

Motors and electromagnetic induction

- 1) A rotating-coil generator consists of a rectangular coil of wire that rotates at constant speed between the poles of a permanent magnet.

Figs. 10.1, 10.2 and 10.3 show views from one end of the coil, when the coil is in different positions.

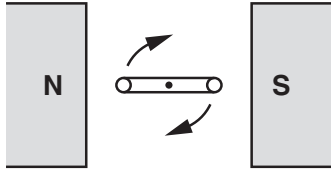


Fig. 10.1

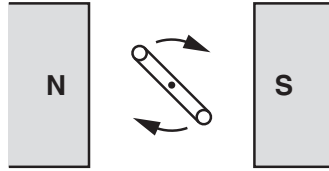


Fig. 10.2

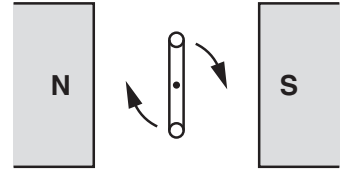


Fig. 10.3

- (a) Which diagram shows the coil in the position where
- (i) the induced e.m.f. in the coil is at its maximum,
 - (ii) the induced e.m.f. in the coil is zero? [2]
- (b) On Fig. 10.4, sketch the graph of e.m.f. against time, for two complete rotations of the coil.



Fig. 10.4

[4]

[Total: 6]

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- 2) (a) The circuit symbol shown in Fig. 9.1 represents a device often used in electrical equipment.

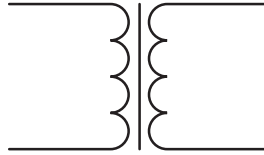


Fig. 9.1

State the name of this device.

.....[1]

- (b) Fig. 9.2 shows, in simplified form, the essential parts of a grid system for distributing electrical energy from a power station to domestic consumers. The device in part (a) is used both at X and at Y.

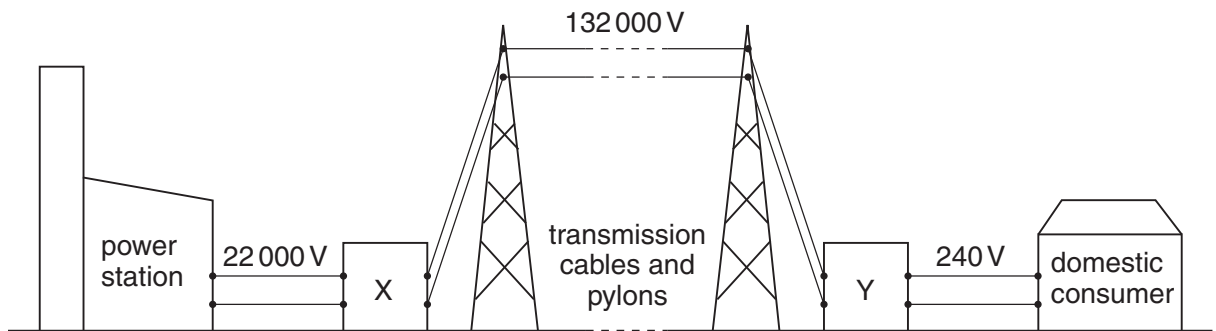


Fig. 9.2

- (i) Using information from Fig. 9.2, deduce the ratio $\frac{\text{secondary turns}}{\text{primary turns}}$ necessary at X and at Y.

turns ratio at X =

turns ratio at Y =[3]

- (ii) State two reasons why power transmission is cheaper if the voltage across the cables is very high.

1.

.....

2.

.....[2]

[Total: 6]

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3)

The pivoted steel arrow from a small compass has become demagnetised.

The coil shown in Fig. 7.1 is to be used to magnetise it again.



Fig. 7.1

(a) Describe carefully

(i) how the coil is used to magnetise the steel arrow,

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

(ii) how the polarity of the magnetised needle may be checked.

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

(b) On Fig. 7.1, draw the magnetic field pattern of the magnetised needle. [2]

[Total: 6]

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- 4) (a) Two coils are wound on an iron rod, as shown in Fig. 9.1. One coil is connected to a cell and a switch. The other is connected to a sensitive centre-zero millivoltmeter.

