# Electromagnetism I – Problem sheet 7

Problem 1.

The loop of wire in the figure below forms a right triangle and carries a current $I = 5$ A in the direction shown. The loop is in a uniform magnetic field that has magnitude $B = 3$ T and the same direction as the current in side PQ of the loop, see figure.

1. Find the force exerted by the magnetic field on each side of the triangle. [**3**]
2. The loop is pivoted about an axis that lies along side PR.

   (a) Use the forces calculated in part (1) to calculate the net torque on the loop. [**1**]
   (b) Is the torque to rotate point Q into the plane of the figure or out of the plane? [**1**]

3. Use the equation $\vec{\tau} = I\vec{A} \times \vec{B}$ to find the torque on the loop. [**1**]
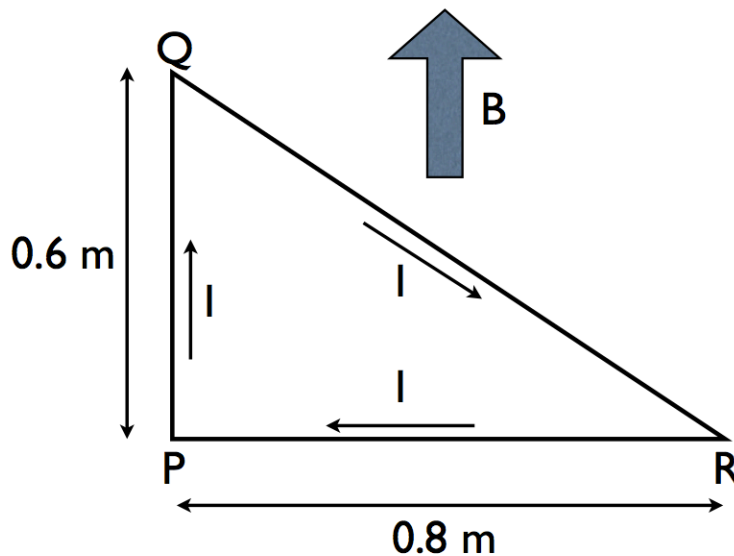
Problem 2.

An interstellar dust grain of mass $m = 10^{-16}$ kg is (roughly) spherical with a radius of 3×10^{-7} m. It has acquired a negative charge such that its potential is -0.15 V.

1. How many extra electrons has it picked up (to the nearest whole number)? [**1**]
2. What is the strength of the electric field on its surface? [**1**]
3. The dust grain moves freely (with velocity much smaller than the speed of light) in a plane perpendicular to the interstellar magnetic field, which in that region has a strength of 3×10^{-10} T.

   (a) What is the "cyclotron frequency" associated to the dust grain motion? [**1**]
   (b) How many years will it take to complete a circular orbit? [**1**]