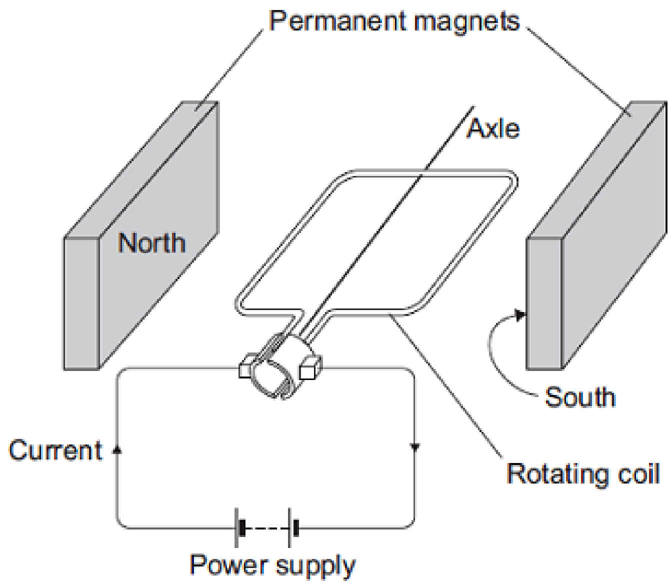
Complete the following sentence to give the conclusion that can be made from **Graph Y**.

The greater the radius of rotation, the .... the centripetal force

on the astronaut.

(1)

(c) The G-machine is rotated by an electric motor. The diagram shows a simple electric motor.



The following statements explain how the motor creates a turning force. The statements are in the wrong order.

M – The magnetic field interacts with the magnetic field of the permanent magnets.

N – A magnetic field is created around the coil.

O – The power supply applies a potential difference across the coil.

P – This creates a force that makes the coil spin.

Q – A current flows through the coil.

Arrange the statements in the correct order. Two of them have been done for you.

O →	→	→	→	**P**

(2)

(d) The electric motor produces a turning force.

Give **two** ways of increasing the turning force.

1 ....

....

2 ....

....

(2)

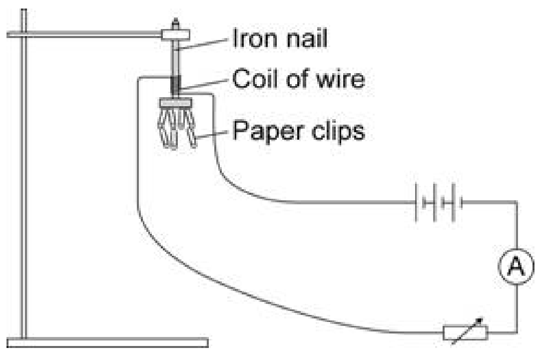
(e) Draw a ring around the correct answer to complete the sentence.

It costs a lot of money to send astronauts into space.

	an economic	
This is	an environmental	issue.
	a social	

(1)
(Total 9 marks)

Q7. The diagram shows the equipment used by a student to investigate the strength of five different electromagnets.



The stronger the electromagnet, the more paper clips it will hold.

(a) Why is it important that the paper clips used in the investigation are all the same size?

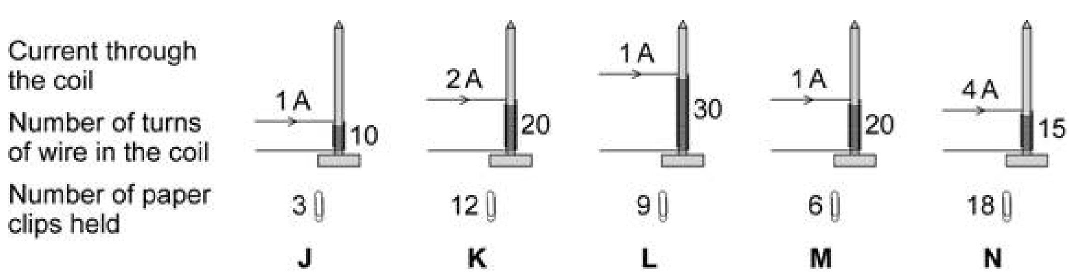
....

....

....

(1)

(b) The five electromagnets, **J**, **K**, **L**, **M** and **N**, used by the student are shown below.
Each electromagnet was made by wrapping lengths of insulated wire around identical iron nails.



