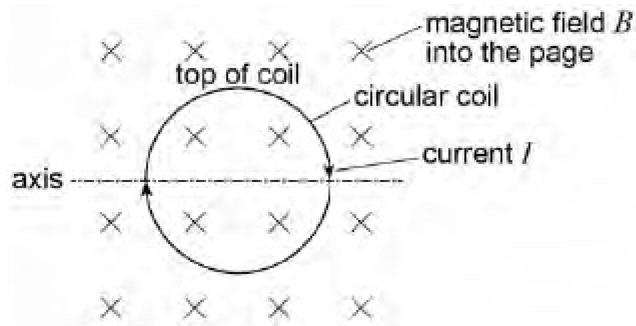
1 The diagram shows a clockwise current I in a circular coil placed in a uniform magnetic field B with the plane of the coil perpendicular to the magnetic field.



What is the effect on the coil of the interaction between the current and the magnetic field?

A It rotates about the axis with the top moving out of the page. ⬭

B It rotates about the axis with the top moving into the page. ⬭

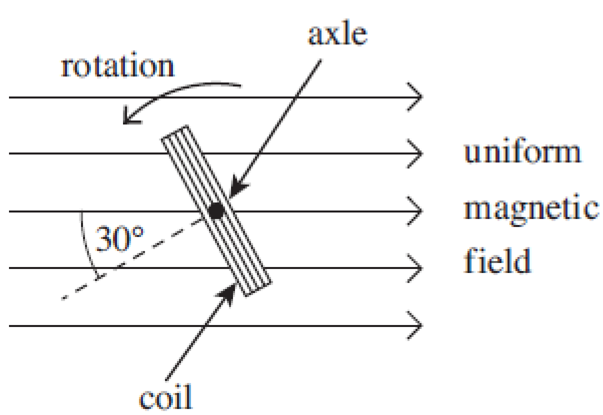
C It causes an increase in the diameter of the coil. ⬭

D It causes a decrease in the diameter of the coil. ⬭

(Total 1 mark)

2 A rectangular coil is rotating anticlockwise at constant angular speed with its axle at right angles to a uniform magnetic field. **Figure 1** shows an end-on view of the coil at a particular instant.

Figure 1



(a) At the instant shown in **Figure 1**, the angle between the normal to the plane of the coil and the direction of the magnetic field is 30°.

(i) State the minimum angle, in degrees, through which the coil must rotate from its position in **Figure 1** for the emf to reach its maximum value.

angle ____________________ degrees

(1)

(ii) Calculate the minimum angle, in radians, through which the coil must rotate from its position in **Figure 1** for the flux linkage to reach its maximum value.

angle ____________________ radians

(2)

(b) **Figure 2** shows how, starting in a different position, the flux linkage through the coil varies with time.

(i) What physical quantity is represented by the gradient of the graph shown in **Figure 2**?

____

(1)

(ii) Calculate the number of revolutions per minute made by the coil.

revolutions per minute ____________________

(2)

