Name: _____

Class: _____

Date: _____

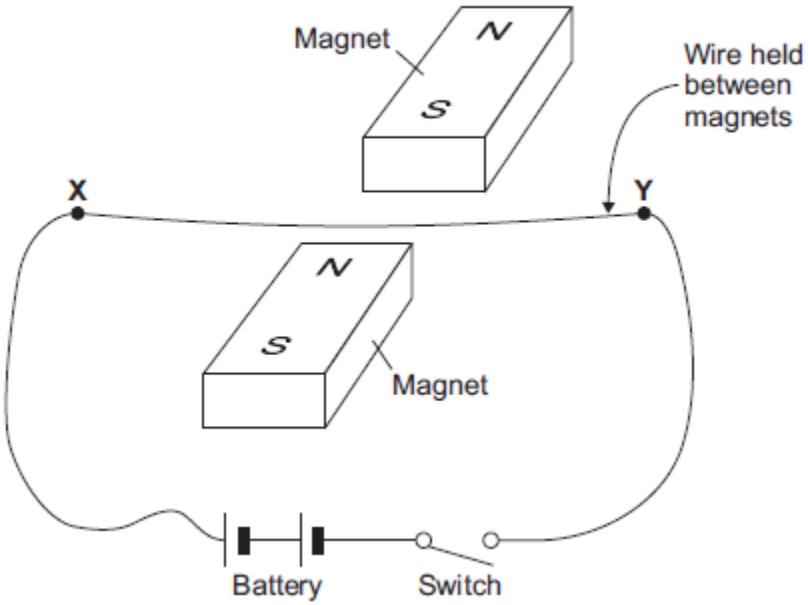
Magnetism part 5 AQA Triple Physics

Time: **87 minutes**

Marks: **87 marks**

Comments:

1. The diagram shows apparatus set up by a student.



Closing the switch creates a force that acts on the wire **XY**.

(a) (i) Explain why a force acts on the wire **XY** when the switch is closed.

_____

_____

_____

_____

_____

_____

(3)

(ii) The force causes the wire **XY** to move.
Draw an arrow on the diagram above to show the direction in which the wire **XY** will move.

(1)

(iii) State the effect that this experiment demonstrates.

_____

(1)

(b) The student replaced the battery with a low frequency alternating current (a.c.) power supply.

The student closed the switch.

(i) Describe the movement of the wire.

_____

(1)

(ii) Give a reason for your answer to part (i).