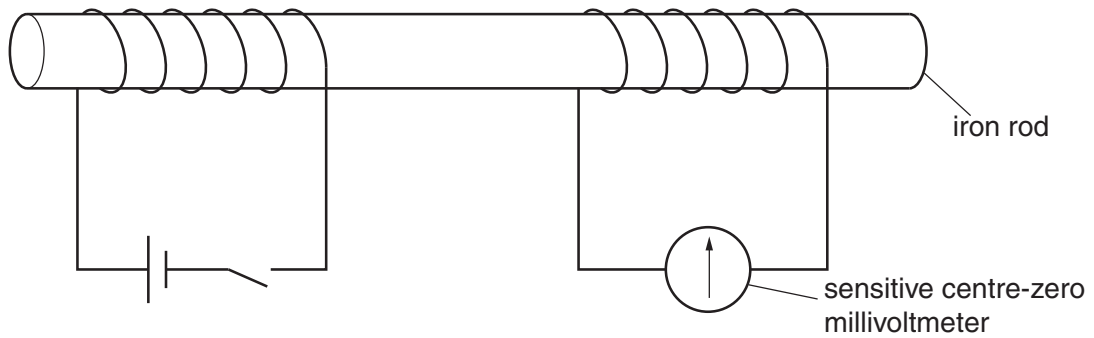


Fig. 9.1

- (i) The open switch is now closed.

State what happens to

1. the iron rod,

..... [1]

2. a small steel pin held close to one end of the iron rod,

..... [1]

3. the needle of the millivoltmeter.

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

- (ii) The switch is opened again.

State what happens to the needle of the millivoltmeter.

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

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- 5) A coil P is joined to a battery and a switch S. A similar coil Q is joined to a sensitive centre-zero millivoltmeter G.

P and Q are placed end to end, as shown in Fig. 10.1.

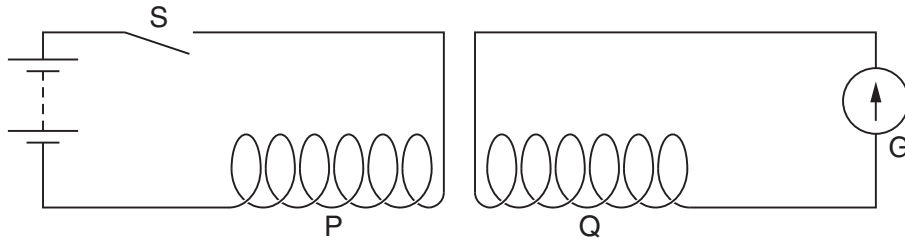


Fig. 10.1

- (a)** Describe what is seen happening to the reading of G

- (i)** as switch S is closed,

.....

 [2]

- (ii)** as switch S is opened again.

.....

 [1]

- (b)** A soft iron bar, as long as the combined lengths of P and Q, is placed inside P and Q.

State what difference this makes to what is observed on G as S is closed.

.....
 [1]

- (c)** The bar in **(b)** is removed and the battery is changed for one with a smaller e.m.f.

State what difference this makes to what is observed on G as S is closed.

.....
 [1]

- (d)** The battery is replaced by an a.c. power supply of frequency 50 cycles per second, and then S is closed.

Describe what is seen on G.

.....
 [1]

[Total: 6]

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6)

The coil in the d.c. motor in Fig. 9.1 is rotating as shown.