Figure 2

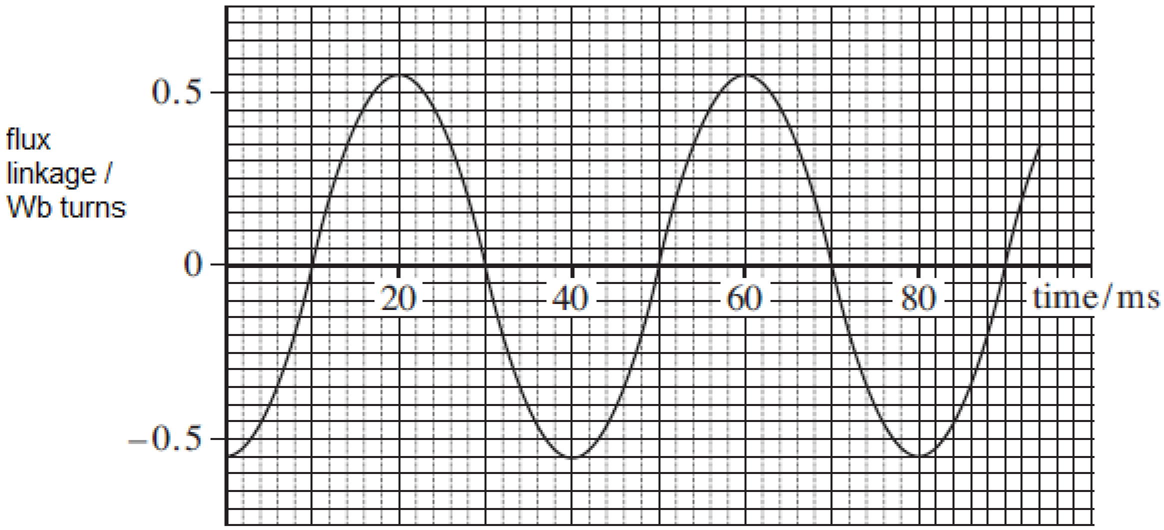
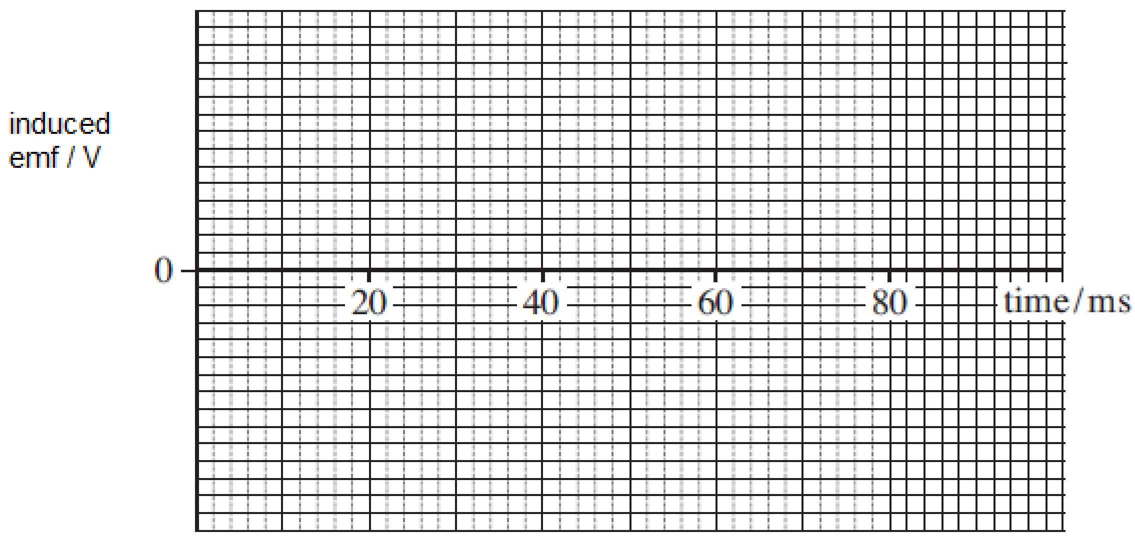


Figure 3



(iii) Calculate the peak value of the emf generated.

peak emf ____________________ V

(3)

(c) Sketch a graph on the axes shown in **Figure 3** above to show how the induced emf varies with time over the time interval shown in **Figure 2**.

(2)

(d) The coil has 550 turns and a cross-sectional area of $4.0 \times 10^{-3} m^2$.

Calculate the flux density of the uniform magnetic field.

flux density ____________________ T

(2)

(Total 13 marks)

3 (a) State Lenz's law.

___

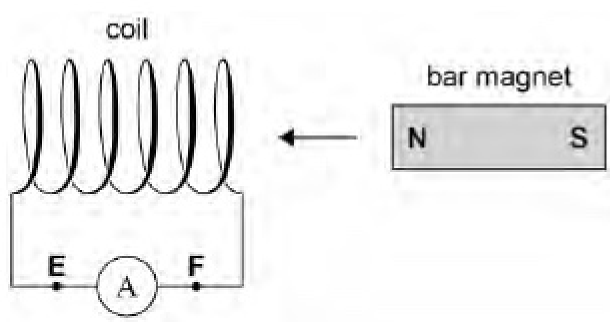
___

___

(1)

(b) Lenz's law can be demonstrated using a bar magnet and a coil of wire connected to a sensitive ammeter as shown in **Figure 1**.

Figure 1



The bar magnet is moved towards the coil and is then brought to a halt.

State how the reading on the ammeter changes during this process.

___

___

___

(1)

(c) During the demonstration an induced current is detected by the ammeter. The induced current is in the direction **E** to **F**.
Explain how this demonstrates Lenz's law.

