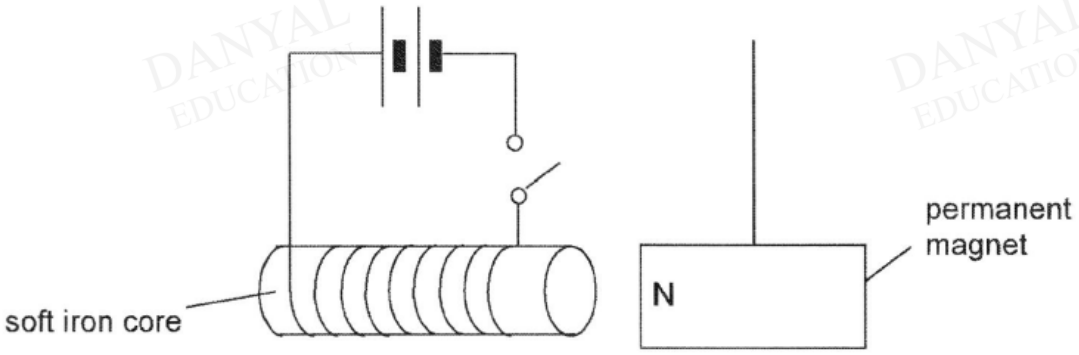
O Level Pure Physics

Electromagnetism Test 3.0

Q1

A coil of wire wound round a soft iron core is connected to a switch and batteries in series.

A permanent magnet is suspended with its North pole near one end of the core as shown in the figure below.



(a) Describe and explain what will happen to the magnet when the switch is closed.

_____

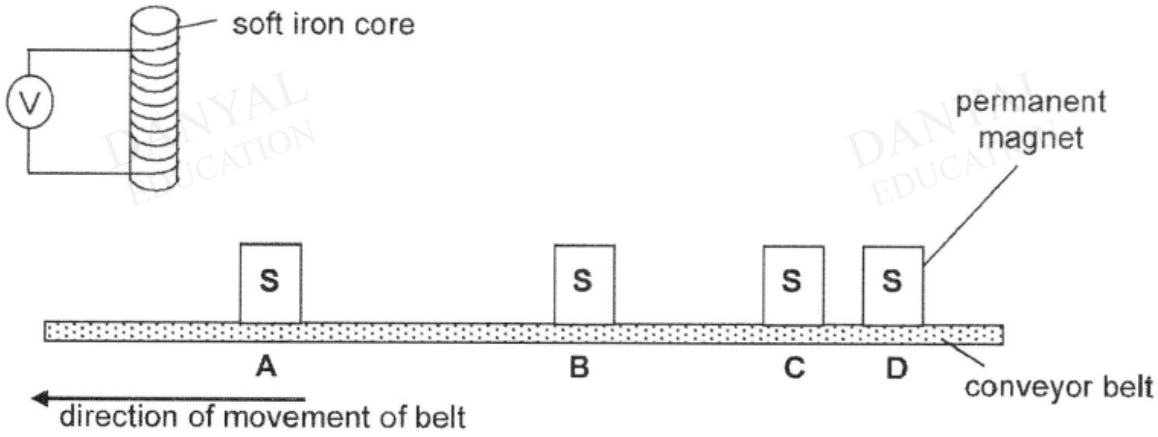
_____

_____

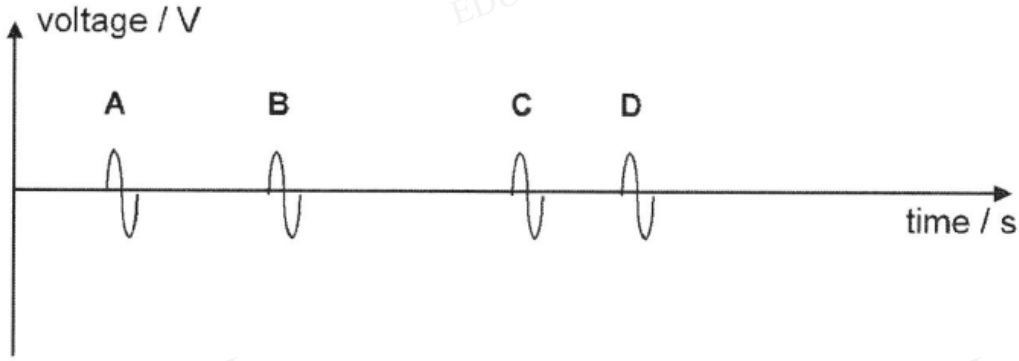
_____ [2]

