

## EM Preliminary Exam

**3 hours; no books, notes, calculators; 1-page formula sheet allowed, need 4 correct answers here (and correct solutions in the notebook) to pass**

NAME:

A1:  $K \sim$

A2:  $\tau =$

A3:  $C \sim$

A4:  $f =$

A5:

A6:  $\tau \sim$

1. A metal rod of length  $l$  is in a uniform electric field  $E$ . Estimate the torque  $K$ .
2. Cosmonauts returning to Earth at  $v = 0.95c$  send a  $t = 1\text{min}$  long message. Calculate the duration of the received message  $\tau$ .
3. Estimate the capacitance  $C$  of a Leiden jar, in Farads. (bottle with foil, inside and outside, (relative) permittivity of glass is about 5).

4. Calculate the magnetic field reduction factor  $f$  for a spherical shield of radius  $R$ , thickness  $d$ , (relative) permeability  $\mu \gg 1$ .
5. Draw the interference picture for four pinholes at the vertices of a square observed at a faraway screen.
6. Estimate the classical lifetime of a hydrogen atom  $\tau$ .