_____

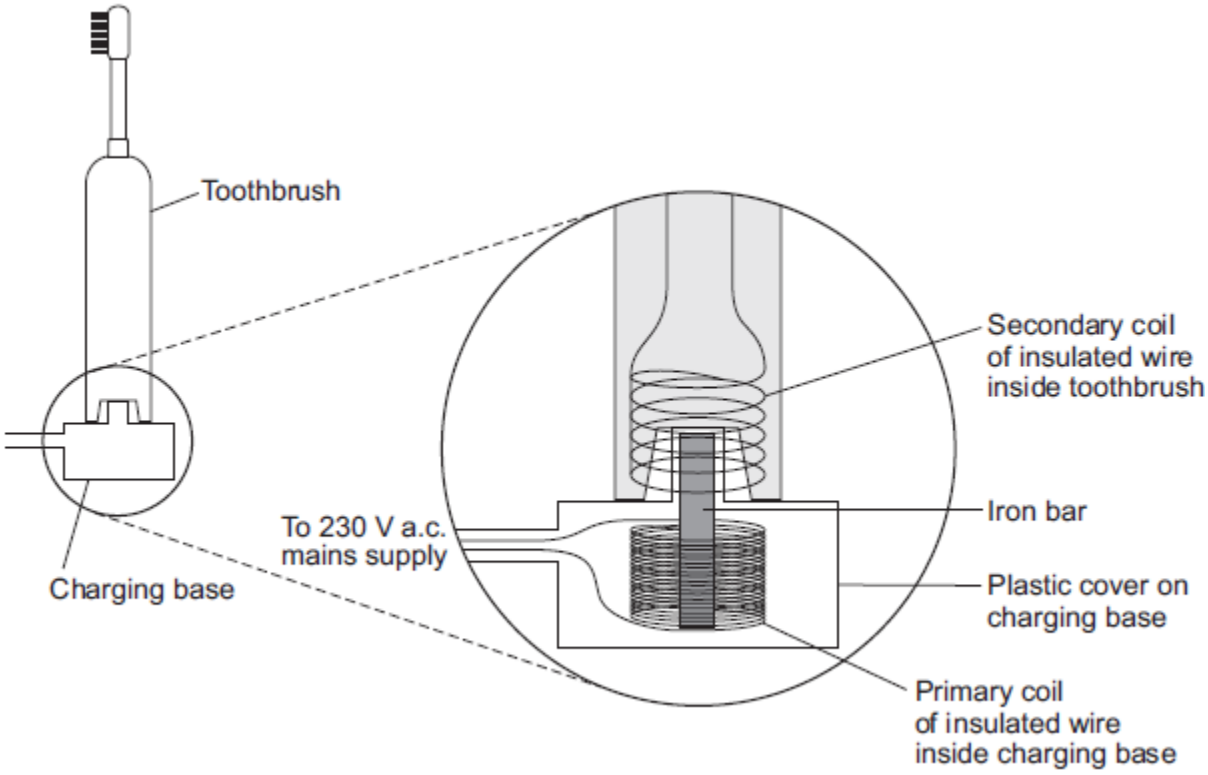
_____

_____

(1)

(Total 7 marks)

2. An electric toothbrush is charged by standing it on a separate charging base.
The diagram shows the inside of the electric toothbrush and the charging base.



(a) An alternating potential difference (p.d.) across the coil in the charging base creates an alternating current in the coil inside the toothbrush.

Explain how.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(b) When the toothbrush is being charged, the p.d. across the primary coil in the charging base is 230 V.

The charging p.d. across the secondary coil in the toothbrush is 7.2 V.

The primary coil in the charging base has 575 turns of wire on its coil.

Calculate the number of turns on the secondary coil inside the toothbrush.

_____

_____

_____

_____

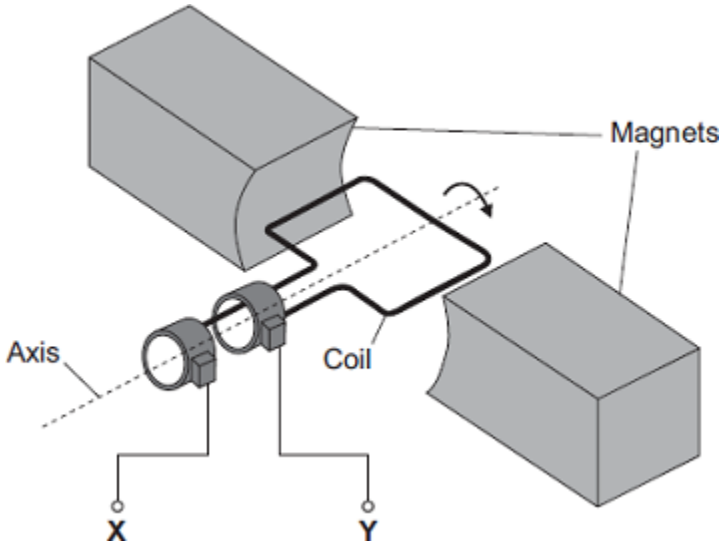
Number of turns on the secondary coil = _____

(2)

(Total 5 marks)

3. The diagram shows an a.c. generator.

The coil rotates about the axis shown and cuts through the magnetic field produced by the magnets.



(a) (i) A potential difference is induced between **X** and **Y**.

Use the correct answer from the box to complete the sentence.

electric	**generator**	**motor**	**transformer**

This effect is called the _____ effect.

(1)

(ii) What do the letters a.c. stand for?

