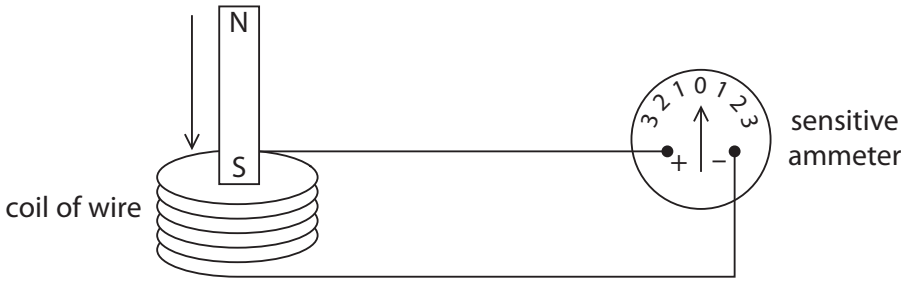
2 (a) A student uses this apparatus to investigate electromagnetic induction.



When the S pole of the magnet is moved into the coil, the pointer on the sensitive ammeter moves to the left.

Describe two ways that the student can make the pointer move to the right.

(2)

1 **reverse the magnet**

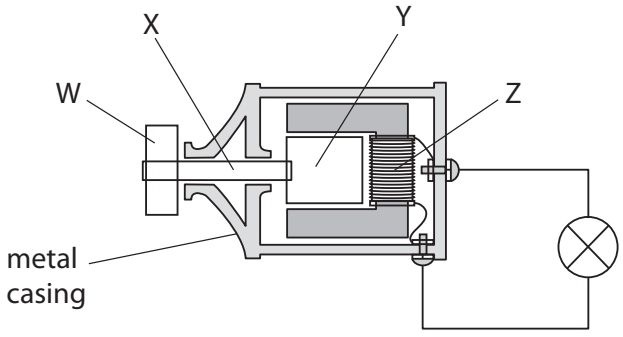
2 **reverse the coil**

(b) The student has a bicycle with a dynamo (generator) that supplies electricity for its lights. The diagram shows the dynamo.

The friction wheel, W, presses against the bicycle tyre. When the student pedals, the friction wheel turns and causes part Y to rotate.

Key

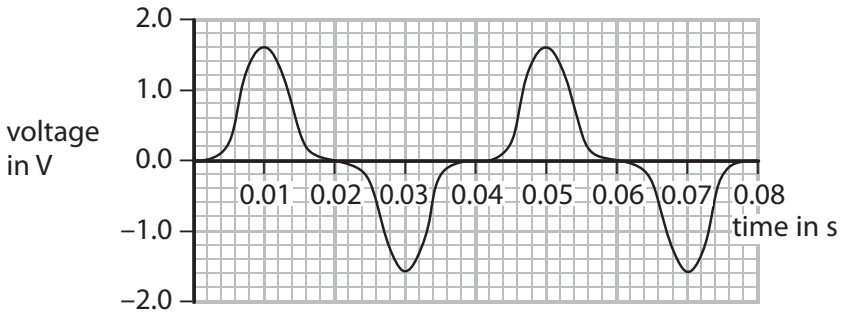
W	friction wheel
X	axle
Y	**magnet**
Z	**coil**



(i) Complete the key for the diagram by giving the names of parts Y and Z.

(2)

(ii) The graph shows how the output voltage of the dynamo varies with time as the student pedals steadily.



State the maximum output voltage of the dynamo.

(1)

maximum output voltage = **1.6V** V

(iii) Calculate the frequency of the output voltage.

(2)

f = 1/ T = 1 / 0.04 = 25Hz

frequency = ... Hz

(iv) Which row of the table is correct when the friction wheel turns faster?

(1)

	Output voltage is	Frequency of output voltage is
☐ **A**	lower	lower
☐ **B**	higher	lower
☒ **C**	higher	higher
☐ **D**	lower	higher

(v) Apart from changing the speed of the friction wheel, suggest how the output voltage of the dynamo can be increased.

(1)

use a stronger magnet

(c) The student cycles for 290 s.

Her dynamo produces a constant useful power output of 3.1 W and is 72% efficient.

(i) Calculate the total useful energy output.

(3)

E = P * t = 3.1 * 290 = 899 = 900J

useful energy output = ... J

(ii) State the relationship between efficiency, useful energy output and total energy input.

(1)

efficiency = useful E out / total E in

(iii) Calculate the total energy input.

(3)

E in = E out / efficiency = 900/0.72 = 1250J

total energy input = ... J

(Total for Question 2 = 16 marks)

3 A solenoid is held in a vertical position. The solenoid is connected to a sensitive, centre-zero ammeter.

A vertical bar magnet is held stationary at position X just above the upper end of the solenoid as shown in Fig. 10.1.

