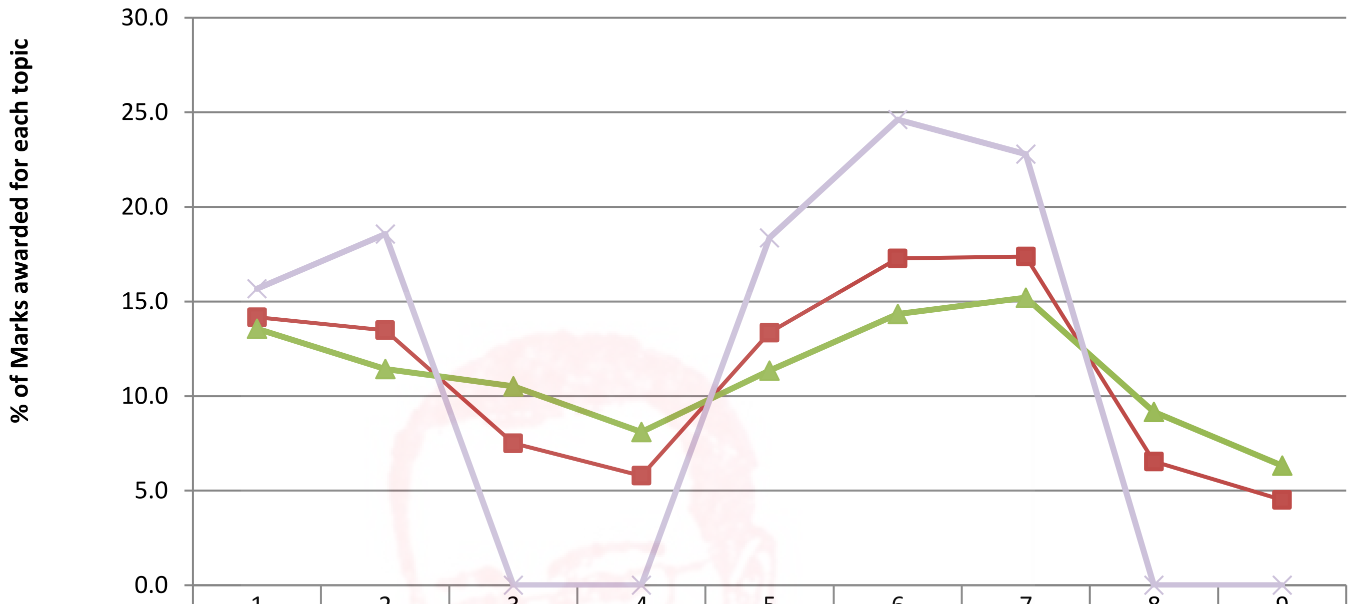
Name

# iG Phx 8 EQ 14w to 02w P3 4Students 190marks

For these stats only papers 3 (which after 2016 became paper 4) and paper 6 were used to examine the topics.

**iG Phx CIE 0625 PAPERS 3 and 6**

**Percentage of all WEIGHTED marks awarded for P3 & 6 each topic from s2002 to w2014 (red squares) and % of Paper 3 marks (green triangles) and paper 6 (purple crosses)**

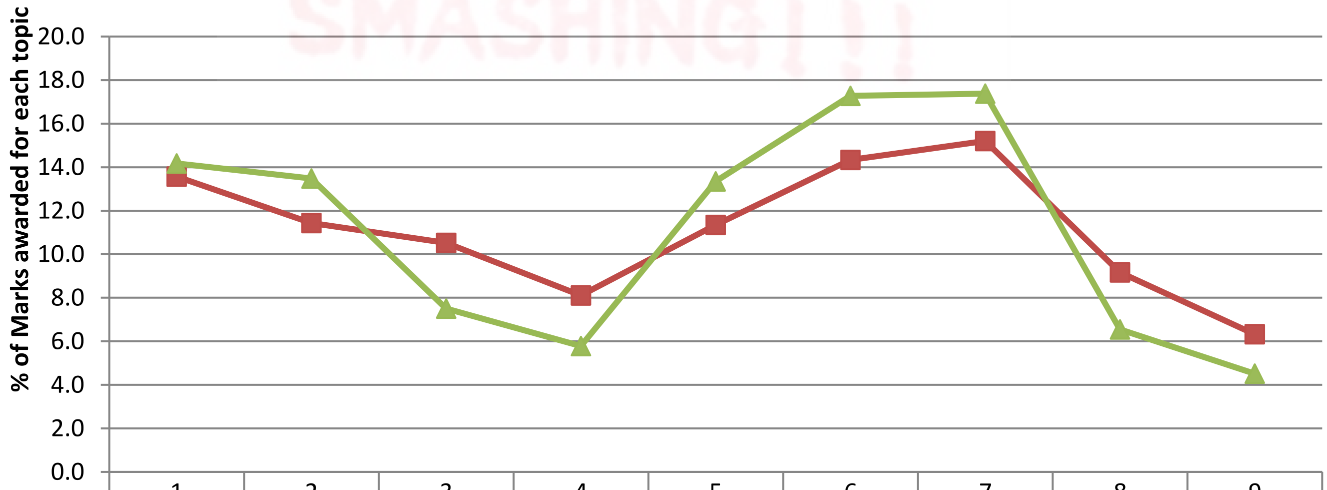



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| PhxBoth P3&6 | 14.2 | 13.5 | 7.5 | 5.8 | 13.4 | 17.3 | 17.4 | 6.5 | 4.5 |
| PhxP3 | 13.6 | 11.4 | 10.5 | 8.1 | 11.3 | 14.3 | 15.2 | 9.2 | 6.3 |
| PhxP6 | 15.7 | 18.6 | 0.0 | 0.0 | 18.4 | 24.6 | 22.8 | 0.0 | 0.0 |

**Papers 3 and 6 Topic Number**

## PAPER 3

Percentage of all marks awarded for each topic from s2002 to w2014 in Paper 3 (red squares) and marks per topic for papers 3 and 6 (green triangles)




| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| ALL P3 % | 13.6 | 11.4 | 10.5 | 8.1 | 11.3 | 14.3 | 15.2 | 9.2 | 6.3 |
| P3 & 6 | 14.2 | 13.5 | 7.5 | 5.8 | 13.4 | 17.3 | 17.4 | 6.5 | 4.5 |

**Paper 3 Topic Number**

## Papers covered in this sample

| | 1st Paper | Last Paper | Marks/ paper | Theor. All Papers | Actual All Marks | Difference | Difference % | Weight per paper | Weight per mark |
|---|---|---|---|---|---|---|---|---|---|
| Paper 3 | 2002w | 2014w | 80 | 2000 | 2072 | 72 | 3.6 | 50 | 0.63 |
| Paper 6 | 2002s | 2015w | 40 | 1120 | 1040 | -80 | -7.1 | 20 | 0.50 |

There are a few missing:

Got all Paper 31s (except 2014w Paper 31), and got 2014w 33

So papers in time zones 2 and 3 are not covered.

## All topics ranked by frequency of marks in exams (P3 and 6 only)

| Topic | PhxBoth P3&6 | PhxP3 | PhxP6 |
|---|---|---|---|
| 7 | 17.4 | 15.2 | 22.8 |
| 6 | 17.3 | 14.3 | 24.6 |
| 1 | 14.2 | 13.6 | 15.7 |
| 2 | 13.5 | 11.4 | 18.6 |
| 5 | 13.4 | 11.3 | 18.4 |
| 3 | 7.5 | 10.5 | 0.0 |
| 8 | 6.5 | 9.2 | 0.0 |
| 4 | 5.8 | 8.1 | 0.0 |
| 9 | 4.5 | 6.3 | 0.0 |

## Other statistics that might be of interest:

| | Topics: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| P3/4 marks | 2072 | 281 | 237 | 218 | 168 | 235 | 297 | 315 | 190 | 131 |
| P3/4 % | | 13.6 | 11.4 | 10.5 | 8.1 | 11.3 | 14.3 | 15.2 | 9.2 | 6.3 |
| P6 | 1040 | 163 | 193 | 0 | 0 | 191 | 256 | 237 | 0 | 0 |
| P6 % | | 15.7 | 18.6 | 0.0 | 0.0 | 18.4 | 24.6 | 22.8 | 0.0 | 0.0 |
| Total Marks (WIEGHTED) | 1815 | 257 | 245 | 136 | 105 | 242 | 314 | 315 | 119 | 82 |
| % of Marks (Weighted) | 1815 | 14.2 | 13.5 | 7.5 | 5.8 | 13.4 | 17.3 | 17.4 | 6.5 | 4.5 |
| # of Questions | | 63 | 64 | 35 | 16 | 63 | 74 | 70 | 26 | 20 |
| Average marks per Q | | **4.1** | **3.8** | **3.9** | **6.6** | **3.8** | **4.2** | **4.5** | **4.6** | **4.1** |

# Final note:

My iG and IB chemistry papers were broken down more carefully than these were, so there may be a mark or two in the wrong topic especially in topics 3 to 5, but if you learnt or taught these topics in sequence than you shouldn't have a problem with seeing material from an earlier topic.

## Defining the Topics: Why not use the units given in the syllabus?

*Artificial topics have been created for the physics syllabus by me so that each topic is roughly the same size. Topics go in syllabus order. I have decided to use the number of marks allocated in previous exams to each syllabus point to determine how many go into each topic.*

# 1. General physics

### Topic 1
1.1 Length and time
1.2 Motion
1.3 Mass and weight
1.4 Density

### Topic 2
1.5 Forces
1.6 Momentum (Extended candidates only)

### Topic 3
1.7 Energy, work and power
1.8 Pressure

# 2. Thermal physics

### Topic 4
2.1 Simple kinetic molecular model of matter

### Topic 5
2.2 Thermal properties and temperature
2.3 Thermal processes

# 3. Properties of waves, including light and sound

### Topic 6
3.1 General wave properties
3.2 Light
3.3 Electromagnetic spectrum
3.4 Sound

# 4. Electricity and magnetism

### Topic 7
4.1 Simple phenomena of magnetism
4.2 Electrical quantities
4.3 Electric circuits
4.4 Digital electronics (Extended candidates only)
4.5 Dangers of electricity

### Topic 8
4.6 Electromagnetic effects

# 5. Atomic physics

### Topic 9
5.1 The nuclear atom
5.2 Radioactivity

9 A circuit contains a battery, a variable resistor and a solenoid. Fig. 9.1 shows the magnetic field pattern produced by the current in the solenoid.