The student wants to find out how the strength of an electromagnet depends on the number of turns of wire in the coil.

Which electromagnets should the student compare in order to do this?

....

(1)

(c) The student concluded:

"The strength of an electromagnet is always directly proportional to the number of turns on the coil."

(i) Explain how the data from the investigation supports the student's conclusion.

....

....

....

....

....

(2)

(ii) The student makes one more electromagnet by winding 100 turns onto a nail.

Before testing the electromagnet, the student predicted the number of paper clips that the electromagnet would hold when the current is 1 amp.

How many paper clips should the student predict that the electromagnet would hold?

Show clearly how you work out your answer.

....

....

....

number of paper clips = ...

(2)

(iii) When the student tested the electromagnet it held 20 paper clips.
This is not what the student predicted.

Explain what the student should do when new data does not seem to support the prediction that was made.

....

....

....

....

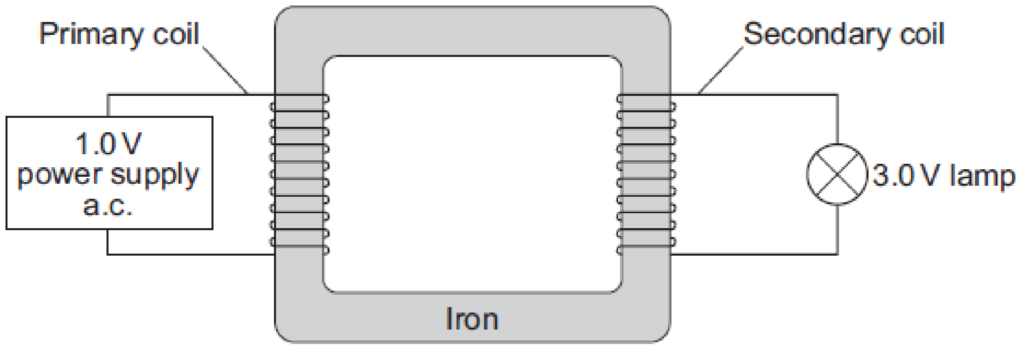
....

....

....

(3)
(Total 9 marks)

Q8. (a) The diagram shows a simple transformer made by a student. The student has designed the transformer to light a 3.0 V lamp using a 1.0 V power supply.



(i) What name is given to the part of the transformer that is made of iron?

Draw a ring around your answer.

centre **connector** **core**

(1)

(ii) When the power supply is switched on, the lamp is not very bright.

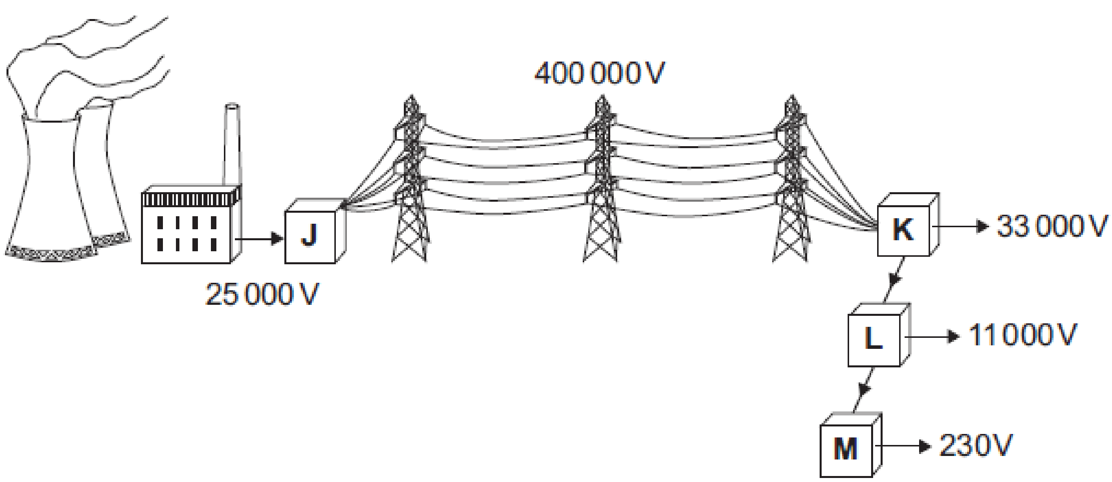
Suggest **one** change that the student can make to increase the brightness of the lamp.
The 1.0 V power supply cannot be changed.

