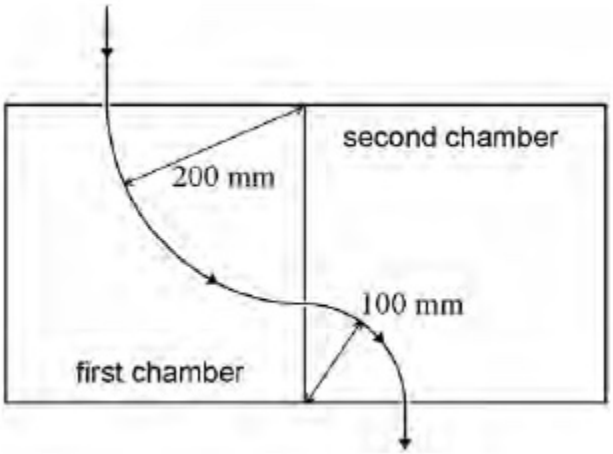
1 Different magnetic fields are present in the two chambers shown. A particle enters the first chamber at a velocity of 80 m s^{-1} and is deflected into a circular path of radius 200 mm
In the second chamber it follows a circular path of radius 100 mm



The particle leaves the second chamber at a speed of

A 20 m s^{-1} ⬭

B 40 m s^{-1} ⬭

C 80 m s^{-1} ⬭

D 160 m s^{-1} ⬭

(Total 1 mark)

2 A coil with 20 circular turns each of diameter 60 mm is placed in a uniform magnetic field of flux density 90 mT.

Initially the plane of the coil is perpendicular to the magnetic field lines as shown in **Figure X**.

Figure X

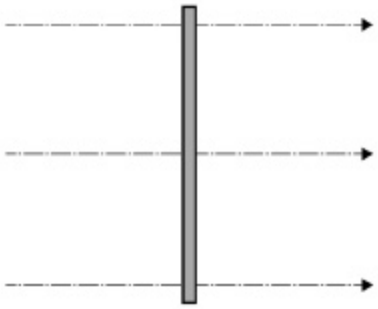
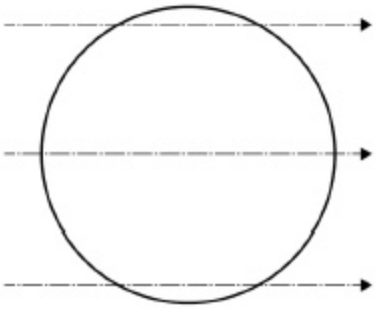


Figure Y



The coil is rotated about a vertical axis by 90° in a time of 0.20 s so that its plane becomes parallel to the field lines as shown in **Figure Y**.
Assume that the rate of change of flux linkage remains constant.

What is the emf induced in the coil?

A zero ⬭

B 1.3 mV ⬭

C 25 mV ⬭

D 100 mV ⬭

(Total 1 mark)

3 The mean power dissipated in a resistor is 47.5 μW when the root mean square (rms) voltage across the resistor is 150 mV.

What is the peak current in the resistor?

A 2.3×10^{-4} A ⬭

B 4.5×10^{-4} A ⬭

C 2.3×10^{3} A ⬭

D 4.5×10^{3} A ⬭

(Total 1 mark)

4 A horizontal copper wire of mass 4.0×10^{-3} kg and length 80 mm is placed perpendicular to a horizontal magnetic field of flux density 0.16 T. The magnetic force acting on the wire supports the weight of the wire.

How many electrons are passing a point in the wire in each second?

