5. (15 pts) A positive charge \((Q > 0)\) is uniformly distributed from \((0, -b)\) to the origin \((0, 0)\). Compute \(E_y\) at \((0, y)\) for \(y > 0\).

\[
dE = \frac{dQ}{r^2} = \frac{Q}{r^2} = \frac{k \lambda \, dy}{r^2}
\]

Then \(dE_y = \frac{k \lambda \, (-dr)}{r^2} \Rightarrow \text{sign ok since} \ dr < 0 \text{ goes from} y' = b \text{ to} y' = 0 \text{ since} y = b \text{ to} y = 0\)

\[
E_y = k \lambda \int_{y}^{y+b} \frac{dr}{r^2} = k \lambda \left[ -\frac{1}{r} \right]_{y}^{y+b} = k \lambda \left( \frac{1}{y} - \frac{1}{y+b} \right)
\]

6. Two uniform line charges are normal to the page. A, with charge density \(4\lambda\), passes through the origin. To its right, B, with charge density \(2\lambda\), passes through \((3a, 0)\).

a. (8 pts) Find the position \((s, 0)\) where the electric field is zero.

\[
E = 0 \quad \implies \quad \frac{2\lambda}{s} = \frac{2 \lambda}{3a-s} \quad \text{so} \quad 2(3a-s) = 6a
\]

b. (7 pts) If \(\lambda\) is represented by four field lines, find the angle between the field lines near A; near B; as viewed from far away from both A and B.

- For A alone, 16 lines, so angles \(\frac{360}{16} = 22.5\degree\)
- For B alone, 8 lines, so angles \(\frac{360}{8} = 45\degree\)
- For combination, 24 lines, so angles \(\frac{360}{24} = 15\degree\)

c. (10 pts) Sketch the field lines for this geometry. Take one field line from A to go directly to the left, and take one field line from B to go directly to the right.