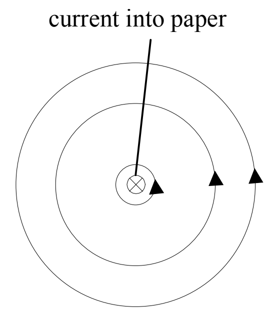
25 Worksheet (A2)

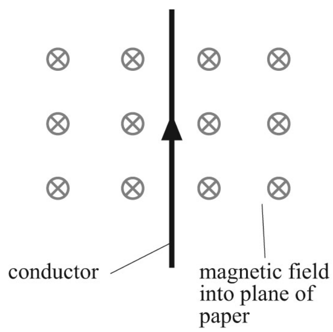
Data needed to answer questions can be found in the Data, formulae and relationships sheet.

1 The diagram shows the magnetic field pattern for a current-carrying straight wire drawn by a student in her notes. List **two** errors made by the student. [2]

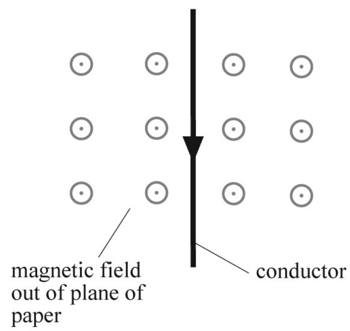


2 A current-carrying conductor is placed in an external magnetic field. In each case below, use Fleming's left-hand rule to predict the direction of the force on the conductor.

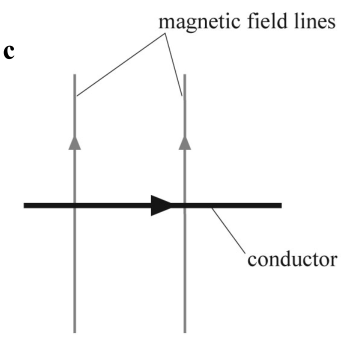
a



b



c



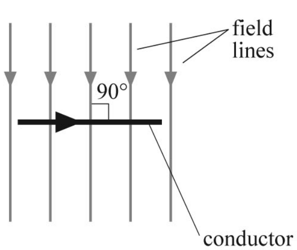
[3]

3 The unit of magnetic flux density is the tesla.
Show that: 1 T = 1 N A^{-1} m^{-1} [2]

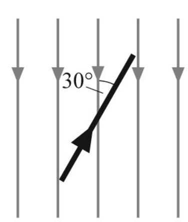
4 Calculate the force for 1 centimetre length of a straight wire placed at right angles to a uniform magnetic field of magnetic flux density 0.12 T and carrying a current of 3.5 A. [3]

5 A 4.0 cm long conductor carrying a current of 3.0 A is placed in a uniform magnetic field of flux density 50 mT. In each of **a**, **b** and **c** below, determine the size of the force acting on the conductor. [6]