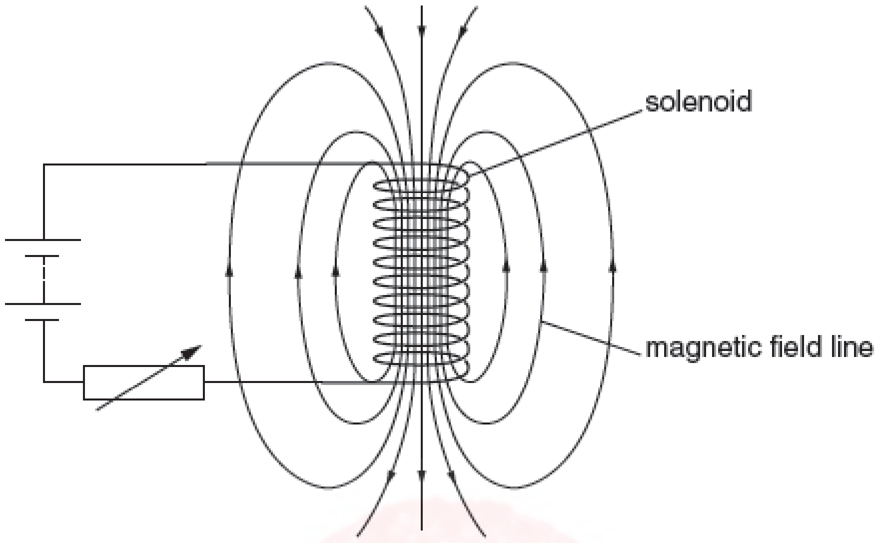



Fig. 9.1

(a) (i) State how the magnetic field pattern indicates regions where the magnetic field is stronger.

..........................................................................................................................................

..........................................................................................................................................[1]

(ii) State what happens to the magnetic field when the current in the circuit is reversed.

..........................................................................................................................................

..........................................................................................................................................[1]

**(b)** A second solenoid is placed next to the first solenoid.

Fig. 9.2 shows the second solenoid connected to a very sensitive ammeter.

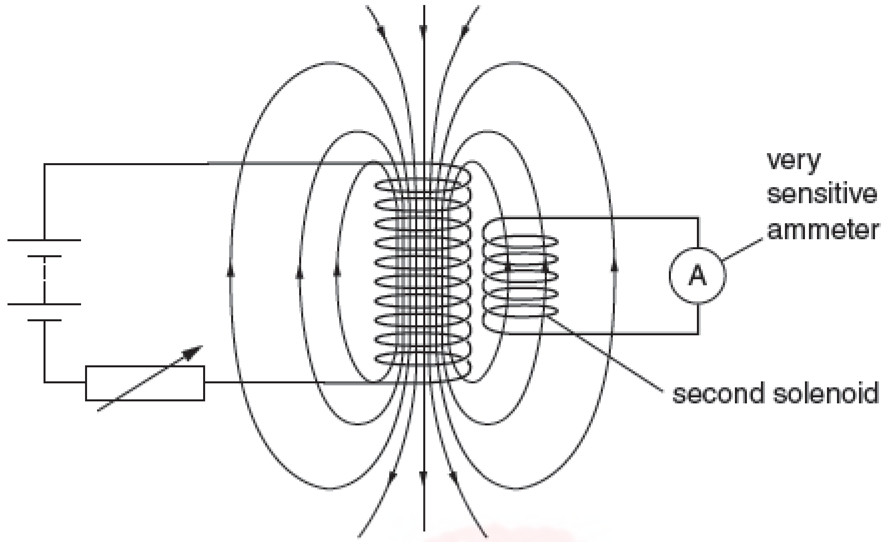



**Fig. 9.2**

**(i)** The variable resistor is adjusted so that its resistance changes quickly.

State and explain what is seen to happen in the circuit of the second solenoid.

..........................................................................................................................................

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.....................................................................................................................................[3]

**(ii)** The variable resistor is adjusted much more slowly than in **(i)**.

State and explain the difference in what is seen to happen in the circuit of the second solenoid.

..........................................................................................................................................

..........................................................................................................................................

.....................................................................................................................................[2]

[Total: 7]

10 Fig. 10.1 shows a coil of wire rotating steadily in the magnetic field between the poles of a permanent magnet. The current generated in the coil is to pass through resistor R.

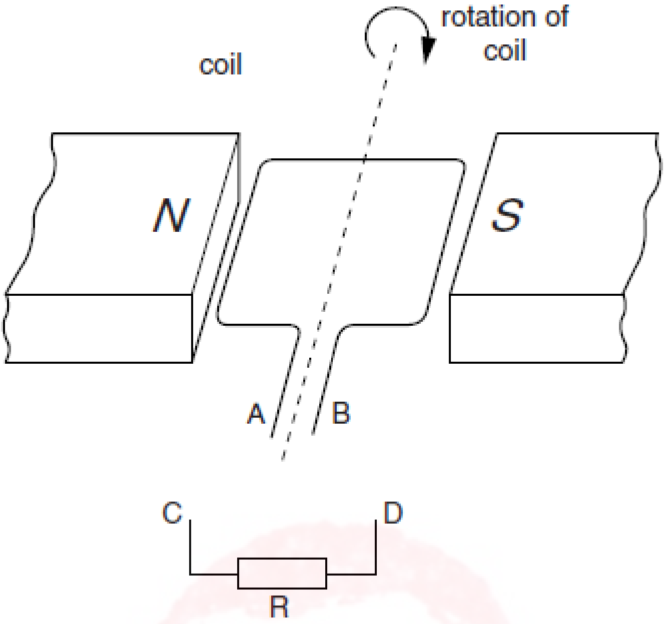


**Fig. 10.1**

**(a)** The apparatus in Fig. 10.1 is part of an a.c. generator. What is connected between the ends A and B of the coil and the connections C and D?

.................................................................................................................................... [1]

**(b)** **(i)** On Fig. 10.2, sketch a graph to show the variation with time of the current through R. [1]

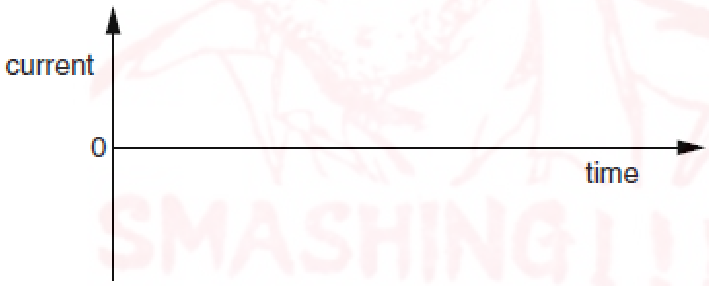


**Fig. 10.2**

**(ii)** On Fig. 10.2, show the time *T* corresponding to one complete rotation of the coil. [1]

**(iii)** State **two** ways in which the graph would be different if the coil spins at a faster rate.

1. ....................................................................................................................

2. .................................................................................................................... [2]

**(c)** Suggest what could be connected between C and R so that the current in R is always in the same direction.

.................................................................................................................................... [1]

[Total: 6]

**(b)** Fig. 8.1 represents a transformer with primary coil P and secondary coil S, wound on an iron core.

There is an alternating current in coil P.

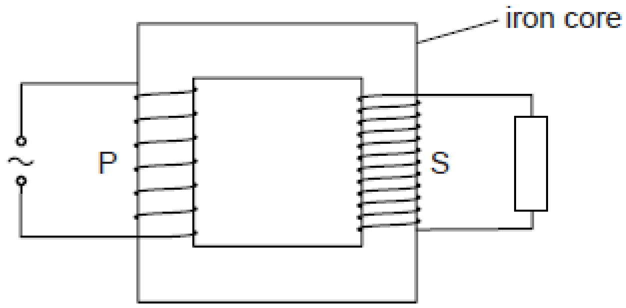


**Fig. 8.1**

**(ii)** Tick the box next to the correct description of the current in S.

☐ higher frequency a.c.

☐ same frequency a.c.

☐ lower frequency a.c.

☐ rectified d.c.

☐ constant d.c. [1]

**(iii)** Coil P has 50 turns of wire, an applied voltage of 12V, and a current of 0.50A. Coil S has 200 turns.

Calculate the current in S. Assume the transformer is 100% efficient.

current = .................................................... [3]

[Total: 9]

**8** **(a)** Describe an experiment that shows how a magnet can be used to produce a current in a solenoid by electromagnetic induction. Sketch and label the arrangement of apparatus you would use.

..........................................................................................................................................

..........................................................................................................................................

.................................................................................................................................... [3]

**(b)** Fig. 8.1 represents a transformer with primary coil P and secondary coil S, wound on an iron core.

There is an alternating current in coil P.

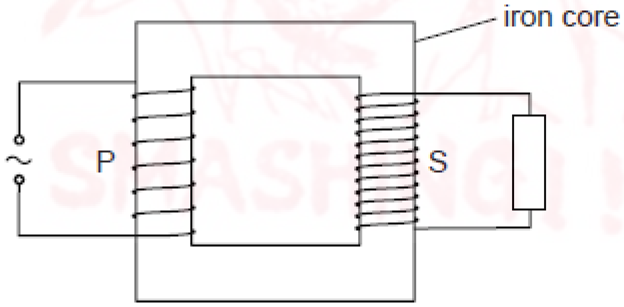


**Fig. 8.1**

**(i)** State what happens in the iron core as a result of the alternating current in P.

..........................................................................................................................................

.................................................................................................................................... [2]

**8** **(a)** Describe an experiment that shows how a magnet can be used to produce a current in a solenoid by electromagnetic induction. Sketch and label the arrangement of apparatus you would use.

..........................................................................................................................................

..........................................................................................................................................

.................................................................................................................................. [3]

**(b)** Fig. 8.1 represents a transformer with primary coil P and secondary coil S, wound on an iron core.

There is an alternating current in coil P.

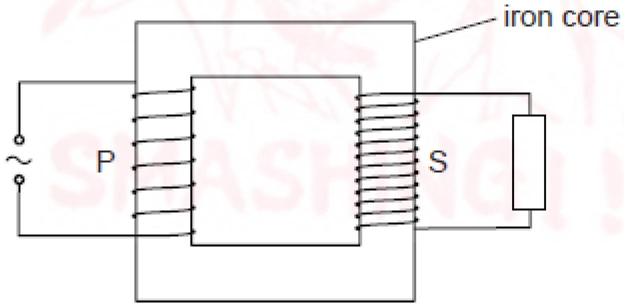


**Fig. 8.1**

**(i)** State what happens in the iron core as a result of the alternating current in P.

..........................................................................................................................................

.................................................................................................................................. [2]

**10 (a)** Fig. 10.1 shows the cross-section of a wire carrying a current into the plane of the paper.

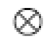

**Fig. 10.1**

On Fig. 10.1, sketch the magnetic field due to the current in the wire. The detail of your sketch should suggest the variation in the strength of the field. Show the direction of the field with arrows. [3]

**(b)** Fig. 10.2 shows part of a model of a d.c. motor.

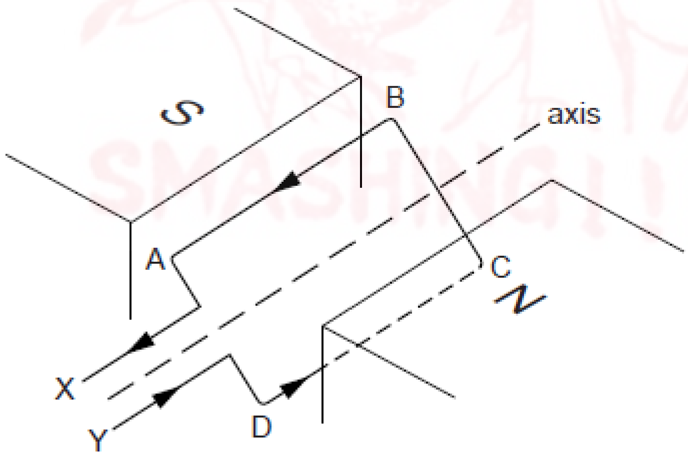


**Fig. 10.2**

A loop of wire ABCD is placed between the poles of a magnet. The loop is free to rotate about the axis shown. There is a current in the loop in the direction indicated by the arrows.