....

....

(1)

(b) The diagram shows part of the National Grid system. The transformers, **J**, **K**, **L** and **M**, are an essential part of the system.



(i) Which transformer, **J**, **K**, **L** or **M**, is a step-up transformer?

Write your answer in the box.

(1)

(ii) Some scientists claim to have found evidence to suggest that children living near to overhead power lines are more likely to develop leukaemia. However, the scientists are not sure that the power lines are the cause of the problem.

The evidence from this and other investigations may worry some people.

What do you think scientists should do?

Put a tick (✓) in the box next to your answer.

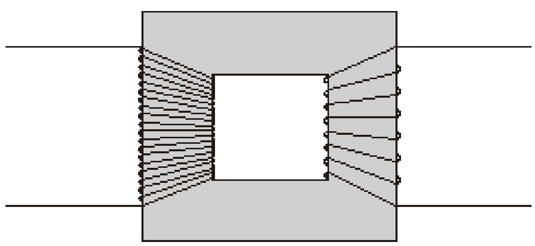
Scientists should always publish the evidence from investigations immediately. ☐

Scientists should ignore any evidence from investigations that may worry people. ☐

Scientists should publish the evidence from an investigation only when they have found out as many facts as possible. ☐

(1)
(Total 4 marks)

Q9. (a) The basic structure of a transformer is a primary coil of insulated wire, an iron core and a secondary coil of insulated wire.



(i) Why is the core made of iron?

....

....

(1)

(ii) Explain how a transformer works.

....

....

....

....

....

....

....

....

(4)

(b) A small step-down transformer is used in the charger for an electric screwdriver.

The input to the transformer is 230 V a.c. mains supply and the output is 5.75 V a.c. There are 3200 turns on the primary coil.

Use the equation in the box to calculate the number of turns on the transformer's secondary coil.

$$\frac{\text{p.d. across primary}}{\text{p.d. across secondary}} = \frac{\text{number of turns on primary}}{\text{number of turns on secondary}}$$

Show clearly how you work out your answer.

....

....

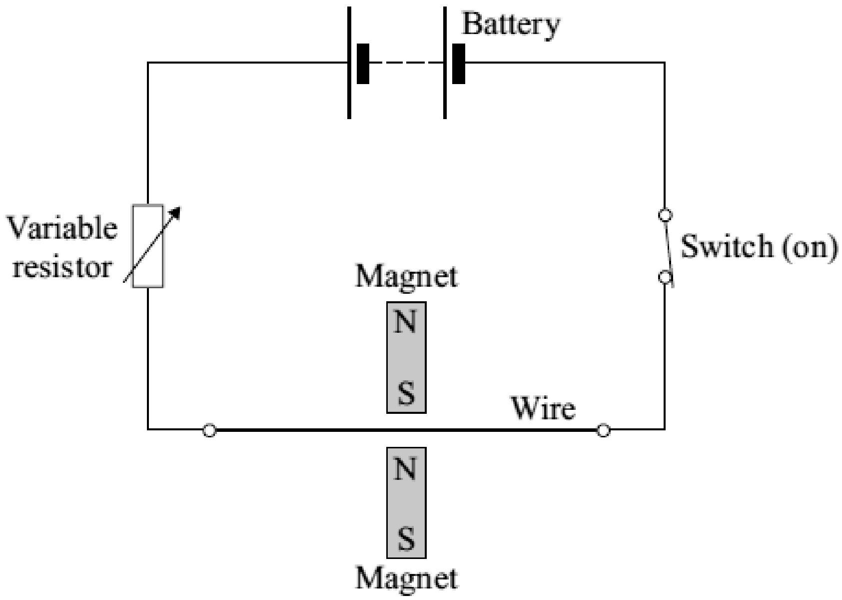
Number of turns = ...

(2)
(Total 7 marks)

Q10. A student investigates the electromagnetic force acting on a wire which carries an electric current. The wire is in a magnetic field.

The diagram shows the circuit which the student uses.

(a) Draw an **X** on the diagram, with the centre of the **X** in the most strongest part of the magnetic field.