(b) The switch and batteries connected to the coil are now removed and replaced by a sensitive voltmeter. Small permanent magnets, attached to a conveyor belt, are moved under the coil which act as a detecting device as shown in the figure below.

The voltmeter records voltage pulses as the conveyor belt moves along positions **A**, **B**, **C** and **D** at constant speed.



The graph below shows how the voltmeter reading varies time, with the letters **A**, **B**, **C** and **D** corresponding to the positions of the belt as each magnet passes under the coil.



(i) Explain why the voltage pulses occur.

_____

_____ [1]

(ii) Explain why the pulse produced by each magnet has a positive and a negative value as it passes the coil.

_____

_____

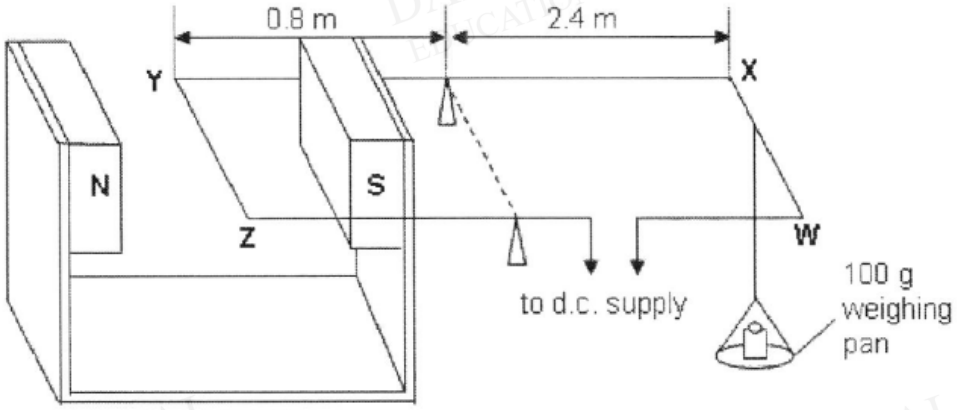
_____ [2]

(iii) State one way to produce a voltage pulse of greater amplitude.

_____

_____ [1]

(c) A rectangular coil is balanced in a horizontal position when current flows through it as shown in the figure below. The coil is pivoted at two fulcrums and connected to a d.c. power supply. A weighing pan of 100 g mass is hung at side **WX**, while side **YZ** is placed inside a magnetic field.



(i) Calculate the moment produced by the weighing pan about the pivot and state the direction of this moment.

moment = _____ [1]

direction = _____ [1]

(ii) Hence, state the direction of the current flowing in **YZ** and explain how you derived your answer.

_____

_____

_____ [2]

Q2

Both rods are found to be magnets. Fig. 8.1 shows a coil **ABCD** placed in between the rods. The fixed paper clips allows current to pass into and out of the coil.