**(i)** On Fig. 10.2, draw arrows to show the directions of the forces acting on side AB and on side CD of the loop. [1]

**(ii)** With the loop in the position shown in Fig. 10.2, explain why the forces on AB and CD cause the loop to rotate about the axis.

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.......................................................................................................................................[1]

**(iii)** The ends X and Y of the loop are connected to a battery using brushes and a split-ring commutator.

State why a split-ring commutator is used.

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..........................................................................................................................................

.......................................................................................................................................[2]

[Total: 7]

**9** Fig. 9.1 shows a thin, straight rod XY placed in the magnetic field between the poles of a magnet. The wires from the ends of XY are connected to a centre-zero voltmeter.

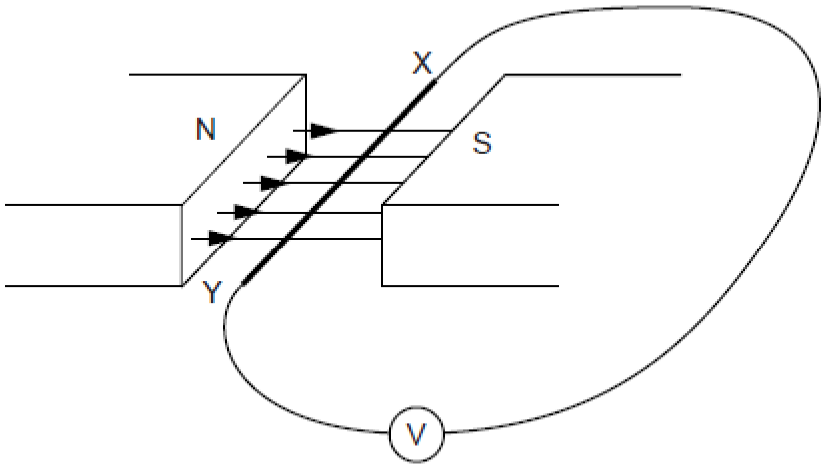


**Fig. 9.1**

**(a)** When XY is moved slowly upwards the needle of the voltmeter shows a small deflection.

**(i)** State how XY must be moved to produce a larger deflection in the opposite direction.

..........................................................................................................................

.................................................................................................................... [2]

**(ii)** XY is now rotated about its central point by raising X and lowering Y. Explain why no deflection is observed.

..........................................................................................................................

..........................................................................................................................

.................................................................................................................... [2]

**8** **(a)** In Fig. 8.1, a magnet is moving towards one end of a solenoid connected to a sensitive centre-zero meter. During this movement a current is induced in the solenoid.

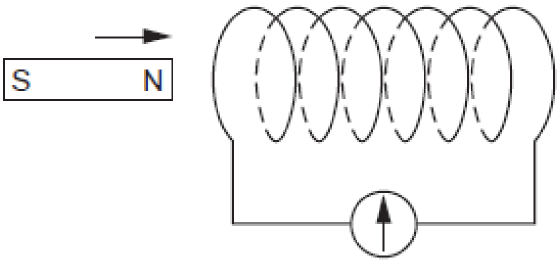


**Fig. 8.1**

Suggest **three** possible changes to the system in Fig. 8.1 that would increase the induced current.

1. ..............................................................................................................................

2. ..............................................................................................................................

3. ..............................................................................................................................[3]

**(b)** Fig. 8.2 shows a transformer. P is the primary coil. S is the secondary coil. The coils are wound on an iron core.

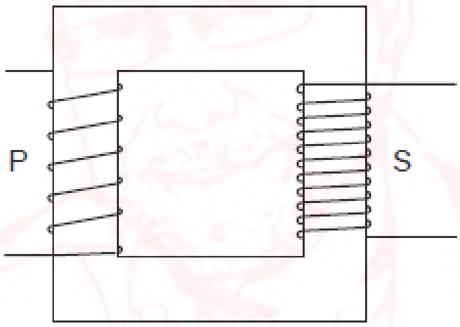


**Fig. 8.2**

P has 200 turns and S has 800 turns. The e.m.f. induced across S is 24 V. The current in S is 0.50 A. The transformer operates with 100% efficiency.

Calculate

**(i)** the voltage of the supply to P,

voltage = ..........................................................[2]

**(ii)** the current in P.

current = ..........................................................[2]

[Total: 7]

**9** A simple motor is made in a school laboratory. A coil of wire is mounted on an axle between the poles of a horseshoe magnet, as illustrated in Fig. 9.1.

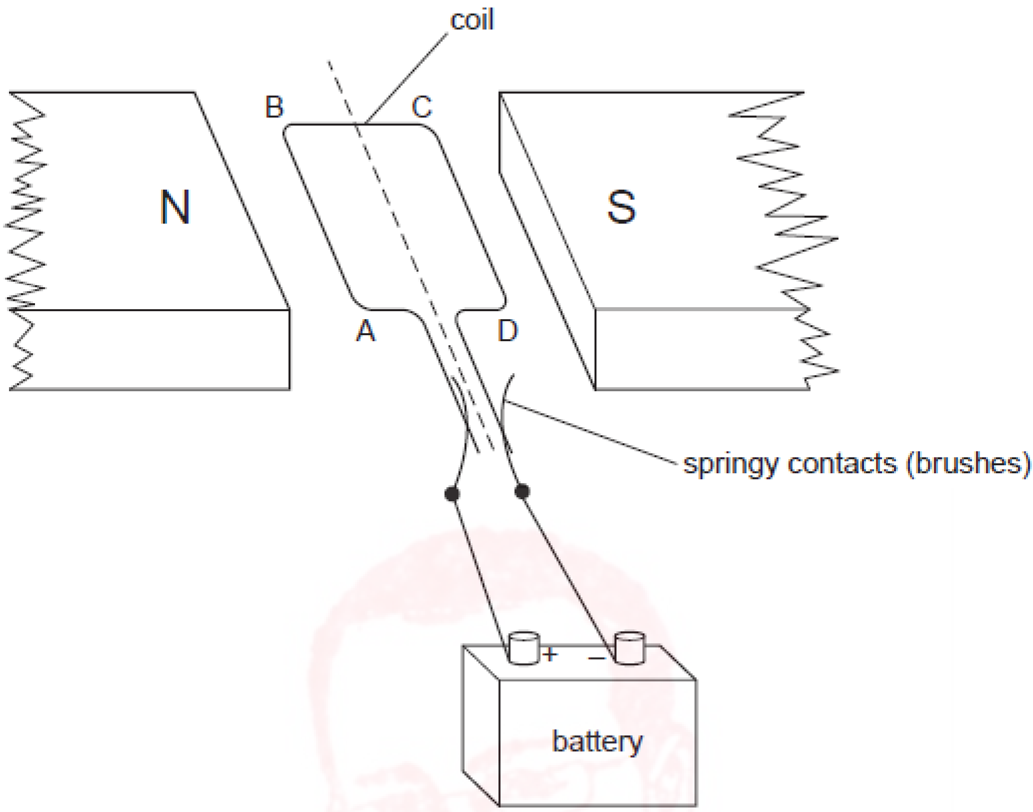


**Fig. 9.1**

**(a)** At the instant illustrated in Fig. 9.1, the coil ABCD is horizontal and the battery is connected as shown.

**(i)** For this position, state the direction of the force on AB and the direction of the motion of AB.

force on AB ..........................................................................................

direction of motion of AB ..........................................................................[1]

**(ii)** Explain why BC does not contribute to the turning force on the coil.

..........................................................................................................

..........................................................................................................[1]

**(b)** At the instant when the coil is vertical, the springy contacts do not, in fact, make contact with the ends of the coil.

Describe and explain what happens to the coil.

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

.....................................................................................................................................[2]

**(c)** The motor in Fig. 9.1 does not rotate very quickly. The designer of a commercial motor is required to produce a faster-rotating motor.

Suggest **one** change that could be made to increase the speed of the motor.

..........................................................................................................................................

.....................................................................................................................................[1]

[Total: 5]

**8** **(a)** The transformer in Fig. 8.1 is used to convert 240V a.c. to 6V a.c.

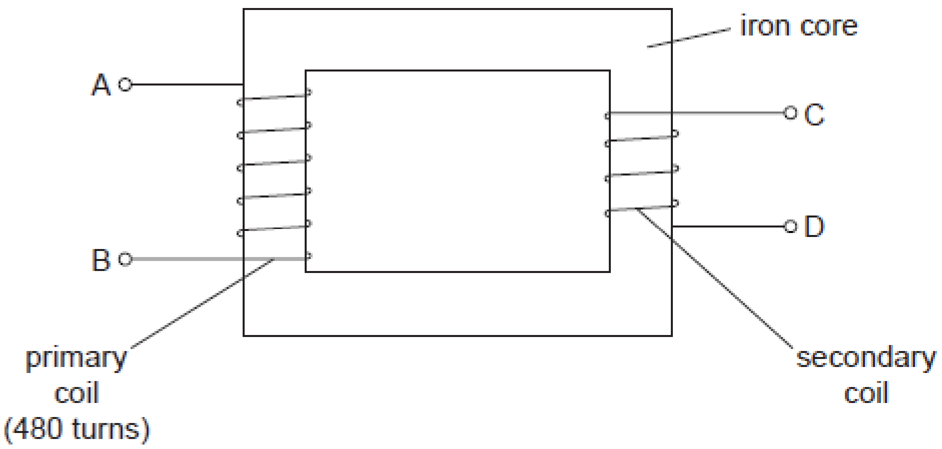


**Fig. 8.1**

**(i)** Using the information above, calculate the number of turns on the secondary coil.

number of turns = .................................................. [2]

**(ii)** Describe how the transformer works.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

.................................................................................................................. [3]

**(iii)** State one way in which energy is lost from the transformer, and from which part it is lost.

.................................................................................................................. [1]

**(b)** Fig. 8.2 shows a device labelled "IGCSE Transformer".

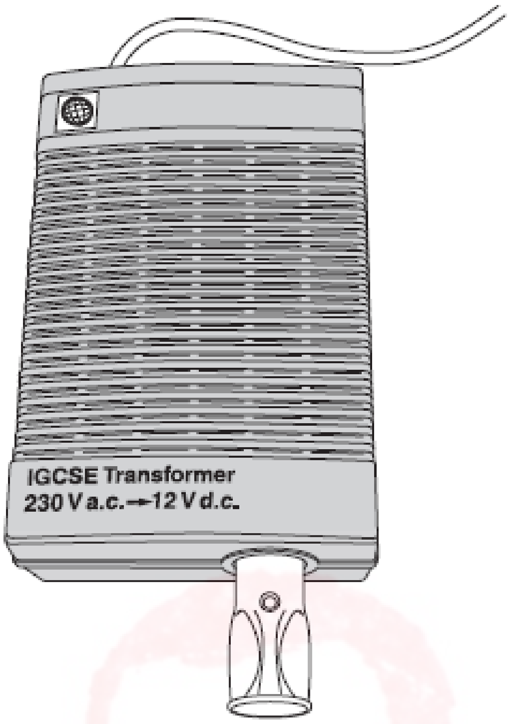


**Fig. 8.2**

Study the label on the case of the IGCSE Transformer.