_____

(1)

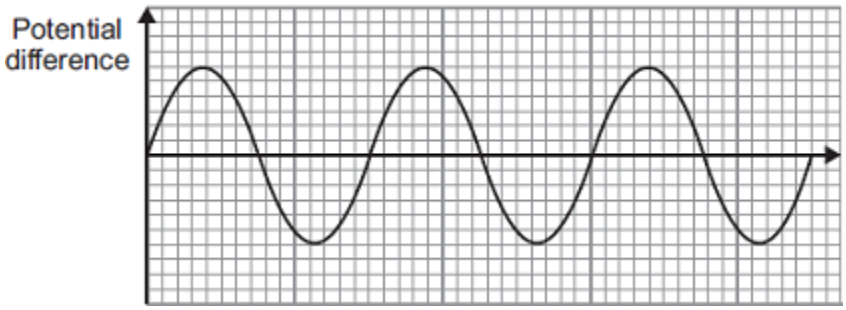
(iii) Name an instrument that could be used to measure the potential difference between **X** and **Y**.

_____

(1)

(b) **Graph 1** shows the output from the a.c. generator.

Graph 1



(i) One of the axes on **Graph 1** has been labelled 'Potential difference'.

What should the other axis be labelled?

_____

(1)

(ii) The direction of the magnetic field is reversed.

On **Graph 1**, draw the output from the a.c. generator if everything else remains the same.

(2)

(c) The number of turns of wire on the coil is increased. This increases the maximum induced potential difference.

State **two** other ways in which the maximum induced potential difference could be increased.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

4. The current in a circuit depends on the potential difference (p.d.) provided by the cells and the total resistance of the circuit.

(a) Using the correct circuit symbols, draw a diagram to show how you would connect 1.5 V cells together to give a p.d. of 6 V.

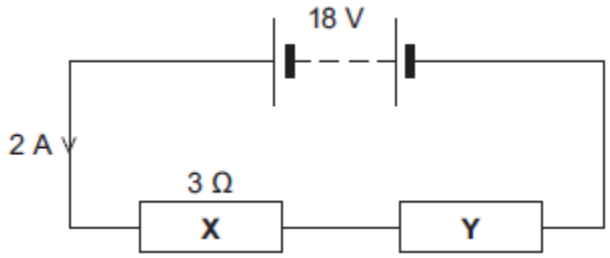
(2)

(b) **Figure 1** shows a circuit containing an 18 V battery.

Two resistors, **X** and **Y**, are connected in series.

- **X** has a resistance of 3 Ω.
- There is a current of 2 A in **X**.

Figure 1



(i) Calculate the p.d. across **X**.

_____

_____

P.d. across **X** = _____ V

(2)

(ii) Calculate the p.d. across **Y**.

_____

_____

_____

P.d. across **Y** = _____ V

(2)

(iii) Calculate the total resistance of **X** and **Y**.

_____

_____

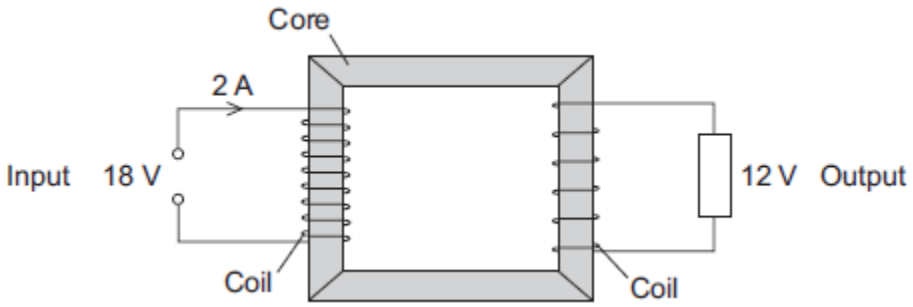
_____

Total resistance of **X** and **Y** = _____ Ω

(2)

(c) **Figure 2** shows a transformer.

Figure 2



(i) An 18 V battery could **not** be used as the input of a transformer.

Explain why.

_____

_____

_____

_____

(2)

(ii) The transformer is 100% efficient.