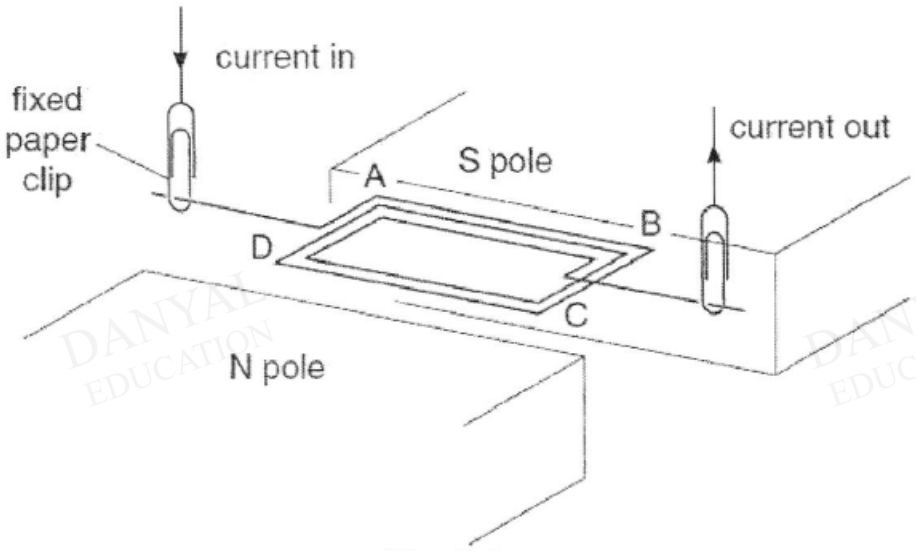


Fig. 8.1

(i) State and explain the direction of the force on side **CD**.

.....

.....

..... [2]

(ii) Describe and explain what will happen to **ABCD** in Fig. 8.1 when the current is left running.

.....

.....

.....

.....

..... [2]

Q3

Fig. 9 shows a direct current passing through an electromagnet.

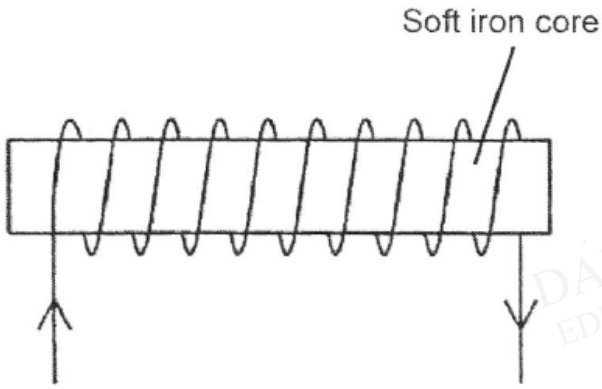


Fig. 9

(a) On **Fig. 9**,

(i) label N at the north pole of the electromagnet, [1]

(ii) draw the magnetic field pattern around the electromagnet. [2]

(b) What is the function of the soft iron core?

.....

..... [1]

(c) Describe **two** ways to increase the magnetic field strength of the electromagnet.

1. .....

.....

2. .....

..... [2]

(d) State the effect on the magnetic field strength if the soft iron core is replaced by a copper core of the same dimensions.

..... [1]

Q4

Fig. 11.1a shows a relay connected to a cell and a switch.

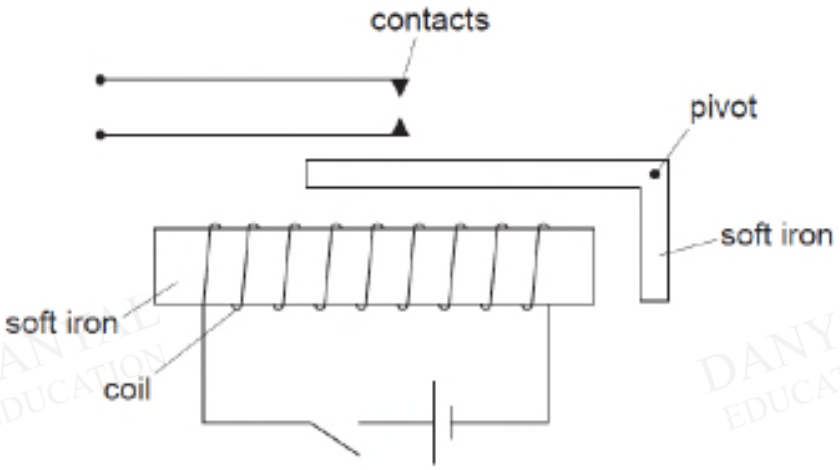


Fig. 11.1a

(a) When the switch is closed, the iron core is magnetised.

(i) Explain how this causes the contacts to close.