**(i)** What is the output of the device? ........................................................................ [1]

**(ii)** From the information on the case, deduce what other electrical component must be included within the case of the IGCSE Transformer, apart from a transformer.

........................................................................................................................ [1]

**(c)** A transformer supplying electrical energy to a factory changes the 11 000V a.c. supply to 440V a.c. for use in the factory. The current in the secondary coil is 200 A.

Calculate the current in the primary coil, assuming no losses from the transformer.

current = ........................................................ [2]

[Total: 10]

**9** **(a)** Fig. 9.1 illustrates the left hand rule, which helps when describing the force on a current-carrying conductor in a magnetic field.

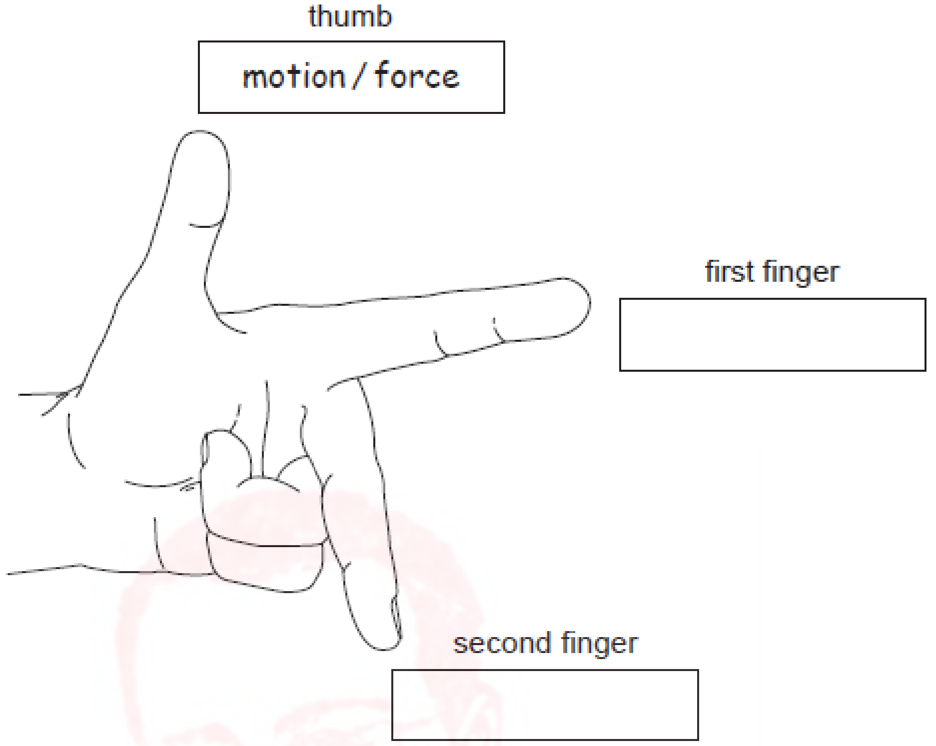


**Fig. 9.1**

One direction has been labelled for you.

In each of the other two boxes, write the name of the quantity that direction represents. [1]

**(b)** Fig. 9.2 shows a simple d.c. motor connected to a battery and a switch.

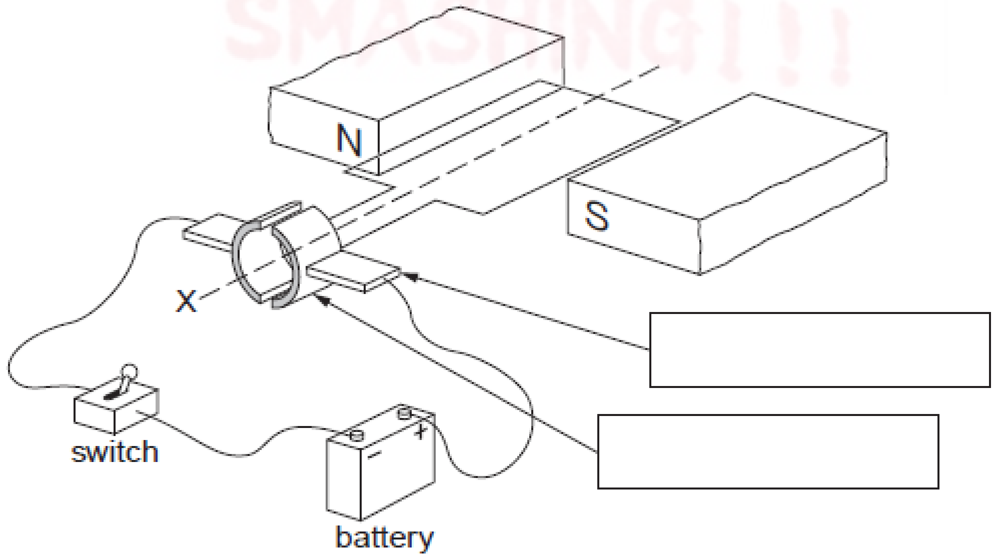


**Fig. 9.2**

**(i)** On Fig. 9.2, write in each of the boxes the name of the part of the motor to which the arrow is pointing. [2]

**(ii)** State which way the coil of the motor will rotate when the switch is closed, when viewed from the position X.

.......................................................................................................... [1]

**(iii)** State two things which could be done to increase the speed of rotation of the coil.

1. ..........................................................................................................

2. .......................................................................................................... [2]

**Q# 12/ iG Phx/2009/w/Paper 31/ www.SmashingScience.org**

**7** Three wires and a meter are used to construct a thermocouple for measuring the surface temperature of a pipe carrying hot liquid, as shown in Fig. 7.1.

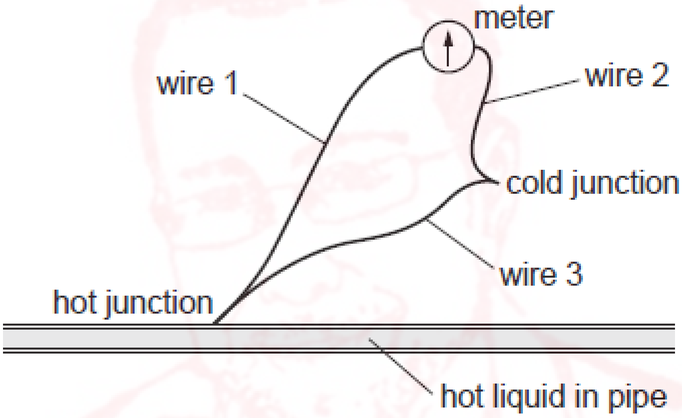


**Fig. 7.1**

**(a)** Copper wire and constantan wire are used in the construction of the thermocouple.

State which metal might be used for

wire 1 ..........................................................

wire 2 ..........................................................

wire 3 ..........................................................
[1]

**(b)** State what type of meter is used.

.......................................................................................................... [1]

**(c)** State one particular advantage of thermocouples for measuring temperature.

.......................................................................................................... [1]

9 Fig. 9.1 is a block diagram of an electrical energy supply system, using the output of a coal-fired power station.

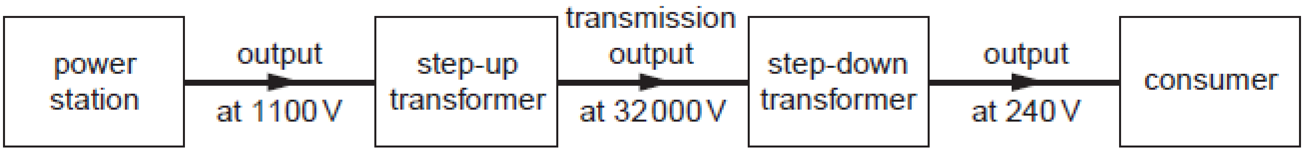


**Fig. 9.1**

**(a)** Suggest **one** possible way of storing surplus energy when the demand from the consumers falls below the output of the power station.

..................................................................................................................................

.......................................................................................................................... [1]

**(b)** State why electrical energy is transmitted at high voltage.

.......................................................................................................................... [1]

**(c)** A transmission cable of resistance $R$ carries a current $I$. Write down a formula that gives the power loss in the cable in terms of $R$ and $I$.

.......................................................................................................................... [1]

**(d)** The step-up transformer has 1200 turns on the primary coil. Using the values in Fig. 9.1, calculate the number of turns on its secondary coil. Assume that the transformer has no energy losses.

number of turns = ................................................ [2]

**(e)** The input to the step-up transformer is 800 kW.

Using the values in Fig. 9.1, calculate the current in the transmission cables, assuming that the transformer is 100% efficient.

current = ................................................ [3]

[Total: 8]

9 Fig. 9.1 shows apparatus used to investigate electromagnetic effects around straight wires.

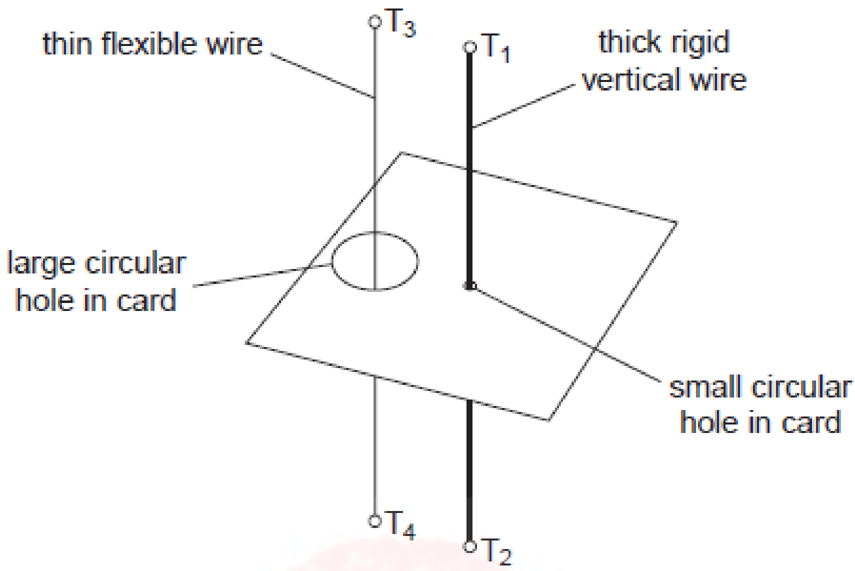


**Fig. 9.1**

Fig. 9.2 is a view looking down on the apparatus shown in Fig. 9.1.