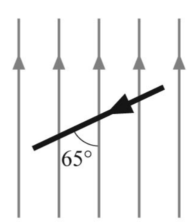
a



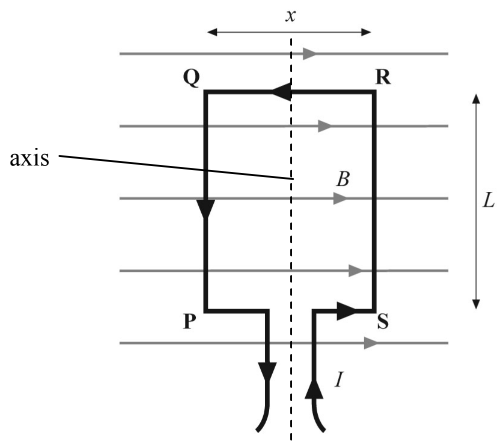
b



c

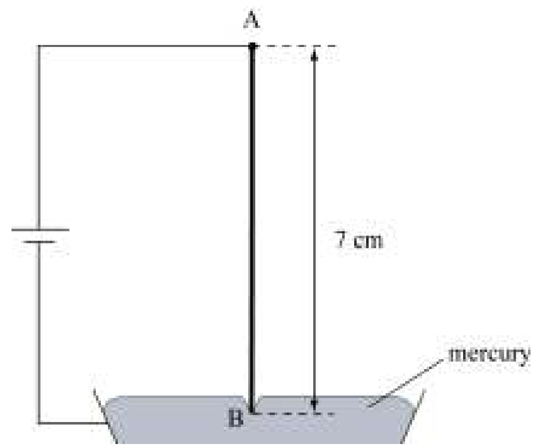


6 The diagram shows the rectangular loop **PQRS** of a simple electric motor placed in a uniform magnetic field of flux density *B*.



The current in the loop is *I*. The lengths **PQ** and **RS** are both *L* and lengths **QR** and **SP** are both *x*. Show that the torque of the couple acting on the loop for a given current and magnetic flux density is directly proportional to the area of the loop. [5]

7 The diagram shows a rigid wire **AB** pivoted at the point **A** so that it is free to move in a vertical plane. The lower end of the wire dips into mercury. A uniform magnetic field of 6.0×10^{-3} T acts into the paper throughout the diagram.



a When the current is switched on, the wire continuously moves up out of the mercury and then falls back again. Explain this motion. [4]

b The force on the wire due to the current may be taken to act at the midpoint of the wire. When the current is first switched on, the moment of this force about **A** is 3.5×10^{-5} N m. Calculate:

i the force acting on the wire [2]

ii the current in the wire. [2]

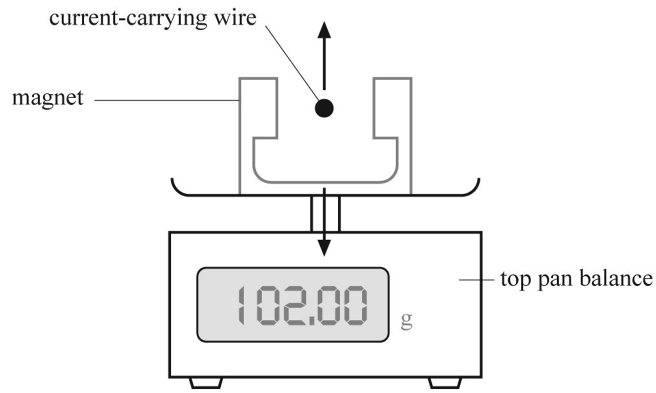
8 The coil in the d.c. motor shown in question **6** has a length $L = 7.0 \times 10^{-2}$ m and width $x = 3.0 \times 10^{-2}$ m. There are 25 turns on the coil and it is placed in a uniform magnetic field of 0.19 T. The coil carries a current of 2.8 A. The coil is free to rotate about an axis midway between **PQ** and **RS**.

a Calculate the force on the longest side of the coil. [2]

b Calculate the maximum torque (moment) exerted on the coil. [2]

c Explain why the force acting on the long side of the coil does not change as the coil rotates but the torque exerted on the coil varies. [2]

9 The diagram shows an arrangement that is used to determine the magnetic flux density between the poles of a magnet.



The magnet is placed on a sensitive top pan balance. A current-carrying wire is placed at right angles to the magnetic field between the poles of the magnet. The force experienced by the current-carrying wire is equal but opposite to the force experienced by the magnet. The magnet is pushed downward when the wire experiences an upward force.

The length of the wire in the magnetic field is 5.0 cm. The balance reading is 102.00 g when there is no current in the wire. The balance reading increases to 103.14 g when the current in the wire is 8.2 A.

a Show that the force experienced by the wire is equal to 1.1×10^{-2} N. [1]

b Calculate the magnetic flux density of the magnetic field between the poles of the magnet. [3]

Total: $\frac{\quad}{39}$ Score: %