(1)

(b) Give **one** change that she can make to the magnets to **decrease** the electromagnetic force on the wire.

....

....

(1)

(c) The student wants to change the electromagnetic force on the wire without changing the magnets or moving their position.

(i) Give **one** way in which she can **increase** the electromagnetic force.

....

....

(1)

(ii) Give **one** way in which she can **reverse** the direction of the electromagnetic force.

....

....

(1)
(Total 4 marks)

Q11. (a) Name a material that could be used to make the outside case of the plug.

....

Give a reason for your choice.

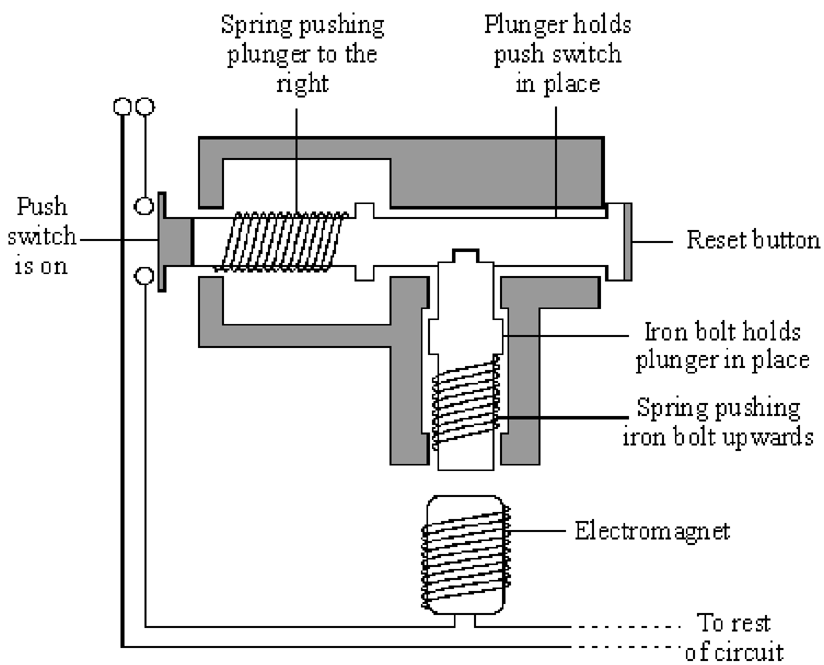
....

....

(2)

(b) *To gain full marks in this question you should write your ideas in good English. Put them into a sensible order and use the correct scientific words.*

Some electrical circuits are protected by a circuit breaker. These switch the circuit off if a fault causes a larger than normal current to flow. The diagram shows one type of circuit breaker. A normal current (15 A) is flowing.



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Explain what happens when a current larger than 15A flows. The answer has been started for you.

When the current goes above 15 A, the electromagnet becomes stronger and

....

....

....

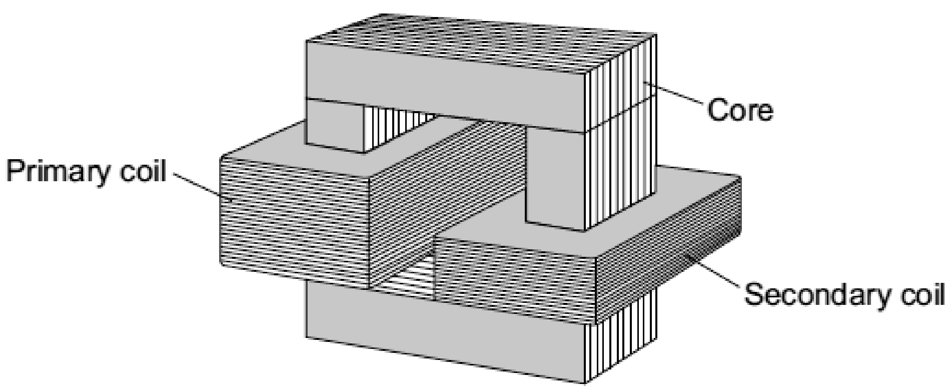
....

....

....

(3)
(Total 5 marks)

Q12. A teacher demonstrates a small transformer.



(a) (i) What is the core made of?

Draw a ring around the correct word in the box.

aluminium	**copper**	**iron**

(1)

(ii) The potential difference (p.d.) across the secondary coil is less than the p.d. across the primary coil.

