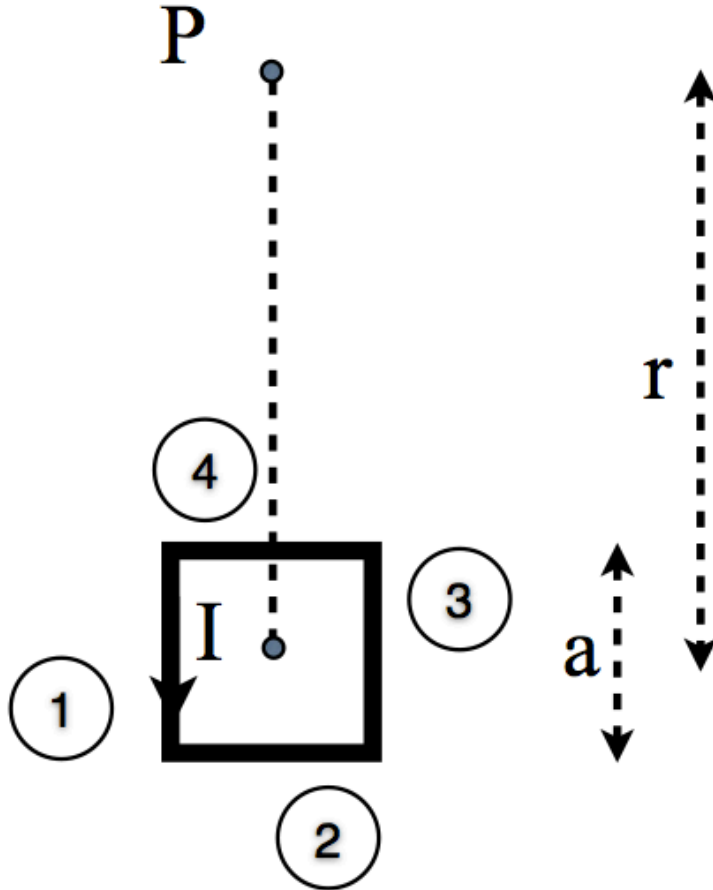


Electromagnetism I – Problem sheet 8

Consider a square loop of side length a . A current I (ignore resistance) circulates anticlockwise in the loop. Point P is directly above the middle of side (4) at distance $r \gg a$ from the centre of the loop, as seen in the figure below. The loop and P are in the (x, y) plane, with the z -axis of the coordinate system pointing out of the page.



1. Explain why the magnitudes of the magnetic field, $\underline{\mathbf{B}}$, at P generated by the current flowing through sides (1) and (3) individually are negligible compared to those from each of the sides (2) and (4). [3]
2. Determine the **total** contribution from the current flowing through sides (2) **and** (4) to $\underline{\mathbf{B}}(P)$ to leading order in (a/r) (magnitude and direction). [3]
3. Determine the **total** contribution from the current flowing through sides (1) **and** (3) to $\underline{\mathbf{B}}(P)$ to leading order in (a/r) (magnitude and direction). [3]
4. Hence, determine the total magnetic field $\underline{\mathbf{B}}(P)$ from the whole loop to leading order in (a/r) . [1]