HA 1.1 The field $\vec{E}$ of a broken ring. [50 points]

Consider a plastic beam folded in a circular shape, as shown in Fig. HA1.1. The radius R of the so-formed broken ring is 1 m. The (minimum) distance $2d$ between the extreme points A and B is 1 cm. Assume the beam carries a uniformly distributed positive charge q of 1 μC.

1) Without any approximation, calculate the electrostatic field $\vec{E}$ in the centre O of the broken ring (always show the chosen coordinate system, all relevant field components, and, if necessary comment the result. All calculations must be shown in full). [30 points]

2) Can you think of a way to solve the same problem with good accuracy, but resorting to a reasonable approximation instead of integrating Coulomb's law brutal force? [20 points]

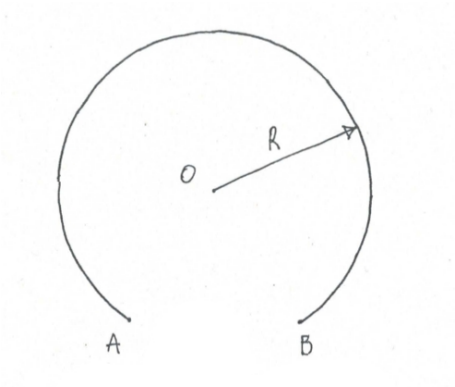

Figure HA1.1