What sort of transformer is it?

....

(1)

(b) Where is a step-up transformer used as part of the National Grid?

....

(1)

(c) The teacher writes a note about the transformer but leaves **five** spaces.

Use the correct words from the box to complete the spaces.

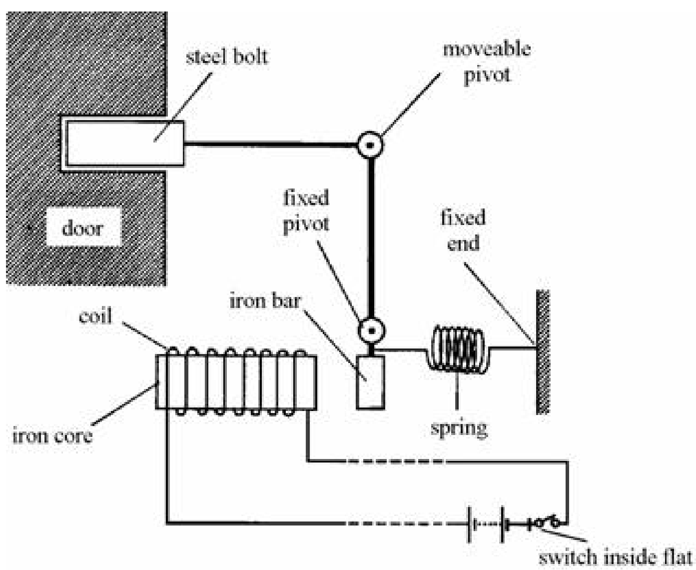
coil	**core**	**current**	**ends**	**field**	**wire**

A transformer works because an alternating .... in the primary .... produces a changing magnetic .... in the .... and then in the secondary coil.

This induces an alternating potential difference across the ....
of the secondary coil.

(5)
(Total 8 marks)

Q13. The diagram below shows a door lock which can be opened from a flat inside a building.



(a) Explain how the door is unlocked when the switch is closed.

....

....

....

....

(4)

(b) State **two** changes which would increase the strength of the electromagnet.

1 ....

2 ....

(2)

(c) Why is the spring needed in the lock?

....

....

(1)

(d) The connections to the coil were accidentally reversed. Would the lock still work?

....

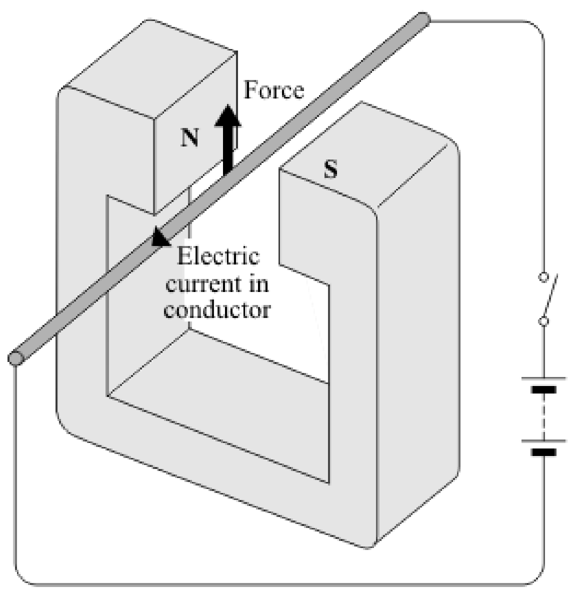
Explain your answer.

....

....

(2)
(Total 9 marks)

Q14. When a conductor carrying an electric current is placed in a magnetic field a force may act on it.



(a) State **two** ways in which this force can be increased.

1 ....

2 ....

(2)

(b) State **two** ways in which this force can be made to act in the opposite direction.

1 ....

2 ....

(2)

(c) In what circumstance will **no** force act on a conductor carrying an electric current and in a magnetic field?

....

....

(1)
(Total 5 marks)

Show clearly how you work out your answer.

....

....

Kinetic energy = ... J

(2)
(Total 7 marks)

M1. (a) 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 also apply a 'best-fit' approach to the marking.

0 marks
No relevant / correct content.

Level 1 (1–2 marks)
Either there is an attempt at a description of the construction of a transformer

or

a correct statement of the effect of one type of transformer on the input p.d.