A 1.9×10^{18} ⬭

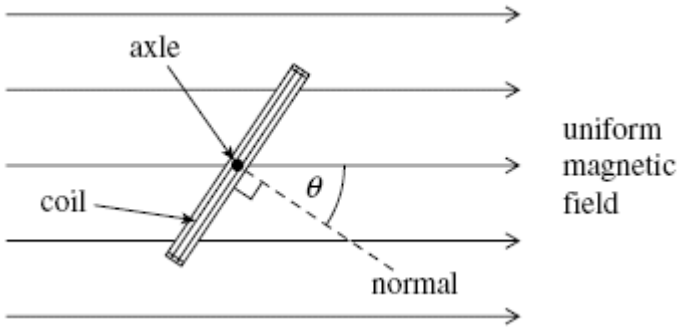
B 1.9×10^{19} ⬭

C 1.9×10^{20} ⬭

D 1.9×10^{21} ⬭

(Total 1 mark)

5 The figure below shows an end view of a simple electrical generator. A rectangular coil is rotated in a uniform magnetic field with the axle at right angles to the field direction. When in the position shown in the figure below the angle between the direction of the magnetic field and the normal to the plane of the coil is θ.



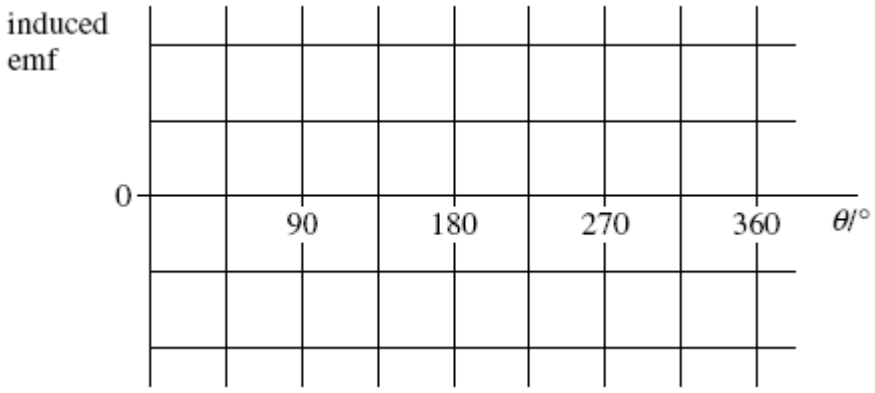
(a) The coil has 50 turns and an area of 1.9×10^{-3} m^2. The flux density of the magnetic field is 2.8×10^{-2} T. Calculate the flux linkage for the coil when θ is 35°, expressing your answer to an appropriate number of significant figures.

answer = _____ Wb turns

(3)

(b) The coil is rotated at constant speed, causing an emf to be induced.

(i) Sketch a graph on the outline axes to show how the induced emf varies with angle θ during one complete rotation of the coil, starting when $\theta = 0$. Values are not required on the emf axis of the graph.



(1)

(ii) Give the value of the flux linkage for the coil at the positions where the emf has its greatest values.

answer = _____ Wb turns

(1)

(iii) Explain why the magnitude of the emf is greatest at the values of θ shown in your answer to part (b)(i).

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 8 marks)

6 A sinusoidal alternating voltage source of frequency 500 Hz is connected to a resistor of resistance 2.0 kΩ and an oscilloscope, as shown in **Figure 1**.

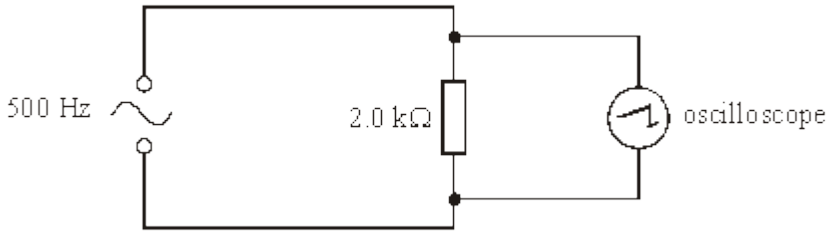


Figure 1

(a) The rms current through the resistor is 5.3 mA. Calculate the peak voltage across the resistor.

_____

_____

_____

(2)

(b) The settings on the oscilloscope are

timebase: 250 μs per division,
voltage sensitivity: 5.0 V per division.

Draw on the grid, which represents the screen of the oscilloscope, the trace that would be seen.

_____

_____

(4)

(Total 6 marks)