Calculate the output current for the transformer shown in **Figure 2**.

_____

_____

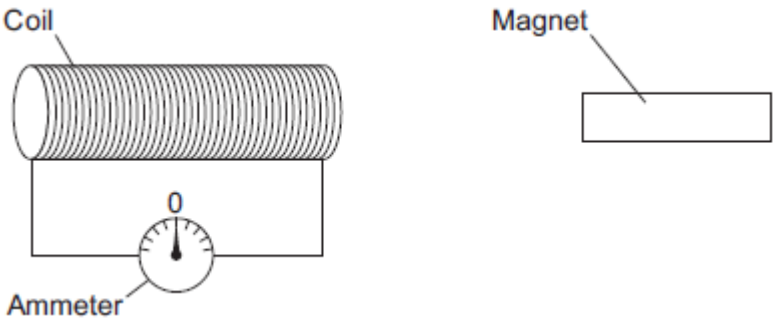
_____

Output current = _____ A

(2)

(Total 12 marks)

5. The figure below shows a coil and a magnet. An ammeter is connected to the coil.



The ammeter has a centre zero scale, so that values of current going in either direction through the coil can be measured.

(a) A teacher moves the magnet slowly towards the coil.

Explain why there is a reading on the ammeter.

(6)

(b) The table below shows some other actions taken by the teacher.

Complete the table to show the effect of each action on the ammeter reading.

Action taken by teacher	**What happens to the ammeter reading?**
Holds the magnet stationary and moves the coil slowly towards the magnet	
Holds the magnet stationary within the coil	
Moves the magnet quickly towards the coil	
Reverses the magnet and moves it slowly towards the coil	

(4)

(c) The magnet moves so that there is a steady reading of 0.05 A on the ammeter for 6 seconds.

Calculate the charge that flows through the coil during the 6 seconds.

Give the unit.

_____

_____

_____

Charge = _____

(3)

(Total 13 marks)

6. If a fault develops in an electrical circuit, the current may become too great. The circuit needs to be protected by being disconnected.

A fuse or a circuit breaker may be used to protect the circuit.
One type of circuit breaker is a Residual Current Circuit Breaker (RCCB).

(a) (i) Use the correct answer from the box to complete the sentence.

earth	**live**	**neutral**

A fuse is connected in the _____ wire.

(1)

(ii) Use the correct answer from the box to complete the sentence.

are bigger	**are cheaper**	**react faster**

RCCBs are sometimes preferred to fuses because they _____ .

(1)

(iii) RCCBs operate by detecting a difference in the current between two wires.

Use the correct answer from the box to complete the sentence.

earth and live	**earth and neutral**	**live and neutral**

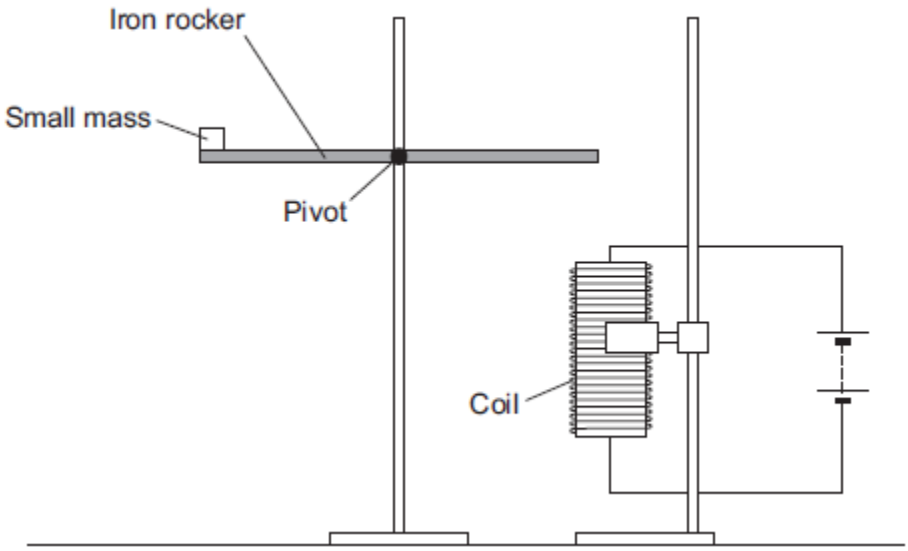
The two wires are the _____ wires.