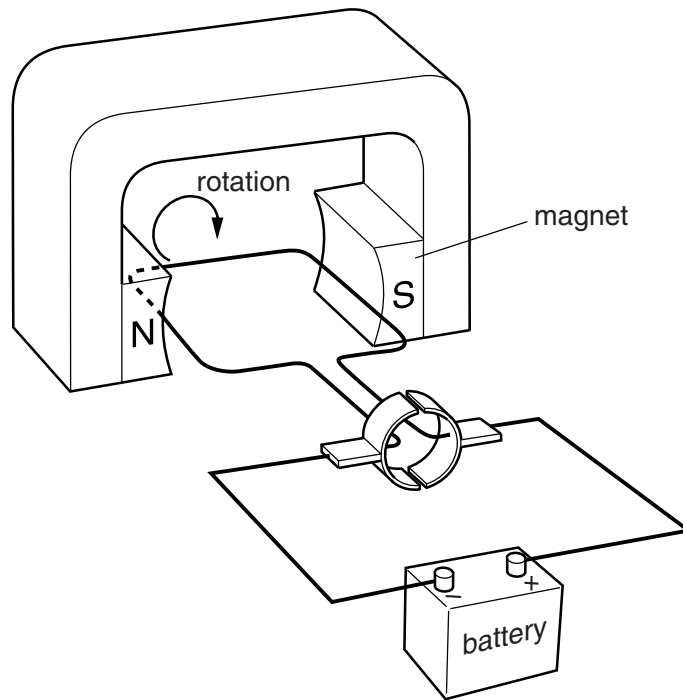


Fig. 9.1

(a) On Fig. 9.1, clearly label the coil. [1]

(b) State two things that could be done to the apparatus shown in Fig. 9.1 in order to make the coil rotate more rapidly.

1.

2. [2]

(c) Suggest how the coil could be made to rotate in the opposite direction.

.....

..... [1]

[Total: 4]

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7)

A solenoid with many turns is connected across a sensitive centre-zero millivoltmeter, as shown in Fig. 9.1.

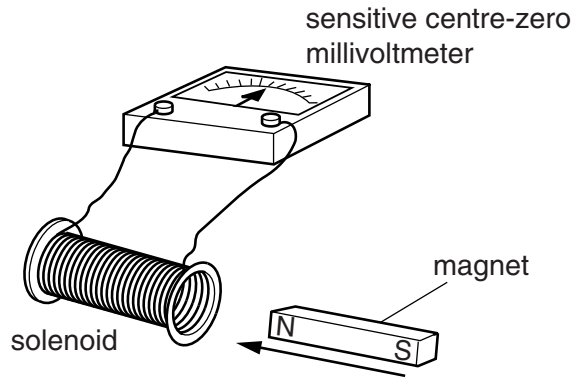


Fig. 9.1

- (a)** The N pole of a magnet is moved into the solenoid, and then held stationary in the solenoid.

Describe what happens to the needle of the millivoltmeter during this process.

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

- (b)** The N pole is then removed from the solenoid.

Describe what happens to the needle during this process.

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

- (c)** Complete the following sentence.

When the N pole moves into the solenoid, is

..... in the solenoid. [2]

[Total: 5]

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8)

A 240V a.c. mains supply is connected to the primary coil of the transformer shown in Fig. 10.1. A lamp that gives full brightness with a 6V supply is connected to the secondary coil.

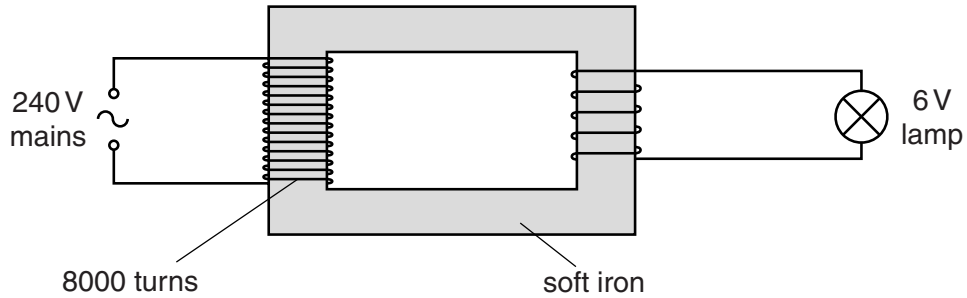


Fig. 10.1

(a) Name a suitable material from which the coils may be made.

..... [1]

(b) State the name given to the part of the transformer that is made of soft iron (see Fig. 10.1).

..... [1]

(c) Calculate the number of turns of wire in the secondary coil that will enable the lamp to light at full brightness.

number of turns = [3]

(d) State what would happen to the lamp if the number of turns in the secondary coil was

(i) much less than that calculated in **(c)**,

..... [1]

(ii) much more than that calculated in **(c)**.

..... [1]

[Total: 7]

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- 9) A wire between the poles of a large horseshoe magnet is carrying a current.

Fig. 10.1 shows the direction of the force acting on the wire.

