H6 Circular Paths of Particles in Magnetic Fields

$^{6}/_{8}$

H6.1 Complete the questions in the table:

B /T	q /C	v /m s^{-1}	m /kg	r /m
0.63	1.6×10^{-19}	3.0×10^{7}	9.1×10^{-31}	(a)
0.63	1.6×10^{-19}	6.4×10^{6}	1.7×10^{-27}	(b)
2.30	3.2×10^{-19}	8.8×10^{7}	(c)	0.80
0.0045	1.6×10^{-19}	(d)	9.1×10^{-31}	0.12

H6.2 In a demonstration, electrons with 200 eV of kinetic energy are going round in a 12 cm **diameter** circle. Calculate the magnetic flux density.

H6.3 In a demonstration, electrons are going round in a 12 cm diameter helix with the beam at 70° to the 0.0032 T magnetic field. Calculate the speed of the electrons.

H6.4 a) Work out the momentum of a muon (same charge as an electron, but mass = 207× electron mass) taking a curved path with a 90 cm radius perpendicular to a 0.0076 T magnetic field.

b) Work out the momentum of an electron which would take the same path in the same field.

H7 Magnetic Flux and Faraday's Law

$^{9}/_{12}$

H7.1 Complete the questions in the table:

Magnetic flux density /T	Area of coil	Angle between plane of coil and magnetic field lines /°	Number of turns	Magnetic flux linkage /Wb turns
2.0	2.0 m × 1.0 m	90	40	(a)
0.00232	5.0 cm × 5.0 cm	60	2400	(b)

H7.2 Calculate the magnetic flux linkage if a 3.0 cm $\times$ 2.0 cm rectangular coil of 200 turns is in a 0.75 T magnetic field, with the field at right angles to the plane of the coil.

H7.3 Calculate the magnetic flux linkage if a 2400 turn coil measuring 3.0 cm $\times$ 3.0 cm lies within a 0.25 T magnetic field, with the field lines making an angle of 30° to the plane of the coil.

H7.4 Assume field lines are perpendicular to the plane of a 400 turn coil of area 3.0×10^{-4} m^2.

a) Calculate the rate of change in the magnetic flux linkage when the magnetic field is reduced from 0.20 T to zero in 0.40 s.

b) What is the voltage induced across the coil?

H7.5 Complete the questions in the table:

Initial flux linkage /Wb turns	Final flux linkage /Wb turns	Time taken for flux to change /s	Voltage induced /V
30	60	0.20	(a)
200	0	(b)	400

H7.6 A single turn coil of 10 cm $\times$ 5.0 cm sits, stationary, in a 21000 T magnetic field, at right angles to the plane of the coil.

a) What is the voltage induced across the ends of the wire?

b) The coil is made of extensible wire and is stretched steadily to 10 cm $\times$ 10 cm over 0.020 s. Calculate the voltage induced across the ends of the wire.

c) What would the induced voltage be if the magnetic field were parallel to the sides of the coil which were originally 5.0 cm long?

H7.7 A bicycle wheel with only one spoke has a magnetic flux of 1.95×10^{-5} Wb passing through it. If the wheel goes round 6 times in one second, what voltage will be induced between the hub and the rim?

Something to think about – would the answer to question H7.7 change if there were twenty spokes?