(1)

(b) An RCCB contains an iron rocker and a coil.

A student investigated how the force of attraction, between a coil and an iron rocker, varies with the current in the coil.

She supported a coil vertically and connected it in an electrical circuit, part of which is shown in the figure below .



She put a small mass on the end of the rocker and increased the current in the coil until the rocker balanced. She repeated the procedure for different masses.

Some of her results are shown in the table below.

Mass in grams	**Current needed for the rocker to balance in amps**
5	0.5
10	1.0
15	1.5
20	2.0

(i) State **two** extra components that must have been included in the circuit in the figure above to allow the data in the above table to be collected.

Give reasons for your answers.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(ii) A teacher said that the values of current were too high to be safe.

Suggest **two** changes that would allow lower values of current to be used in this investigation.

Change 1 _____

_____

Change 2 _____

_____

(2)

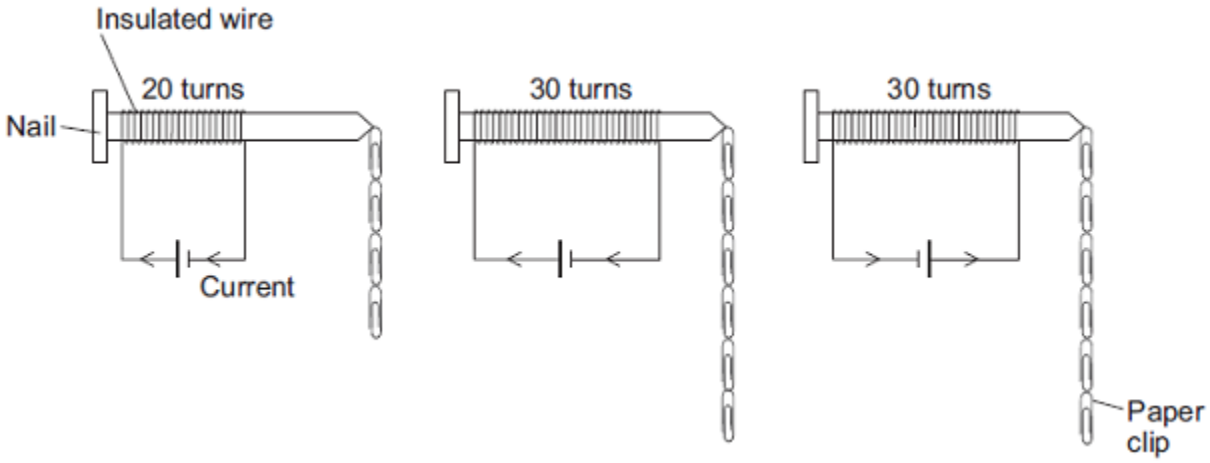
(Total 9 marks)

7. 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.

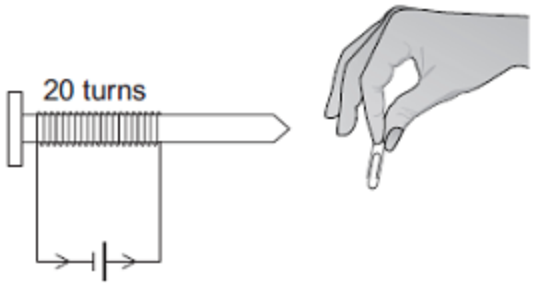
1. _____

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)

8. **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.