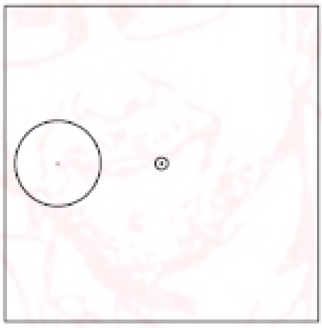

**Fig. 9.2**

**(a)** A battery is connected to $T_1$ and $T_2$ so that there is a current vertically down the thick wire.

On Fig. 9.2, draw three magnetic field lines and indicate, with arrows, the direction of all three. [2]

**(b)** Using a variable resistor, the p.d. between terminals $T_1$ and $T_2$ is gradually reduced.

State the effect, if any, that this will have on

**(i)** the strength of the magnetic field, .................................................................. [1]

**(ii)** the direction of the magnetic field. .................................................................. [1]

**(c)** The battery is now connected to terminals $T_3$ and $T_4$, as well as to terminals $T_1$ and $T_2$, so that there is a current down both wires. This causes the flexible wire to move.

**(i)** Explain why the flexible wire moves.

..................................................................................................................................

..................................................................................................................................

..................................................................................................................................

.............................................................................................................................. [2]

**(ii)** State the direction of the movement of the flexible wire.

.............................................................................................................................. [1]

**(iii)** The battery is replaced by one that delivers a smaller current.

State the effect that this will have on the force acting on the flexible wire.

..................................................................................................................................

.............................................................................................................................. [1]

[Total: 8]

**9** Electromagnetic induction may be demonstrated using a magnet, a solenoid and other necessary apparatus.

**(a)** Explain what is meant by *electromagnetic induction*.

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

.................................................................................................................................... [2]

**(b)** In the space below, draw a labelled diagram of the apparatus set up so that electromagnetic induction may be demonstrated. [2]

**(c)** Describe how you would use the apparatus to demonstrate electromagnetic induction.

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..........................................................................................................................................

..........................................................................................................................................

.................................................................................................................................... [2]

**(d)** State two ways of increasing the magnitude of the induced e.m.f. in this experiment.

1. ......................................................................................................................................

..........................................................................................................................................

2. ......................................................................................................................................

.................................................................................................................................... [2]

[Total: 8]

9 Fig. 9.1 is a sketch of some apparatus, found in a Science museum, which was once used to show how electrical energy can be converted into kinetic energy.

When the switch is closed the wheel starts to turn.

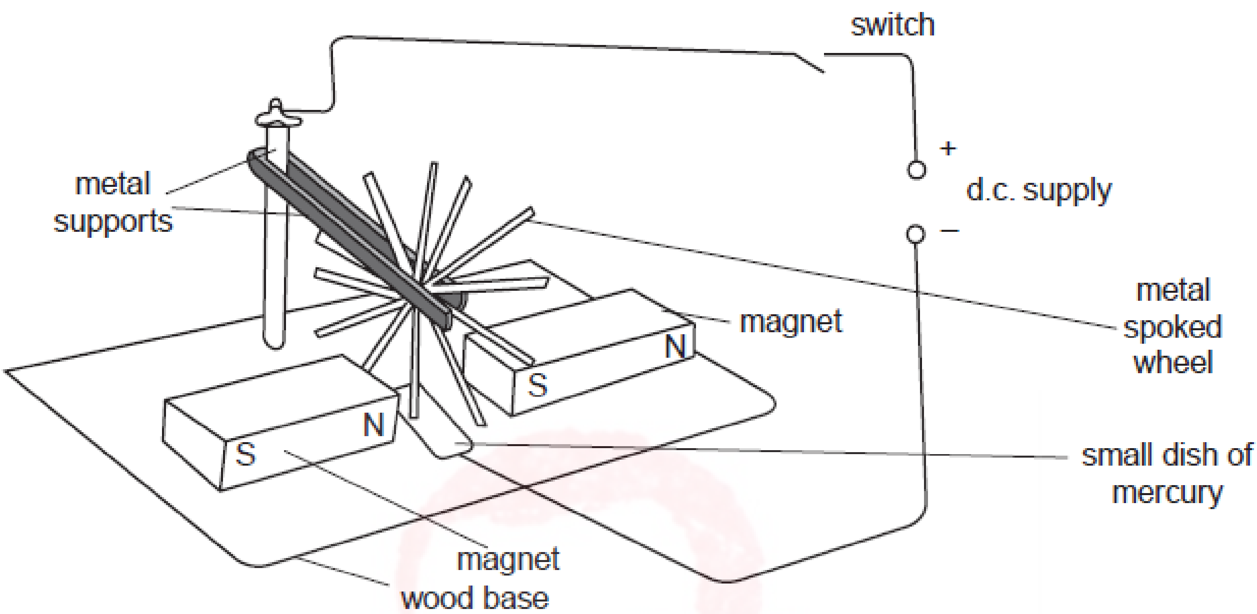



**Fig. 9.1**

**(a)** Explain why the wheel turns when the switch is closed.

..................................................................................................................................

..................................................................................................................................

..................................................................................................................................

.................................................................................................................................. [2]

**(b)** On Fig. 9.1, draw an arrow to show the direction of rotation of the wheel. [1]

**(c)** The d.c. motor is another way to convert electrical energy into kinetic energy.

In the space below, draw a labelled diagram of a d.c. motor.

[3]

**(d)** Describe how the split-ring commutator on an electric motor works.

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

.................................................................................................................................... [2]

[Total: 8]

**9** A transformer is needed to step down a 240 V a.c. supply to a 12 V a.c. output.

**(a)** In the space below, draw a labelled diagram of a suitable transformer. [3]

**(b)** Explain

**(i)** why the transformer only works on a.c.,

..........................................................................................................................

..........................................................................................................................[1]

**(ii)** how the input voltage is changed to an output voltage.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................[2]

**(c)** The output current is 1.5 A.

Calculate

**(i)** the power output,

power = ..........................[1]

**(ii)** the energy output in 30 s.

energy = ..........................[1]

**10** Fig. 10.1 shows the basic parts of a transformer.

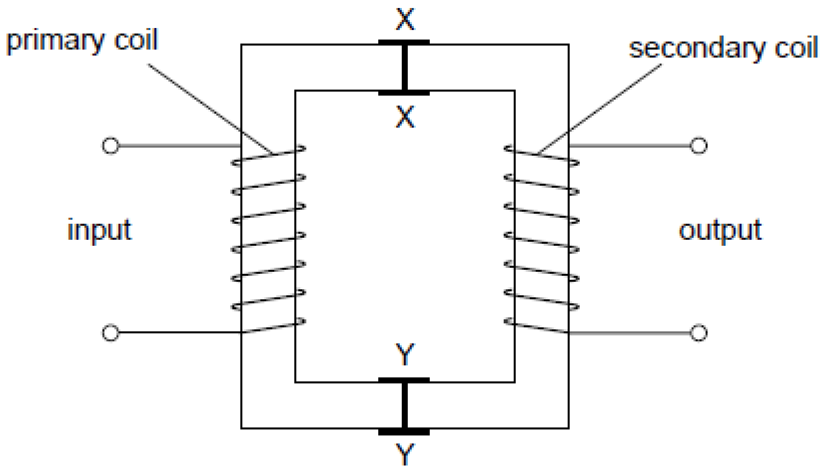



**Fig. 10.1**

**(a)** Use ideas of electromagnetic induction to explain how the input voltage is transformed into an output voltage. Use the three questions below to help you with your answer.

What happens in the primary coil?

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

What happens in the core?

..........................................................................................................................................

..........................................................................................................................................

What happens in the secondary coil?

..........................................................................................................................................

..........................................................................................................................................

.................................................................................................................................... [5]

**(b)** State what is needed to make the output voltage higher than the input voltage.

.................................................................................................................................... [1]

**(c)** The core of this transformer splits along XX and YY. Explain why the transformer would not work if the two halves of the core were separated by about 30 cm.

..........................................................................................................................................

.................................................................................................................................. [1]

**(d)** A 100% efficient transformer is used to step up the voltage of a supply from 100 V to 200 V. A resistor is connected to the output. The current in the primary coil is 0.4 A.

Calculate the current in the secondary coil.

current = ........................ [2]

**Q# 19/ iG Phx/2005/s/ www.SmashingScience.org**

**11** Fig. 11.1 shows a flexible wire hanging between two magnetic poles. The flexible wire is connected to a 12 V d.c. supply that is switched off.

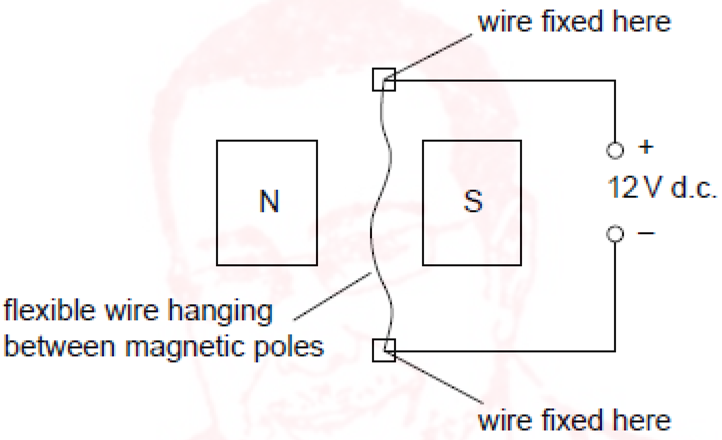



**Fig. 11.1**

**(a)** Explain why the wire moves when the supply is switched on.

..........................................................................................................................................

..........................................................................................................................................

.................................................................................................................................. [2]

**(b)** State the direction of the deflection of the wire.

..........................................................................................................................................

.................................................................................................................................. [2]

**(c)** When the wire first moves, energy is changed from one form to another. State these two forms of energy.

from ........................................................ to ........................................................ [1]

**(d)** Fig. 11.2 shows the flexible wire made into a rigid rectangular coil and mounted on an axle.

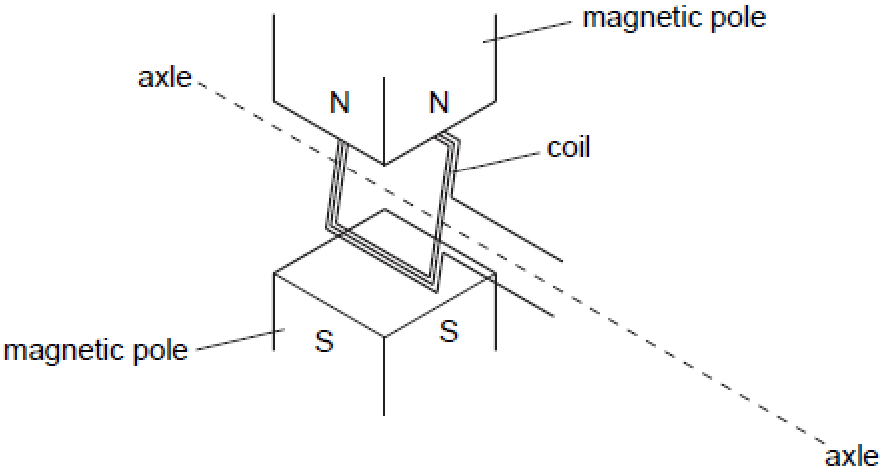



**Fig. 11.2**

**(i)** Add to the diagram an arrangement that will allow current to be fed into the coil whilst allowing the coil to turn continuously. Label the parts you have added. [1]

**(ii)** Briefly explain how your arrangement works.

..........................................................................................................................................