___

___

___

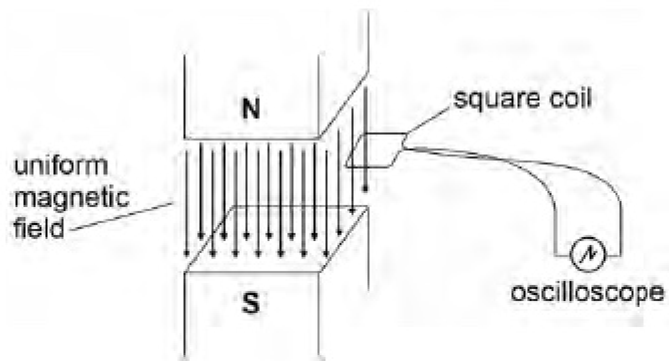
___

___

(2)

(d) **Figure 2** shows an arrangement for investigating induced emf.

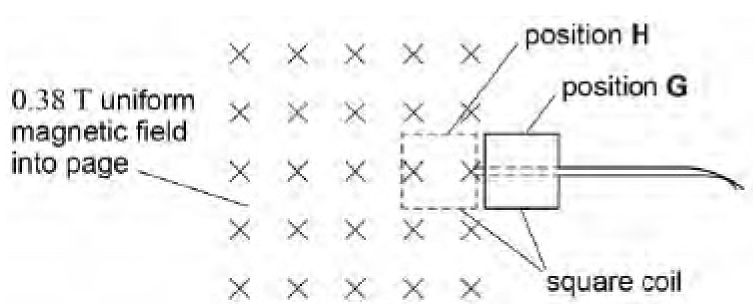
Figure 2



As shown, the uniform vertical magnetic field is confined to the gap between the poles of the magnet. The plane of the square coil is horizontal and is made of conducting wire. The coil consists of a single turn and is attached by flexible wire to an oscilloscope.

The oscilloscope gives a reading of 2.9×10^{-4} V when the coil is moved at uniform speed from position **G** outside the field to position **H** inside the field, as shown in **Figure 3**.

Figure 3



Length of side of square coil = 32 mm

Magnetic flux density of uniform magnetic field = 0.38 T

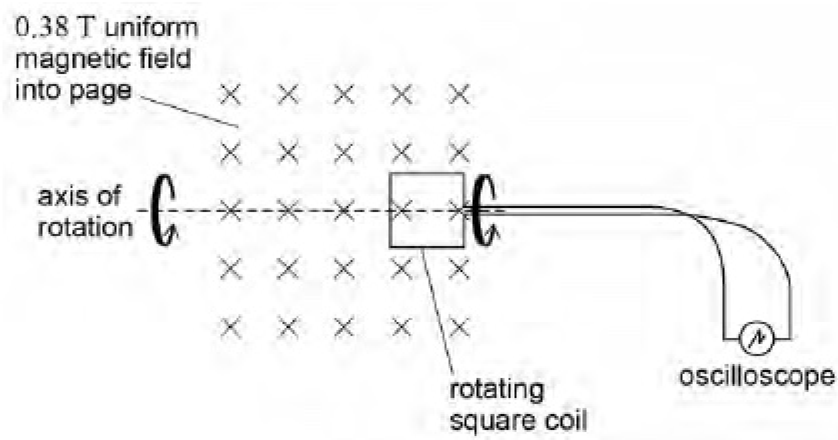
Calculate the time taken to move the coil from position **G** to position **H**.

time = ____________________ s

(2)

(e) The square coil is rotated through 360° at a constant angular speed about the horizontal axis shown in **Figure 4**.

Figure 4



Calculate the angular speed of the coil when the maximum reading on the oscilloscope is 5.1 mV

angular speed = ____________________ rad s^{-1}

(2)

(Total 8 marks)

4 A transformer has an efficiency of 80%
It has 7000 turns on its primary coil and 175 turns on its secondary coil. When the primary of the transformer is connected to a 240 V ac supply, the secondary current is 8.0 A

What are the primary current and secondary voltage?

	Primary current / mA	**Secondary voltage / V**	
A	250	6.0	⬭
B	160	6.0	⬭
C	250	9600	⬭
D	160	9600	⬭

(Total 1 mark)