Extra space

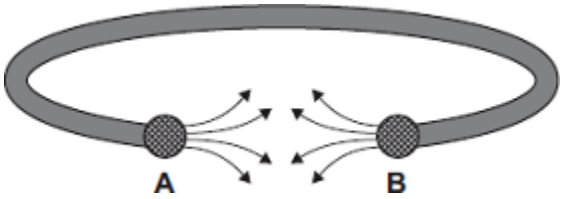
(Total 6 marks)

9. (a) Some people wear magnetic bracelets to relieve pain.

Figure 1 shows a magnetic bracelet.

There are magnetic poles at both **A** and **B**.
Part of the magnetic field pattern between **A** and **B** is shown.

Figure 1



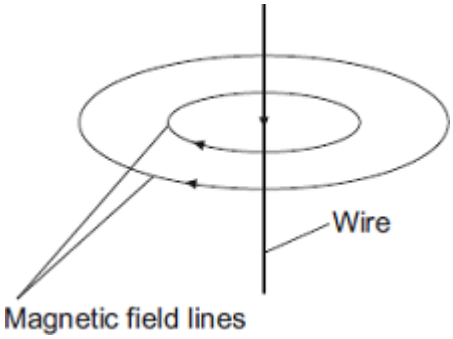
What is the pole at **A**? _____

What is the pole at **B**? _____

(1)

(b) **Figure 2** shows two of the lines of the magnetic field pattern of a current-carrying wire.

Figure 2



The direction of the current is reversed.

What happens to the direction of the lines in the magnetic field pattern?

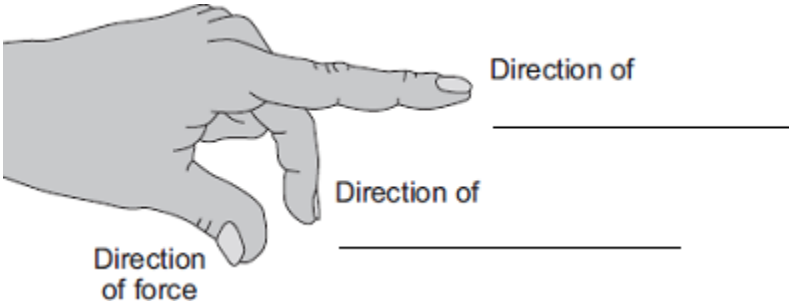
_____

(1)

(c) Fleming's left-hand rule can be used to identify the direction of a force acting on a current-carrying wire in a magnetic field.

(i) Complete the labels in **Figure 3**.

Figure 3

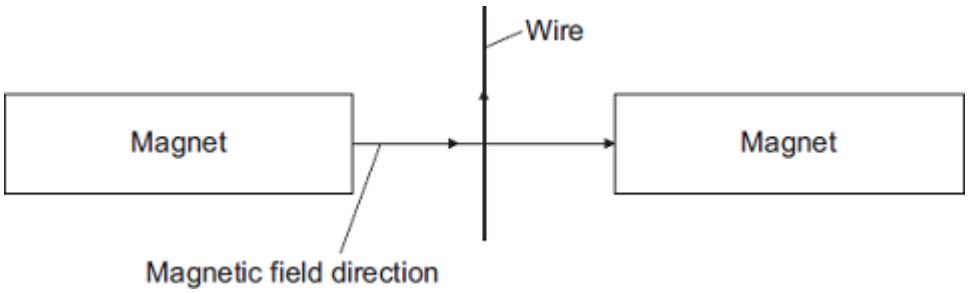


(2)

(ii) **Figure 4** shows:

- the direction of the magnetic field between a pair of magnets
- the direction of the current in a wire in the magnetic field.

Figure 4



In which direction does the force on the wire act?

_____

(1)

(iii) Suggest **three** changes that would **decrease** the force acting on the wire.