.................................................................................................................................... [2]

**9** **(a)** An engine on a model railway needs a 6 V a.c. supply. A mains supply of 240 V a.c. is available.

**(i)** In the space below, draw a labelled diagram of a transformer suitable for producing the required supply voltage.

**(ii)** Suggest suitable numbers of turns for the coils.

..........................................................................................................................................

.......................................................................................................................................... [4]

**(b)** The power needed for this model engine is 12 W. Calculate the current taken from the mains when just this engine is in use, assuming that the transformer is 100% efficient.

current = ......................[2]

**(c)** Explain why transformers will only work when connected to an a.c. supply.

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................[2]

9 Electromagnetic induction can be demonstrated using a solenoid, a magnet, a sensitive ammeter and connecting wire.

(a) In the space below, draw a labelled diagram of the apparatus set up to demonstrate electromagnetic induction. [2]

(b) State one way of using the apparatus to produce an induced current.

..........................................................................................................................

..........................................................................................................................[1]

(c) Explain why your method produces an induced current.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................[2]

(d) Without changing the apparatus, state what must be done to produce

(i) an induced current in the opposite direction to the original current,

..........................................................................................................................

..........................................................................................................................

(ii) a larger induced current.

..........................................................................................................................

..........................................................................................................................

[2]

**8** Fig. 8.1 shows the outline of an a.c. generator. The peak output voltage of the generator is 6.0 V and the output has a frequency of 10 Hz.

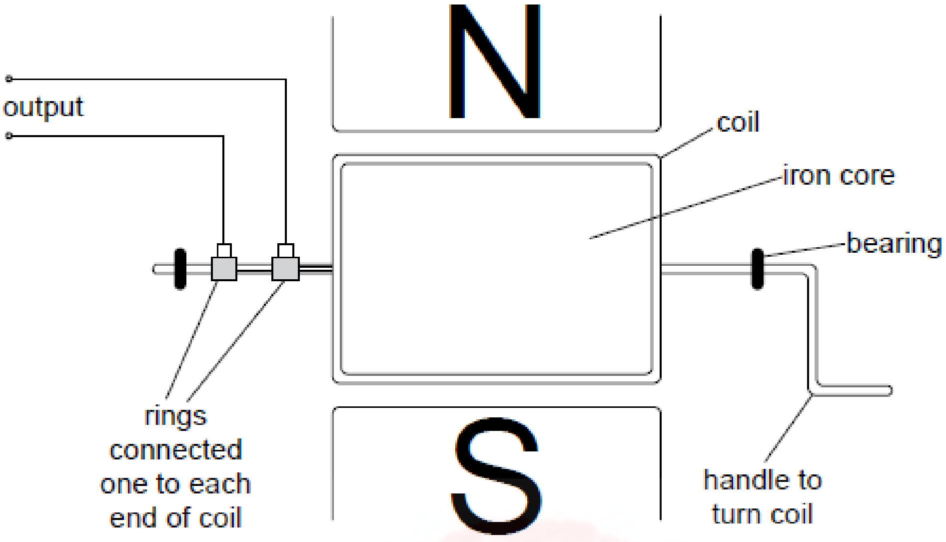



**Fig. 8.1**

**(a)** Fig. 8.2 shows the axes of a voltage-time graph for the generator output.

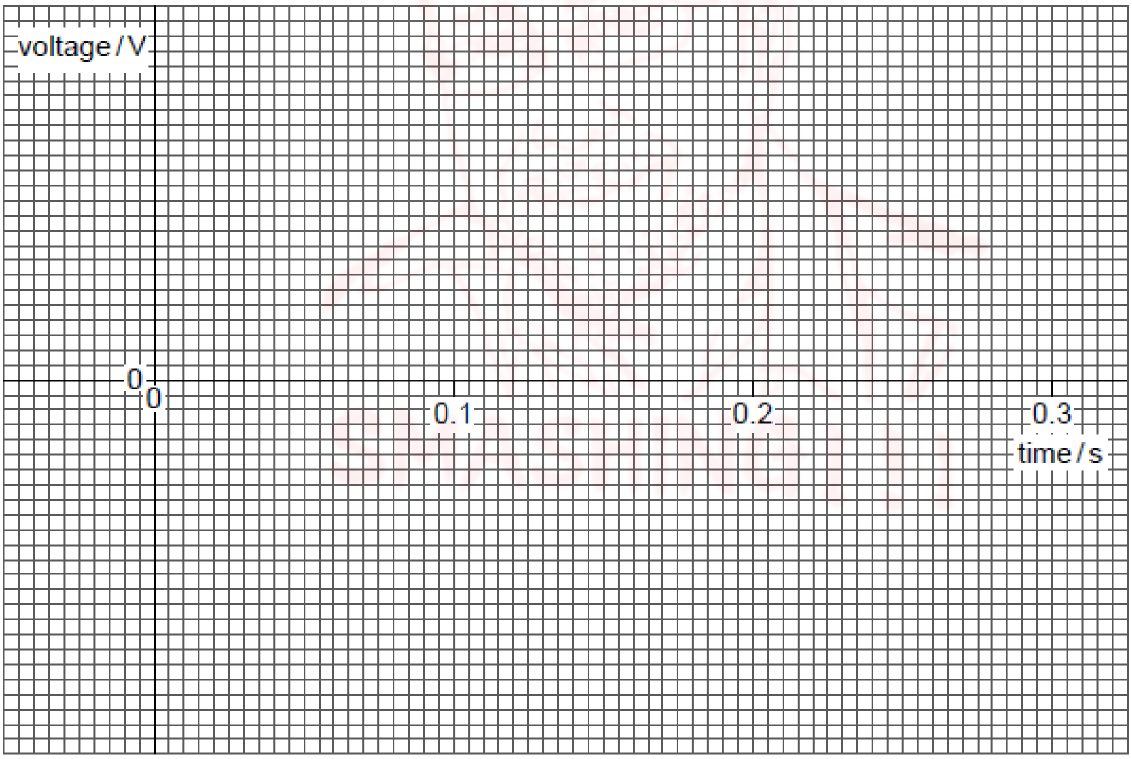



**Fig. 8.2**

On Fig. 8.2,

**(i)** mark suitable voltage values on the voltage axis,

**(ii)** draw a graph of the generator output.

[3]

**(b)** The generator shown in Fig. 8.1 works by electromagnetic induction.

Explain how this effect produces the output voltage.

..........................................................................................................................................

..........................................................................................................................................

..........................................................................................................................................

.................................................................................................................................. [3]

**(c)** State the energy changes that occur in the generator when it is producing output.

.................................................................................................................................. [2]

**Q# 23/_iG Phx/2003/s/ www.SmashingScience.org**

**9** A transformer has an output of 24 V when supplying a current of 2.0 A. The current in the primary coil is 0.40 A and the transformer is 100% efficient.

**(a)** Calculate

**(i)** the power output of the transformer,

power = ..................................

**(ii)** the voltage applied across the primary coil.

voltage = ..................................

[4]

**(b)** Explain

**(i)** what is meant by the statement that the transformer is 100% efficient,

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

**(ii)** how the transformer changes an input voltage into a different output voltage.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

[4]

**10** Fig. 10.1 and Fig. 10.2 show two views of a vertical wire carrying a current up through a horizontal card. Points P and Q are marked on the card.

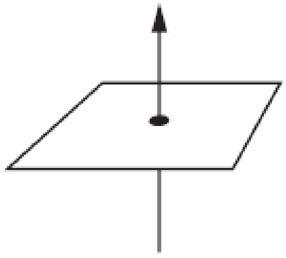
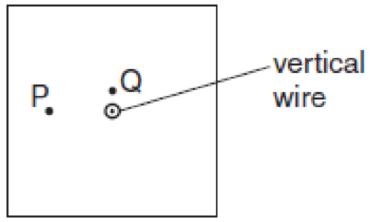


**Fig. 10.1**




view from above the card

**Fig. 10.2**

**(a)** On Fig. 10.2,

**(i)** draw a complete magnetic field line (line of force) through P and indicate its direction with an arrow,

**(ii)** draw an arrow through Q to indicate the direction in which a compass placed at Q would point.

[3]

**(b)** State the effect on the direction in which compass Q points of

**(i)** increasing the current in the wire,

..........................................................................................................................

**(ii)** reversing the direction of the current in the wire.

..........................................................................................................................

[2]

**(c)** Fig. 10.3 shows the view from above of another vertical wire carrying a current up through a horizontal card. A cm grid is marked on the card. Point W is 1 cm vertically above the top surface of the card.

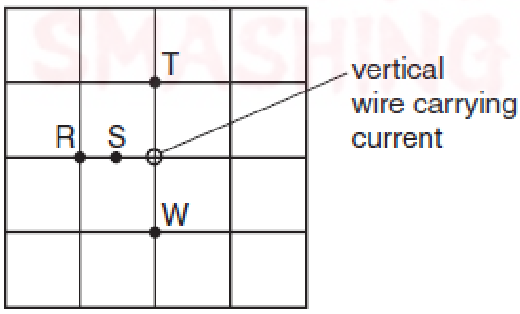



**Fig. 10.3**

State the magnetic field strength at S, T and W in terms of the magnetic field strength at R. Use one of the alternatives, **weaker**, **same strength** or **stronger** for each answer.

at S ..........................................................................

at T ..........................................................................

at W.......................................................................... [3]

**8** Fig. 8.1 shows a long straight wire between the poles of a permanent magnet.
It is connected through a switch to a battery so that, when the switch is closed, there is a steady current in the wire.

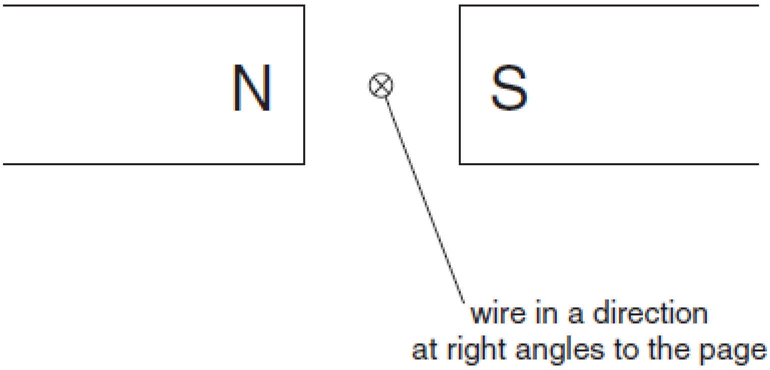



**Fig. 8.1**

**(a)** State the direction of the magnetic field between the poles of the magnet.

.......................................................................................................................[1]

**(b)** The wire is free to move. The current is switched on so that its direction is into the page.

**(i)** State the direction of movement of the wire.

.......................................................................................................................