[2]

(ii) On Fig. 11.1a, mark

1. the S-pole of the iron core,

2. the N-pole and the S-pole of the iron armature. [2]

Q5

Fig. 9.1 shows a d.c. motor.

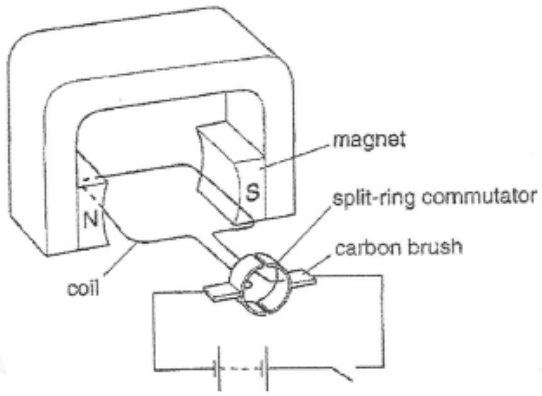


Fig. 9.1

The coil is horizontal, as shown in Fig. 9.1.

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

.....

.....

..... [2]

(ii) Explain why the coil continues to turn in the same direction when it has turned 180°.

.....

.....

..... [2]

(b) Fig. 9.2 shows how the moment acting on the coil depends on time.

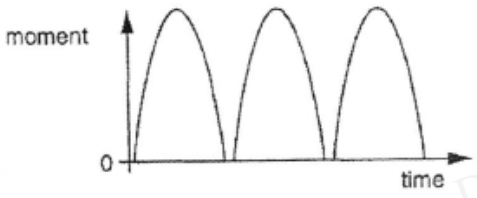


Fig. 9.2

(i) On Fig. 9.2, mark with letter H one time when the coil is horizontal. [1]

(ii) The e.m.f. of the battery is increased. State two changes that this causes to Fig. 9.2.

1. ..... [1]
2. ..... [1]

Answers

Electromagnetism Test 3.0

Q1

(a) When switch is closed and current flows in the coil, the end of the coil facing the magnet becomes a North pole **[1]**
Hence the magnet repels from the coil as like poles repel. **[1]**

(b) **(i)** As the magnet moves with the conveyor belt, the coil experiences a changing magnetic flux, thus inducing an emf in the coil. **[1]**

(ii) As the magnets approach the coil, the coil experiences a changing magnetic flux that induces an emf in one direction to try to repel the magnet. **[1]**
As the magnets move away from the coil, the coil experiences a changing magnetic flux, producing an emf in the opposite direction to try to attract the magnet. **[1]**

(iii) Increase the speed of the conveyor belt **[1]**

Alternatives: increase the number of turns of coil around the iron core / use stronger permanent magnets with stronger magnetic field strength.

