Don't waste time on questions you aren't sure of. When you answer a question, be clear and concise. A cluttered response will not get full credit.

1. (10 pts) A non-conducting rod lies on the x-axis from \((-b, 0, 0)\) to \((b, 0, 0)\), where \(b\) is a constant. It has charge per unit length \(\lambda = \beta x^6\), where \(\beta\) is a constant. What units must \(\beta\) and \(b\) have? In terms of \(\beta\) and \(b\), find the total charge \(Q\) on the rod, and the average charge per unit length \(\lambda\).

\[
\lambda = \frac{C}{m^2}, \quad \beta - is \ in \ \frac{C}{m^2}
\]

\[
Q = \int_{-b}^{b} \lambda \ dx = \int_{-b}^{b} \beta x^6 \ dx = \beta \left( \frac{x^7}{7} \right)_{-b}^{b} = \frac{2 \beta b^7}{7}
\]

\[
\bar{\lambda} = \frac{Q}{2b} = \frac{\frac{2 \beta b^7}{7}}{2b} = \frac{\beta b^6}{7}
\]

2. (10 pts) For the benefit of Bart Simpson's teacher, concisely explain the amber effect and why it is attractive. In your figure use a positive source charge.

See p. 2 at ch. 2

3. A quarter with charge \(12 \times 10^{-9}\) C, and a dime with charge \(-4 \times 10^{-9}\) C sit on well-separated insulators. A thin insulated wire connects them and is then removed.

![Wax](image1.png)

a. (5 pts) The voltage of the quarter now is 3.0 V relative to a copper doorknob. Find the voltage of the dime.

\[
V_{\text{dime}} = V_{\text{quarter}} = 3.0 \ \text{V}
\]

b. (5 pts) The dime now has a charge of \(3.2 \times 10^{-9}\) C. Find the charge on the quarter.

\[
12 \times 10^{-9} C + (-4) \times 10^{-9} C = 3.2 \times 10^{-9} C + Q_{\text{quarter}}
\]

\[
8 \times 10^{-9} C = 3.2 \times 10^{-9} C + Q_{\text{quarter}}, \quad 1 \times Q_{\text{quarter}} = 4.8 \times 10^{-9} C
\]