.......................................................................................................................

**(ii)** Explain how you reached your answer to **(b)(i)**.

.......................................................................................................................

.......................................................................................................................

.......................................................................................................................
[4]

**(c)** This experiment is the basis of an electric motor.
Describe two changes to the arrangement shown in Fig. 8.1 that would enable continuous rotation to take place.

change 1 .......................................................................................................

.......................................................................................................................

change 2 .......................................................................................................

.......................................................................................................................[2]

7 Fig. 7.1 shows an arrangement that could be used for making an electromagnet or a permanent magnet.

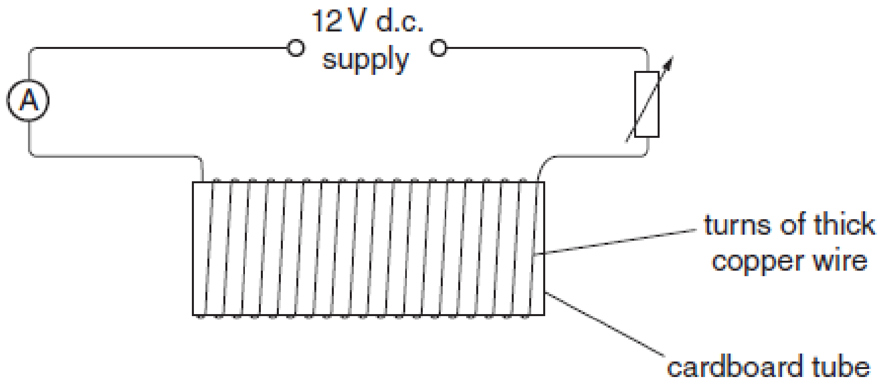



**Fig. 7.1**

Two bars of the same size are also available, one made of iron and the other of steel.

**(a)** **(i)** State which bar should be used to make a permanent magnet.

..........................................................................................................................

**(ii)** Describe how the apparatus would be used to make a permanent magnet.

..........................................................................................................................

..........................................................................................................................

..........................................................................................................................

**(iii)** Suggest one reason why the circuit contains an ammeter and a variable resistor.

..........................................................................................................................

..........................................................................................................................

[3]

**(b)** During the making of a permanent magnet, the ammeter reads a steady current of 4.0 A throughout the 5.0 s that the current is switched on. The voltage of the supply is 12 V.

Calculate

**(i)** the total circuit resistance,

resistance = ............................

**(ii)** the power of the supply,

power = ................................

**(iii)** the energy supplied during the 5.0 s.

energy = ................................

[6]

**(c)** The potential difference across the variable resistor is 7.0 V and that across the ammeter is zero.

**(i)** Calculate the potential difference across the magnetising coil.

potential difference = ................................

**(ii)** State the general principle used in making this calculation.

..........................................................................................................................

..........................................................................................................................

[3]

Mark Scheme

**Q# 1/ iG Phx/2014/w/Paper 33/ www.SmashingScience.org**

| | | | | |
|---|---|---|---|---|
| 9 | (a) | (i) | (magnetic field) lines closer together / denser / more lines | B1 |
| | | (ii) | (magnetic field (lines) direction reversed | B1 |
| | (b) | (i) | ammeter needle deflects / reading on ammeter | B1 |
| | | | (magnetic) field cuts coil **OR** changing (magnetic) field | B1 |
| | | | (electromagnetic) induction | B1 |
| | | (ii) | deflection / reading on ammeter smaller **OR** lasts longer | B1 |
| | | | slower rate of cutting field lines **OR** slower rate of change of field | B1 |
| | | | | **[Total: 7]** |

**Q# 2/ iG Phx/2014/s/Paper 31/ www.SmashingScience.org**

| | | | | |
|---|---|---|---|---|
| 10 | (a) | | slip-rings (and brushes) | B1 |
| | (b) | (i) | sinusoidal curve, any value at $t = 0$ | B1 |
| | | (ii) | appropriate $T$ value indicated on graph | B1 |
| | | (iii) | smaller $T$ / time of one cycle OR higher frequency | B1 |
| | | | higher maximum current / greater amplitude / higher peaks / higher peak-to-peak | B1 |
| | (c) | | diode / rectifier | B1 |
| | | | | **[Total: 6]** |

**Q# 3/ iG Phx/2013/w/Paper 31/QiG Phx/2008/(b)**

| | | |
|---|---|---|
| (ii) | same frequency a.c. ticked | B1 |
| (iii) | $V_S/V_P = N_S/N_P$ in any form OR ($V_S$ =) 12 × 200/50 OR 48 (V) | C1 |
| | $V_S I_S = V_P I_P$ in any form OR with numbers | C1 |
| | ($I_S$ =) 12 × 0.50/48 = 0.12 A OR 0.13 A | A1 |
| | OR | |
| | $I_S/I_P = N_P/N_S$ in any form | (C2) |
| | ($I_S$ =) 0.5 × 50/200 = 0.12 A OR 0.13 A | (A1) |

**Q# 4/_iG Phx/2013/w/Paper 31/ www.SmashingScience.org**

**8** **(a)** circuit with solenoid AND galvanometer or ammeter or voltmeter — B1

magnet labelled OR poles shown, with any orientation, near solenoid OR inside solenoid — B1

appropriate action described e.g. move magnet/solenoid — B1

**(b)** **(i)** magnetic field (in core) — M1

(magnetic field is) alternating/changing/reversing — A1

**(ii)** same frequency a.c. ticked — B1

**(iii)** $V_S/V_P = N_S/N_P$ in any form OR $(V_S =)$ 12 × 200/50 OR 48 (V) — C1

$V_S I_S = V_P I_P$ in any form OR with numbers — C1

$(I_S =)$ 12 × 0.50/48 = 0.12 A OR 0.13 A — A1

OR

$I_S / I_P = N_P / N_S$ in any form — (C2)

$(I_S =)$ 0.5 × 50/200 = 0.12 A OR 0.13 A — (A1)

**[Total: 9]**

**Q# 5/_iG Phx/2013/w/Paper 31/ www.SmashingScience.org**

**8** **(a)** circuit with solenoid AND galvanometer or ammeter or voltmeter — B1

magnet labelled OR poles shown, with any orientation, near solenoid OR inside solenoid — B1

appropriate action described e.g. move magnet/solenoid — B1

**(b)** **(i)** magnetic field (in core) — M1

(magnetic field is) alternating/changing/reversing — A1

**Q# 6/ iG Phx/2013/s/Paper 31/ www.SmashingScience.org**

| | | | | |
|---|---|---|---|---|
| 10 | (a) | | at least 3 concentric circles centred on wire | B1 |
| | | | arrows clockwise on each circle / at least one circle | B1 |
| | | | spacing of circles increasing as radius increases | B1 |
| | (b) | (i) | arrow pointing down on side AB, up on side CD | B1 |
| | | (ii) | forces on AB and CD are opposite OR up and down and separated / not in same line (so cause rotation)<br>OR have moments in same sense / direction<br>OR cause couple / torque | B1 |
| | | (iii) | to reverse current in loop or keep current in AB or CD in the same direction<br>OR keep current on side near a pole in the same direction when (plane of) coil is vertical<br>OR every half turn<br>OR when AB and CD swap sides | B1 |
| | | | so that:<br>rotation continues (in same direction)<br>OR so that rotation doesn't reverse its direction<br>OR to maintain sense/direction of moments/couple<br>OR coil turns more than half a revolution | B1 |
| | | | | **[Total 7]** |

**Q# 7/ iG Phx/2012/w/Paper 31/ www.SmashingScience.org**

| | | | | |
|---|---|---|---|---|
| 9 | (a) | (i) | In the opposite direction OR downwards | B1 |
| | | | Faster / fast | B1 |
| | | (ii) | No voltage/current induced | B1 |
| | | | Currents/voltages (induced) in each half of XY are equal and in opposite directions/oppose each other | B1 |

**Q# 8/ iG Phx/2011/w/Paper 31/ www.SmashingScience.org**

| | | | | | |
|---|---|---|---|---|---|
| 8 | (a) | | any three from:<br>use a strong(er) magnet<br>increase the number of coils in the solenoid / turns of solenoid closer together<br>move the magnet fast(er).<br>place iron core in the solenoid<br>use thick(er) wire / low(er) resistance wire for solenoid | max B3 | |
| | (b) | (i) | $N_P/N_S = V_P/V_S$ OR $200/800 = V_P/24$ OR $V_P = N_P V_S/N_S$<br>OR $V_P = 200 \times 24/800$ | C1 | |
| | | | 6.0 V | A1 | |
| | | (ii) | $I_pV_p = I_sV_s$ OR $I_pN_p = I_sN_s$ OR $I_P = I_SV_S/V_P$ OR $I_P = I_SN_S/N_P$<br>OR $I_P = (0.5 \times 24)/6$ OR $I_P = (0.5 \times 800)/200$ | C1 | |
| | | | 2(.0) A<br>allow ecf from **(b)(i)** | A1 | [7] |

**Q# 9/ iG Phx/2011/s/Paper 31/ www.SmashingScience.org**

9 (a) (i) down
down OR anti-clockwise } both — B1

(ii) BC is parallel to the field/doesn't cut field or vice-versa/not at angle to field
ignore BC not perpendicular to field — B1

(b) continues moving/turning NOT reverse/other direction — M1
idea of moving things continue moving OR reference to Newton's Laws
OR reference to momentum/KE/inertia NOT reference to force still acting — A1

(c) more turns/several coils
iron core
increase current/voltage
stronger magnet
smaller air gap
curved poles
more efficient brushes
poles closer
use split-ring commutator
} any 1 — B1 [5]

**Q# 10/ iG Phx/2010/s/Paper 31/ www.SmashingScience.org**

8 (a) (i) $N_1/N_2 = V_1/V_2$ in any form, symbols, words or numbers — C1
12 (turns) [possible unit penalty] — A1

(ii) mention of magnetic / electromagnetic field
change of flux linkage / magnetism
OR field lines being cut
Induced current / emf / voltage
Fewer coils in secondary so smaller emf / voltage
OR larger current
) any 3 — B1 x 3

(iii) heat in either coil / wires
eddy currents in core / heat in core
magnetic leakage from core
sound from core/coil
) any 1 — B1

(b) (i) 12 V d.c. OR low d.c.voltage — B1

(ii) diode OR rectifier [Ignore extras unless wrong] — B1

(c) $V_1I_1 = V_2I_2$ in any form, or words or numbers
OR power in = power out or equivalent — C1