Level 2 (3–4 marks)
There is a description of the construction of a transformer
and
a correct statement of the effect of one type of transformer on the input p.d.

Level 3 (5–6 marks)
There is a clear description of the construction of a transformer
and
there is a correct description of how transformers affect the input p.d.

details of construction:

extra information

a (laminated) core

core is made from a magnetic material / iron

2 coils

the coils are made from an electrical conductor / copper

the coils are covered in plastic / insulation

the coils are (usually) on opposite sides

step-up transformer has more turns on secondary coil than (its) primary (or vice versa)

step-down transformer has fewer turns on secondary coil than (its) primary (or vice versa)

effect on input p.d. :

step-up transformer, the output p.d. is greater (than the input p.d.)

accept voltage for p.d.

step-down transformer, the output p.d. is lower (than the input p.d.)

6

(b) switch mode (transformer)

1

[7]

M2. (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]

M3. (a) aluminium cannot be magnetised

accept aluminium is not magnetic

"it" refers to aluminium

*do **not** accept aluminium is not easily magnetised*

reference to conduction and aluminium negates mark

iron can be magnetised is insufficient

1

(b) (i) 10 to 50

either order

1

(ii) (data is) anomalous

*accept does **not** fit the pattern*

it is an error is insufficient

1

(iii) 21

accept 22

*do **not** accept any fraction of a turn ie 20.1*

1

secondary p.d. (just) larger than primary p.d.

accept output (just) larger than input/2V

or

there must be more turns on the secondary coil than primary coil

*do **not** accept coil for turns*

1

(c) to reduce/step-down the (input) p.d./voltage

mains p.d. is too high is insufficient

step-down transformer is insufficient

*answers in terms of changing/ stepping-up current **or** fuse blowing **or** not working with 230 volts are insufficient*

any mention of step-up negates mark

*stepping down both voltage/p.d. **and** current negates mark*

1

[6]

M4. (a) iron

correct positions only

1

primary

1

secondary

1

(b) (it) decreases the p.d.

accept it would increase current

accept voltage for p.d.

the voltage goes from 230(V) to 20(V) is insufficient

*do **not** accept decreases current / energy / power*

*do **not** accept decreases p.d. / voltage and current*

1

(c) any **one** from:

- lighter

  accept it is easier to carry around

- smaller

- use (very) little power / current / energy when switched on and no load / phone not connected

  accept no power / current / energy is drawn

  *do **not** accept electricity for power / current / energy*

- more efficient

  *accept does not get as hot **or** less heat produced*

1

(d) an environmental

1

[6]

M5. (a) (it is) magnetic

__or__ will carry (an alternating) magnetic field

__or__ magnetises and demagnetises (easily)

reference to conduction negates the mark

1

(b) so the current / electricity does not flow through the iron / core

accept 'so the current / electricity / wires do not short (circuit)'

responses in terms of heat insulation negate the mark

ignore references to safety

1

(c) 5.75 or 5.8 or 6(.0)

*allow for **1** mark **either***

$$\frac{230}{p.d.} = \frac{20\,000}{500}$$

or

p.d. = 230 ÷ 40

2

V / volt(s)

1

[5]

M6. (a) A

1

(b) (i) 9000

*an answer of 9 k(N) gains **1** mark*

1

(ii) increase

accept other comparative terms, eg give a bigger

affect / change is insufficient

1

(iii) small<u>er</u>

accept other comparative terms, eg less

1

(c) Q N M

all three in correct boxes

*one statement in correct box gains **1** mark*

2

(d) any **two** from:

- increase the current / p.d. (supplied to the coil)

  *accept reduce the resistance of the coil **or** increase cross sectional area of wire*

  *accept more cells / batteries **or** turn up the power supply*

  increase power is insufficient

- increase number of turns (on the coil)

- increase the area (of the coil)

  accept increase the width of the coil

  increase width / size is insufficient

- increase the (strength of the permanent) magnetic field

  accept move the magnets closer to the coil

  accept use stronger magnets

  *do **not** accept use larger magnets*

2

(e) an economic

1

[9]

M7. (a) so the results can be compared fairly

fair test is insufficient

1

(b) **J L M**

all 3 required and no other

1

(c) (i) for a given current the number of paper clips increases by the same factor as the number of turns