1. _____

2. _____

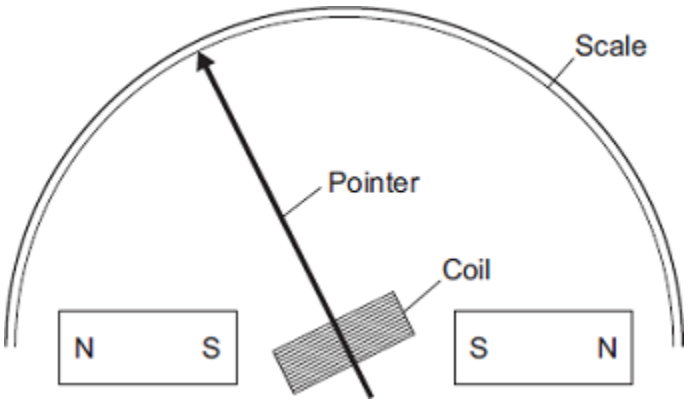
3. _____

(3)

(d) **Figure 5** shows part of a moving-coil ammeter as drawn by a student.

The ammeter consists of a coil placed in a uniform magnetic field.
When there is a current in the coil, the force acting on the coil causes the coil to rotate and the pointer moves across the scale.

Figure 5



(i) The equipment has **not** been set up correctly.

What change would make it work?

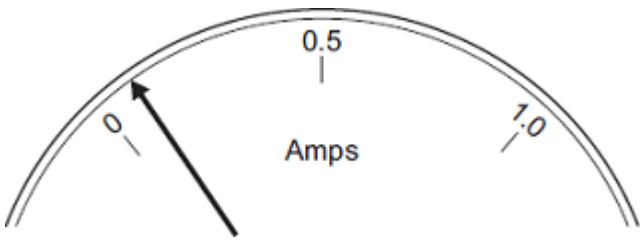
_____

_____

(1)

(ii) **Figure 6** shows the pointer in an ammeter when there is no current.

Figure 6



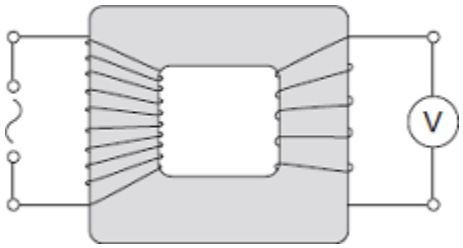
What type of error does the ammeter have?

_____

(1)

(Total 10 marks)

10. The diagram shows a transformer with a 50 Hz (a.c.) supply connected to 10 turns of insulated wire wrapped around one side of the iron core.
A voltmeter is connected to 5 turns wrapped around the other side of the iron core.



(a) What type of transformer is shown in the diagram?

Draw a ring around the correct answer.

step-down **step-up** **switch mode**

(1)

(b) The table shows values for the potential difference (p.d.) of the supply and the voltmeter reading.

p.d. of the supply in volts	Voltmeter reading in volts
6.4	3.2
3.2	
	6.4

(i) Complete the table.

(2)

(ii) Transformers are used as part of the National Grid.

How are the values of p.d. in the table different to the values produced by the National Grid?

_____

_____

(1)

(c) Transformers will work with an alternating current (a.c.) supply but will **not** work with a direct current (d.c.) supply.

(i) Describe the difference between a.c. and d.c.

(2)

(ii) Explain how a transformer works.

(4)

(Total 10 marks)

1. (a) (i) (closing the switch makes) a current (through the wire)

1

(the current flowing) creates a magnetic field (around the wire)

1

this field interacts with the permanent magnetic field

accept links / crosses attracts / repels is insufficient

1

(ii) arrow drawn showing upwards force on XY

judge vertical by eye the arrow must be on or close to the wire XY

1

(iii) motor

accept catapult

1

(b) (i) the wire moves up and down
or
the wire vibrates

back and forth or side to side is insufficient for vibrate

1

(ii) the force (continually) changes direction (from upwards to downwards, on the wire)

accept the direction of the magnetic field (of the wire) changes

1

[7]

2. (a) an alternating current through the primary coil (in the charging base)

it must be clear which coil is being referred to

1

causes a changing / alternating magnetic field in / around the (iron) bar

1

which induces an (alternating) p.d. across the secondary coil (in the toothbrush)

accept induces an (alternating) current in the secondary coil

1

(b) 18

*allow **1** mark for correct substitution, ie*

$$\frac{230}{7.2} = \frac{575}{n_s}$$

2

[5]