8 A — A1 [10]

**Q# 11/ iG Phx/2010/s/Paper 31/ www.SmashingScience.org**

9 (a) first finger – field / magnetism / flux )
second finger – current / charge flow (NOT electron flow) ) both B1

(b) (i) brush OR contact OR sliding connector B1
split ring OR commutator NOT slip ring B1

(ii) clockwise OR right side down OR left side up OR correct arrows on figure NOT turn to the right B1

(iii) more current / more voltage / "stronger battery" / more power )
more turns on coil / more coils )
stronger magnet Ignore bigger magnets )
closer magnet / magnetic poles ) any 2 B1, B1
more magnets )
iron core ) [6]

**Q# 12/ iG Phx/2009/w/Paper 31/ www.SmashingScience.org**

7 (a)

| EITHER | OR |
|---|---|
| copper | constantan |
| copper | constantan |
| constantan | copper |

B1

(b) galvanometer OR millivoltmeter OR milliammeter OR digital ammeter OR digital voltmeter B1

(c) rapid response )
small area )
can measure high / low temperatures )
small thermal capacity (idea of) ) any 1 B1
remote reading )
large range )
data logging / continuous monitoring possible )
takes temperature of a surface )
N.B. (very) sensitive not accepted

**[3]**

**Q# 13/ iG Phx/2008/w/Paper 31/ www.SmashingScience.org**

**Q# 14/ iG Phx/2008/s/Paper 31/ www.SmashingScience.org**

| | | | | |
|---|---|---|---|---|
| 9 | (a) | | 3 complete circles about thick wire, roughly concentric on wire<br>clockwise or anticlockwise arrows on any 2 correct circles, and no contradictions | B1<br>B1 |
| | (b) | (i) | reduced | B1 |
| | | (ii) | same OR none | B1 |
| | (c) | (i) | thin wire is a current-carrying conductor in a magnetic field<br>field produced by current in thick wire<br>OR alternative approach:<br>( both wires produce a magnetic field<br>( fields interact | B1<br>B1<br><br>B1 )<br>B1 ) |
| | | (ii) | inwards/towards thick wire/to right/towards $T_1T_2$ | B1 |
| | | (iii) | smaller force | B1 |

[8]

**Q# 15/ iG Phx/2007/w/Paper 31/ www.SmashingScience.org**

| | | | |
|---|---|---|---|
| 9 | (a) | when magnetic field cuts/cut by conductor/wire/coil/solenoid<br>OR change in magnetic field linked with coil etc. | <br>B1 |
| | | current/e.m.f caused | B1 |
| | (b) | solenoid ends connected to meter/lamp note: any sign of a cell gets B0<br>magnet indicated in suitable position on axis of solenoid | B1<br>B1 |
| | (c) | insert/withdraw/move magnet into/out of solenoid<br>meter gives reading (as magnet moves) OR watch the meter OR lamp glows | B1<br>B1 |
| | (d) | move magnet faster )<br>increase strength of magnet ) any 2<br>more turns on solenoid )<br>closer to solenoid ) | B1+B1 |

[Total: 8]

**Q# 16/ iG Phx/2007/s/Paper 31/ www.SmashingScience.org**

| | | | | |
|---|---|---|---|---|
| 9 | (a) | current in spoke in magnetic field | B1 | |
| | | causes force on spoke/wheel | B1 | [2] |
| | (b) | arrow to indicate anticlockwise motion | B1 | [1] |
| | (c) | outline of coil, pole pieces | B1 | |
| | | d.c. supply connected to brushes | B1 | |
| | | split rings connected to coil | B1 | [3] |
| | (d) | brushes connect to other split ring every half turn/coil vertical | B1 | |
| | | reverses direction of current every half turn/coil vertical | B1 | [2] |
| | | | | [Total: 8] |

**Q# 17/ iG Phx/2006/s/Paper 31/ www.SmashingScience.org**

| | | | | | |
|---|---|---|---|---|---|
| 9 | (a) | | primary and secondary coils on iron core labelled<br>240 V a.c. to primary, 12 V a.c. to secondary<br>turns ratio shown or stated 20:1, stepdown | B1<br>B1<br>B1 | <br><br>3 |
| | (b) | (i) | must be constantly changing magnetic field | B1 | |
| | | (ii) | magnetic field of primary passes through core to secondary<br>magnetic field of secondary cuts coil, induces output | B1<br>B1 | <br>3 |
| | (c) | (i) | 18 W | A1 | |
| | | (ii) | 540 J | A1 | 2<br>[8] |

**Q# 18/ iG Phx/2005/w/Paper 31/ www.SmashingScience.org**

| | | | | |
|---|---|---|---|---|
| 10 | (a) (i) | a.c. input causes constantly changing current through coil<br>magnetic field formed in or around coil<br>constantly changing magnetic field | B1<br>B1<br>B1 | <br><br>[M2] |
| | (ii) | (changing) magnetic field transferred to secondary coil | B1 | |
| | (iii) | (changing) magnetic field cuts secondary coil<br>induces e.m.f. | B1<br>B1 | <br>[3] |
| | (b) | more turns on secondary (than on primary) | B1 | [1] |
| | (c) | no transfer of magnetic field from primary to secondary | B1 | [1] |
| | (d) | Vp.Ip = Vs. Is or 100 x 0.4 = 200 x Is<br>Is = 0.2 A | C1<br>A1 | <br>[2]<br>Total [9] |

Q# 19/_iG Phx/2005/s/ www.SmashingScience.org

| | | | | | |
|---|---|---|---|---|---|
| 11 | (a) | | magnetic field and current at right angles causes<br>force on wire which deflects it<br>or<br>field around wire (B1)<br>interacts with the field of the magnet (B1) | B1<br>B1 | <br>2 |
| | (b) | | normal to/between poles, either way however expressed<br>out of paper | C1<br>A1 | <br>2 |
| | (c) | | converts electrical energy to work/k.e./movement energy | B1 | 1 |
| | (d) | (i) | split rings and brushes or equivalent (e.g. leaning wires) | B1 | |
| | | (ii) | every half turn current passes from one ring to the other<br>so current flows opposite way around coil or commutates | B1<br>B1 | <br>3<br>[8] |

Q# 20/_iG Phx/2004/w/Paper 3/ www.SmashingScience.org

| | | | | | |
|---|---|---|---|---|---|
| 9 | (a) | (i) | two coils on continuous core (not allow coils joined) | 1 | |
| | | | primary coil to 240 V, secondary coil to 6 V | 1 | |
| | | | <u>iron</u> core, primary/input and secondary/output labelled | 1 | |
| | | (ii) | any values with <u>correct</u> 40:1 ratio, accept here or on diagram | 1 | 4 |
| | (b) | | power in = power out or 240 x I = 12 | 1 | |
| | | | current = 0.05 A | 1 | 2 |
| | (c) | | must be a changing magnetic field, only from a.c. | 1 | 2 |
| | | | so that induction can take place | 1 | (8) |

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| | | | | | |
|---|---|---|---|---|---|
| 9 | (a) | | Solenoid ends connected to meter, both labelled | B1 | |
| | | | <u>One</u> magnet in correct position to enter / leave solenoid, labelled | B1 | 2 |
| | (b) | | Push magnet into coil / pull out / move near end of coil | B1 | 1 |
| | (c) | | (magnet has / produces) magnetic lines of force / magnetic field | B1 | |
| | | | lines cut (coils of) solenoid / coils / wires | B1 | 2 |
| | (d) | (i) | Pull magnet out of coil / <u>reverse</u> effect to answer **(b)** | B1 | |
| | | (ii) | Move magnet faster or effect in **(a)** faster | B1 | 2<br>[7] |

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| | | | | |
|---|---|---|---|---|
| 8 (a) (i) | | 0-6 (V) positive and negative | A1 | |
| | (ii) | all waves roughly 6V amplitude | B1 | |
| | | 3 waves approx. one wave every 0.1 s | B1 | 3 |
| (b) | | any mention of magnetic field | B1 | |
| | | coils (forced to) cut magnetic field | B1 | |
| | | induces e.m.f./voltage/current in the coils | B1 | |
| | | as in Fleming's R.H. rule | B1 | M3 |
| (c) | | mechanical energy/work (in)/kinetic energy | B1 | |
| | | electrical (out) (+ heat) (ignore sound) | B1 | 2 |
| | | | | [8] |

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| | | | | | |
|---|---|---|---|---|---|
| 9 | (a) | (i) | power = VI or 24 X 2 | C1 | |
| | | | power is 48 W | A1 | |
| | | (ii) | voltage = power/current or 48/0.4 | C1 | |
| | | | voltage is 120 V | A1 | 4 |
| | (b) | (i) | no/very little energy/power lost or energy/power in = energy/power out | B1 | |
| | | (ii) | any mention of magnetic field | B1 | |
| | | | changing magnetic field | B1 | |
| | | | field passes through core or secondary coil | B1 | |
| | | | induces voltage in secondary coil | B1 | |
| | | | number of turns on secondary determines voltage output | B1 | max 4 |
| | | | | | [8] |

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| | | | | | |
|---|---|---|---|---|---|
| 10 | (a) | (i) | circular line of force around wire through P | M1 | |
| | | | arrow(s) on line anticlockwise - none wrong | A1 | |
| | | (ii) | arrow through Q to left | A1 | 3 |
| | (b) | (i) | none/stays same | B1 | |
| | | (ii) | direction reverses | B1 | 2 |
| | (c) | | at S - stronger | B1 | |
| | | | at T - same (strength) | B1 | |
| | | | at W - same (strength) | B1 | 3 |
| | | | | | [8] |

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| | | | | |
|---|---|---|---|---|
| 8 a | (magnetic field) from left to right/ N to S | 1 | B1 | 1 |
| b(i) | movement at right angles/between poles, up or down | | C1 | |
| | (vertically) down, stated or reference to arrow on diagram or label | 2 | A1 | |
| (ii) | mention of Fleming's L.H.R. or interacting fields | | C1 | |
| | full explanation ~~leading to correct direction~~ e.g what fingers show | 2 | A1 | 4 |

| | | | | |
|---|---|---|---|---|
| 7 a(i) | steel | 1 | A1 | |
| (ii) | insert bar in coil (switch on, leave, switch off) | 1 | B1 | |
| (iii) | to control/measure current or stop circuit/coil overheating | 1 | B1 | 3 |
| b(i) | R = 12/4 | | C1 | |
| | = 3 ohms* | 2 | A1 | |
| (ii) | P = 12 x 4 | | C1 | |
| | = 48 W* | 2 | A1 | |
| (iii) | E = 48 x 5 | | C1 | |
| | =240 J* | 2 | A1 | 6 |
| c(i) | 5 (V) | 1 | A1 | |
| (ii) | sum of p.d.'s = circuit supply p.d. | | C1 | |
| | above + detail eg across each component/ in closed circuit etc | 2 | A1 | 3 |
| | | | | QT 12 |