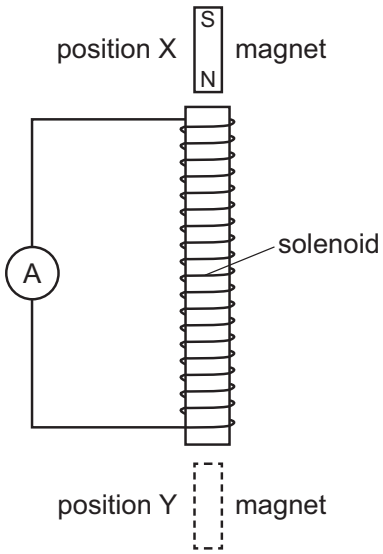


Fig. 10.1

The magnet is released and it falls through the solenoid. During the initial stage of the fall, the sensitive ammeter shows a small deflection to the left.

(a) Explain why the ammeter shows a deflection.

the magnetic field lines cut through the solenoid coils causing a current to flow.

[1]

(b) The magnet passes the middle point of the solenoid and continues to fall. It reaches position Y.

Describe and explain what is observed on the ammeter as the magnet falls from the middle point of the solenoid to position Y.

the direction of the current changes because the magnet is now leaving the coil and since the magnet is speeding up the size of the current increases.

[4]

(c) Suggest **two** changes to the apparatus that would increase the initial deflection of the ammeter.

1. **a stronger magnet** .....

.....

2. **drop the magnet from a greater height** .....

.....

[2]

[Total: 7]

5 **(a)** Fig. 10.1 shows the gap between the N-pole and the S-pole of a magnet.

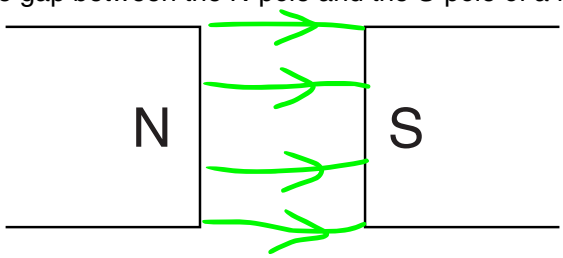


Fig. 10.1

The magnetic field in the gap is uniform.

On Fig. 10.1, draw four field lines to show the pattern and direction of the magnetic field in the gap. [2]

(b) Fig. 10.2 shows a horizontal copper wire PQ between two opposite magnetic poles.

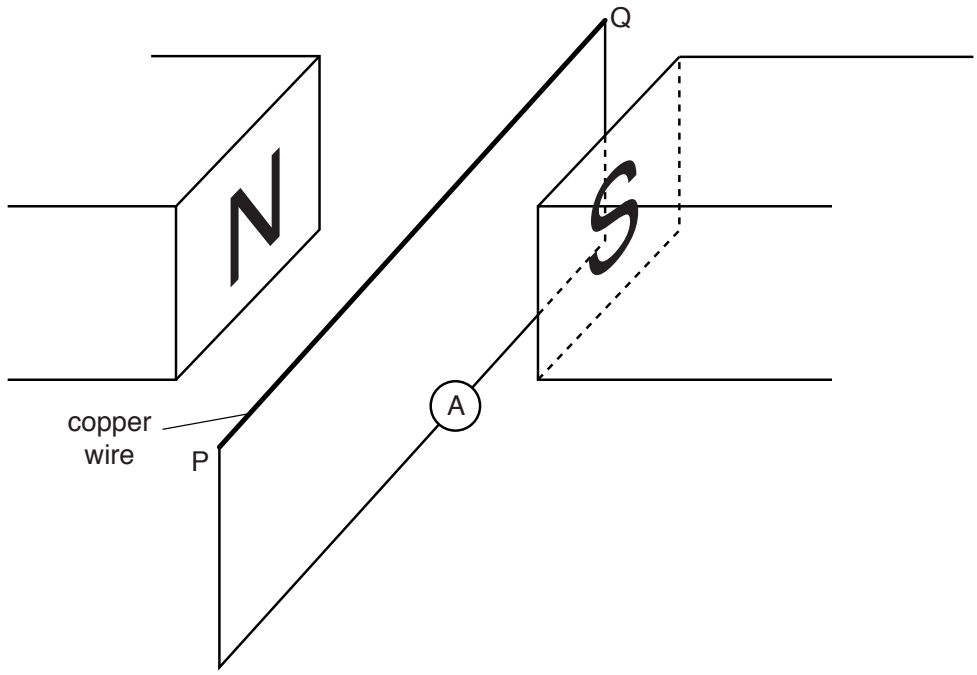


Fig. 10.2

A circuit is made by connecting a sensitive digital ammeter between P and Q. The wire PQ is then moved vertically downwards.

(i) State and explain what is observed on the ammeter.

The ammeter will deflect because the moving wire cuts through the magnetic field lines causing an emf to be induced causing a current to flow.

[3]

(ii) State what is observed on the ammeter when PQ is moved

1. vertically downwards at a greater speed,

a larger current flows [1]

2. vertically upwards at the same speed as in **1**.

the current is the same size but in the opposite direction. [1]

[Total: 7]