3. (a) (i) generator

1

(ii) alternating current

1

(iii) voltmeter / CRO / oscilloscope / cathode ray oscilloscope

1

(b) (i) time

1

(ii) peaks and troughs in opposite directions

1

amplitude remains constant

dependent on first marking point

1

(c) any **two** from:

- increase speed of coil
- strengthen magnetic field
- increase area of coil

*do **not** accept larger*

2

[8]

4. (a) *attempt to draw four cells in series*

1

correct circuit symbols

circuit symbol should show a long line and a short line, correctly joined together

example of correct circuit symbol:

1

(b) (i) 6 (V)

*allow **1** mark for correct substitution, ie*

*V = 3 × 2 scores **1** mark*

provided no subsequent step

2

(ii) 12 (V)

ecf from part (b)(i)

18 – 6

or

*18 – their part (b)(i) scores **1** mark*

2

(iii) 9 (Ω)

ecf from part (b)(ii) correctly calculated

3 + their part (b)(ii) / 2

or

*18 / 2 scores **1** mark*

provided no subsequent step

2

(c) (i) need a.c.

1

battery is d.c.

1

(ii) 3 (A)

*allow **1** mark for correct substitution, ie*

*18 × 2 = 12 × I_S scores **1** mark*

2

[12]

5. (a) *there is a* magnetic field *(around the magnet)*

1

(this magnetic field) changes / moves

1

and cuts through coil

accept links with coil

1

so a p.d. *induced* across coil

1

the coil forms *a* complete circuit

1

so a current (*is* induced)

1

(b) ammeter reading does not change

must be in this order

accept ammeter has a small reading / shows a current

1

zero

1

greater than before

accept a large(r) reading

1

same as originally but in the opposite direction

accept a small reading in the opposite direction

1

(c) 0.30

*allow **1** mark for correct substitution, ie 0.05 = Q / 6*

2

C / coulomb

allow A s

1

[13]

6. (a) (i) live

1

(ii) react faster

1

(iii) live and neutral

1

(b) (i) ammeter

1

to measure current

accept to measure amps

1

plus any **one** from:

- *variable resistor* (1)
  to vary current (1)
  accept variable power supply
  accept change or control
- *switch* (1)
  to stop apparatus getting hot / protect battery
  or
  to reset equipment (1)
- fuse (1)
  to break circuit if current is too big (1)

2

(ii) any **two** from:

- use smaller mass(es)
- move mass closer to pivot
- reduce gap between coil and rocker
- more turns (on coil) *coil / loop*
- iron core in coil

accept use smaller weight(s)

2

[9]

7. (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]

8. 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

[6]

9. (a) north (pole)

accept N

north (pole)

both needed for mark

1

(b) reverses

accept changes direction

1

(c) (i) first finger:
(direction of) (magnetic) field

1

second finger:
(direction of) (conventional) current

1

(ii) into (plane of the) paper

1

(iii) less current in wire

accept less current / voltage / more resistance / thinner wire

1

weaker field

allow weaker magnets / magnets further apart

*do **not** accept smaller magnets*

1

rotation of magnets (so) field is no longer perpendicular to wire

1

(d) (i) reverse one of the magnets

*do **not** accept there are no numbers on the scale*

1

(ii) systematic or zero error

accept all current values will be too big

accept it does not return to zero
accept it does not start at zero

1

[10]

10. (a) step-down

1

(b) (i) 1.6

correct order only

1

12.8

1

(ii) values of p.d. are smaller than 230 V

1

(c) (i) a.c. is constantly changing direction

accept a.c. flows in two / both directions

accept a.c. changes direction(s)

a.c. travels in different directions is insufficient

1

d.c. flows in one direction only

1

(ii) an alternating current / p.d. in the primary creates a changing / alternating magnetic field

1

(magnetic field) in the (iron) core

current in the core negates this mark

accept voltage for p.d.

1

(and so) an alternating p.d.

1

(p.d.) is induced across secondary coil

1

[10]