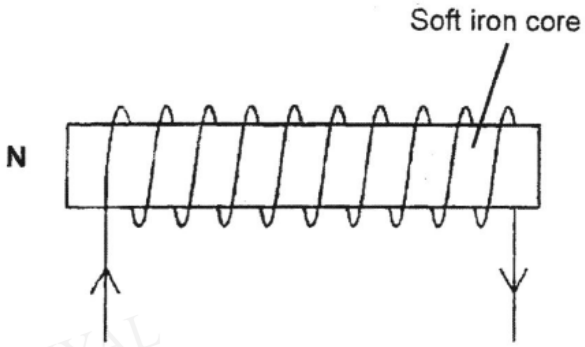
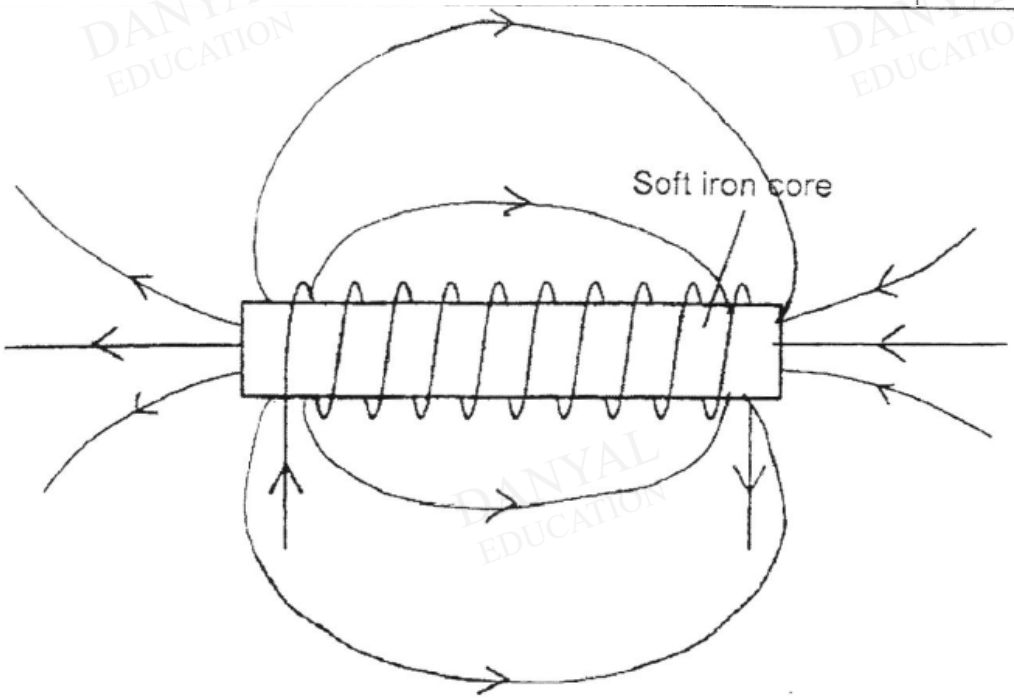
(c) **(i)** moment = 1 x 2.4 **[1]**
= 2.4 Nm
direction = clockwise **[1]**

(ii) Force on **YZ** needs to be downwards to produce an anticlockwise moment as balance the moment of the pan. **[1]**
Using Fleming's Left Hand Rule, the current should flow from **Z** to **Y** to produce a downward force. **[1]**

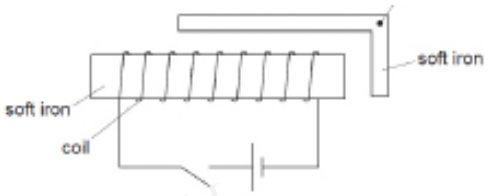
Q2

bi	Downward force Flemings left hand rule	B1 B1
bii	ABCD cannot continue to make a full rotation and would eventually rotate until it **becomes vertical** Current doesn't change direction and thus the AB end would always experience an upward force while the CD end would always experience a downward force	B1 B1

Q3

ai		[1]
aii	 *[1] for correct shape* *[1] for correct direction*	[2]
b	It is used to concentrate the magnetic field lines, thereby increasing the magnetic field strength of the electromagnet.	[1]
c	**1.** Increase the current flowing through the coil. **[1]** **2.** Increase the number of turns per unit length of the coil. **[1]**	[2]
d	The magnetic field strength of the electromagnet will **decrease**.	[1]

Q4

(a)	(i)	The magnetised iron core attracts the iron armature, which will rotate clockwise about the pivot. The horizontal arm of the armature will then close the contacts.	[1] [1]
(a)	(ii)		[2]

Accept if the S-pole of the iron armature is drawn on the horizontal arm, either at the pivot or the far end of the armature.

Q5

(ai) When the switch is closed, current flows in the coil. [1]
By using Fleming's left-hand rule, the side of the coil next to the N-pole experiences an upward force while the side of the coil next to the S-pole experiences a downward force. [1]
This results in the coil to turn.

(aii) The direction of the current in the coil reverses after it has turned 180°. [1]
However, the force acting on the side of the coil next to the N-pole continues to act upward in the same direction as before. [1]

(bi)
H is indicated at any of the peak.

(bii)
1. The peak of the curve becomes higher. / The moment acting on the coil increases.

2. The frequency of the curve increase. / The time for one period on the graph decreases.