1

plus a mathematical explanation using the data eg a current of 1 A with 10 turns picks up 3 clips, a current of 1 A with 20 turns picks up 6 clips

1

(ii) 30

*allow **1** mark for showing correct use of figures eg*
20 turns × 5 = 100 turns

2

(iii) check the new data / repeat the experiment

1

to identify any anomalous results

1

then reconsider prediction / hypothesis in the light of new evidence

1

[9]

M8. (a) (i) core

1

(ii) increase number of turns on <u>secondary</u> (coil)

*do **not** accept coils for turns*

or

reduce number of turns on <u>primary</u> (coil)

1

(b) (i) **J**

1

(ii) Scientists should publish the evidence from an investigation only when they have found out as many facts as possible

1

[4]

M9. (a) (i) (quickly) becomes magnetized

***or** (quickly) loses its magnetism*
***or** 'it's (a) magnetic (material)'*
any reference to conduction of electricity/heat nullifies the mark

1

(ii) any **four** from:

- insulation prevents electricity/current flowing through the iron/core
  or *'insulation so electricity/current only flows in the wires/turns/coils'*
- <u>alternating</u> current/a.c. in the primary (coil)
- produces a <u>changing</u> magnetic field (in the iron/core)
- (and hence magnetic) field in the secondary (coil)
- induces/generates/produces an <u>alternating</u> potential difference/p.d./voltage across the secondary (coil)
- (and hence) <u>alternating</u> current/a.c. in the secondary (coil)

4

(b) 80 (turns)

or *credit (1) for any equation which <u>if correctly evaluated</u> would give 80 example*

example

$$\frac{230}{5.75} = \frac{3200}{number of\ turns}$$

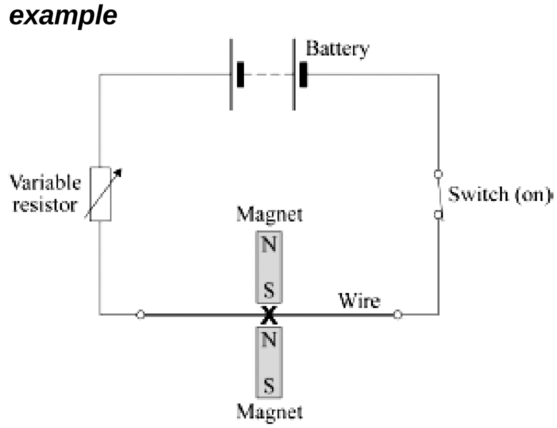
2

[7]

M10. (a) centre of the **X** midway between the poles

intention correct as judged by eye

example



1

(b) move the poles further apart

accept turn for move

accept ends / magnets for poles

accept use weaker magnets

*do **not** accept use smaller magnets*

1

(c) (i) add more cells (to the battery)

*do **not** accept 'use a bigger battery'*

accept increase the potential difference / voltage

accept increase the current

or

reduce the resistance (of the variable resistor)

*do **not** accept any changes to the magnets, to the wire or to their relative positions*

1

(ii) reverse (the polarity of) the battery

accept turn the battery / cells round

accept swap the connections to the battery

*do **not** accept any changes to the magnets, to the wire or to their relative positions*

1

[4]

M11. (a) plastic or rubber

accept any named plastic
*do **not** accept wood*

1

it is a (good) insulator **or** it is a poor conductor

ignore mention of heat if in conjunction with electricity

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]

M12. (a) (i) iron

1

(ii) step-down (transformer)

1

(b) any **one** from:

- after the power station
- after the generator
- before the power lines
- before the pylons

1

(c) each correct (1)

in its correct place

current

coil

field

core

ends

5

[8]

M13. (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]

M14. (a) increase the current (1)

credit increase the p.d./voltage
credit reduce the resistance
credit have thicker wiring
credit add extra / more cells

1

increase the magnetic field (strength) (1)

credit 'have stronger magnet(s)
*do **not** credit 'bigger magnets' either order*

1

(b) **either** reverse polarity

or connect the battery the other way round

1

either reverse direction of the magnetic field

or put the magnet the other way round / reverse the magnet

*do **not** give any credit to a response in which both are done at the same time*

either order

1

(c) **either**

conductor parallel to the magnetic field

or lines of magnetic force and path of electricity do not cross

1

[5]