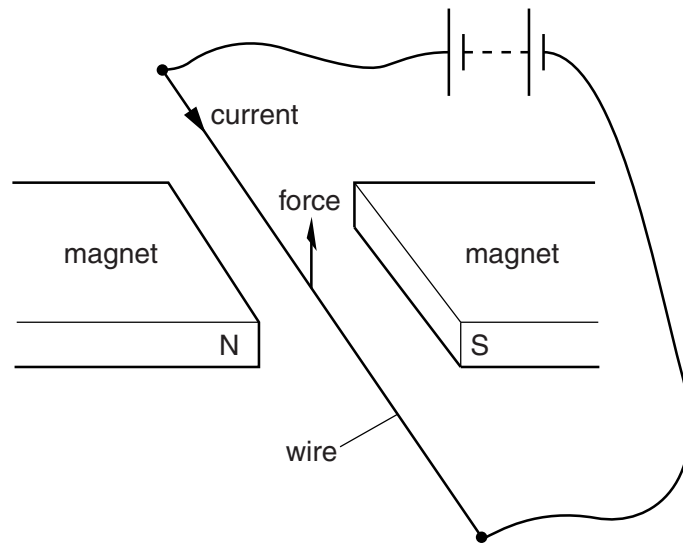


Fig. 10.1

- (a) The magnetic poles are interchanged.

On Fig. 10.2 below, draw an arrow to show the direction of the force on the wire.

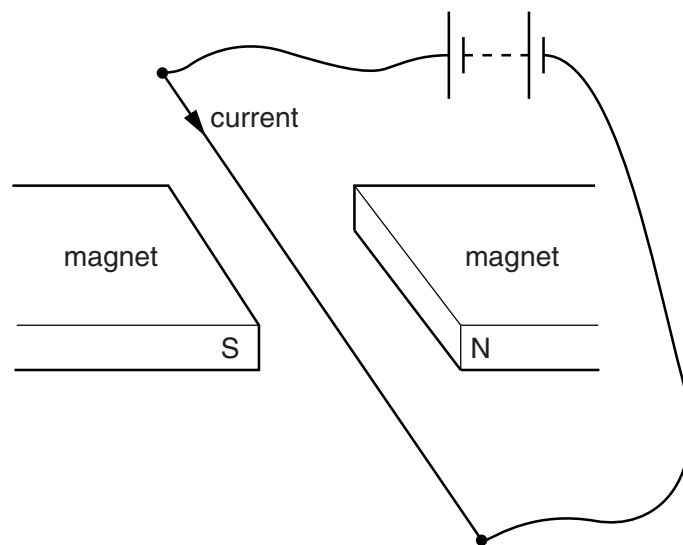


Fig. 10.2

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- (b) The battery is now reversed.

On Fig. 10.3 below, draw an arrow to show the direction of the force on the wire.

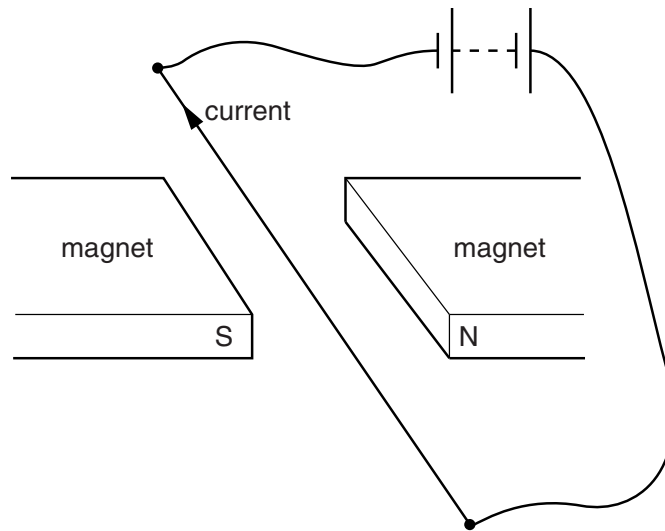


Fig. 10.3

[1]

- (c) In the arrangement of Fig. 10.1 at the beginning of this question, the electromagnetic force on the wire is greater than the weight of the wire.

- (i) Suggest what happens to the wire as the current is switched on.

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

- (ii) Suggest one common device that makes use of this effect.

..... [1]

[Total: 4]