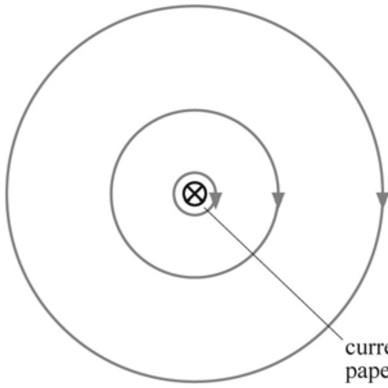
25 Marking scheme: Worksheet (A2)

1 The direction of the magnetic field should be clockwise (and not anticlockwise). [1]
The separation between adjacent circular field lines should increase further away from the wire (see below). [1]



2 **a** The conductor is pushed to the left. [1]
b The conductor is pushed to the left. [1]
c The conductor is pushed out of the plane of the paper. [1]

3 $B = \dfrac{F}{Il}$ [1]

$[B] = \dfrac{\text{N}}{\text{A m}} = \text{N A}^{-1}\ \text{m}^{-1}$ [1]

4 $F = BIl$ [1]
$F = 0.12 \times 3.5 \times 0.01$ (length = 1.0 cm) [1]
$F = 4.2 \times 10^{-3}$ N [1]

5 **a** $F = BIl \sin\theta$
$F = 0.050 \times 3.0 \times 0.04 \times \sin 90°$ [1]
$F = 6.0 \times 10^{-3}$ N [1]
b $F = 0.050 \times 3.0 \times 0.04 \times \sin 30°$ [1]
$F = 3.0 \times 10^{-3}$ N [1]
c $F = 0.050 \times 3.0 \times 0.04 \times \sin 65°$ [1]
$F = 5.44 \times 10^{-3}\ \text{N} \approx 5.4 \times 10^{-3}$ N [1]

6 Force experienced by **PQ** = force experienced by **RS** (but in opposite direction). [1]
No force experienced by **QR** and **PS** (since current is parallel to the field). [1]
torque = one of the forces × perpendicular distance between forces = $(BIL)x$ [1]
torque = $BI(Lx)$, Lx = area of loop = A [1]
torque = $BIA \propto A$ [1]
The torque is directly proportional to the area of the loop.

7 **a** Current is at right angles to magnetic field. [1]
Left-hand rule produces force on **AB** towards the right. [1]
Wire leaves mercury and breaks contact/current stops/force stops. [1]
Weight causes **AB** to fall back/return and make contact again. [1]
b **i** Moment = Fd [1]
$F = \dfrac{3.5 \times 10^{-5}}{0.035} = 1.0 \times 10^{-3}$ N [1]

ii $F = BIl \Rightarrow I = \dfrac{F}{Bl}$ [1]

$I = \dfrac{1.0 \times 10^{-3}}{(6.0 \times 10^{-3} \times 0.07)} = 2.38\ \text{A} \approx 2.4\ \text{A}$ [1]

8 **a** $F = BIl \times$ number of turns [1]

$F = 0.19 \times 2.8 \times 0.07 \times 25 = 0.93$ N [1]

b Torque= $Fd = 0.93 \times 0.03$ [1]

torque = 0.028 N m [1]

c The longest side always stays at 90º to the magnetic field as the coil turns so the force is constant. [1]

The perpendicular distance between the forces changes as the coil turns so the torque (moment) changes. [1]

9 **a** $F = mg = (103.14 - 102.00) \times 10^{-3} \times 9.81$ so $F = 1.12 \times 10^{-2}$ N $\approx 1.1 \times 10^{-2}$ N [1]

b $B = \dfrac{F}{Il}$ [1]

$B = \dfrac{1.12 \times 10^{-2}}{8.2 \times 0.05}$ [1]

$B = 2.73 \times 10^{-2}$ T (27 mT) [1]