

Bing Bai ✓

Yellow

Exam 1, Physics 208

Name Printed in Ink: \_\_\_\_\_

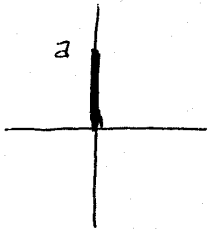
Key

Dr. Saslow, 6/21/02

Section: \_\_\_\_\_

Don't waste time on questions you aren't sure of. Be clear and concise. A cluttered response will not get full credit.

1. (10 pts) A non-conducting rod lies on the  $y$ -axis from  $(0, 0, 0)$  to  $(0, a, 0)$ , where  $a$  is a constant. It has charge per unit length  $\lambda = 8\alpha y^3$ , where  $\alpha$  is a constant. What units must  $a$  and  $\alpha$  have? In terms of  $\alpha$  and  $a$ , find the total charge  $Q$  on the rod, and the average charge per unit length  $\bar{\lambda}$ .

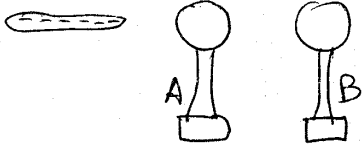


$a \rightarrow [m]$        $\lambda \rightarrow [C/m]$        $\alpha \rightarrow [C/m^4]$

$$Q = \int_0^a \lambda dy = \int_0^a 8\alpha y^3 dy = 8\alpha \frac{y^4}{4} \Big|_0^a = 2\alpha a^4$$

$$\bar{\lambda} = \frac{Q}{a} = 2\alpha a^3$$

2. (12 pts) Conducting globes A and B, on insulating bases, initially are neutral. An insulating charged rod with  $-6$  units of charge is brought near A, without contact or sparking. Next, B is made to contact A and then is withdrawn. Finally, the charged rod is removed. A drawing with  $-7$  units of charge on A and  $+5$  units of charge on B violates what physics principles?



- ① <sup>should be</sup> (+) charge on A, (-) charge on B
- ②  $Q_A + Q_B = 0$
- ③ charges induced should be no more than 6 units

3. (13 pts) An electron starts from rest at A, and accelerates leftward in a non-uniform electric field to B. If the potential changes by 8 volts when the electron moves by 6 cm, how fast is the electron moving at B? Is the potential higher or lower at B? In what general direction does  $\vec{E}$  point during the electron's motion?

B •

$$\frac{1}{2} m_e v_B^2 = eV$$

$$\Rightarrow v_B = \sqrt{\frac{2eV}{m_e}} = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 8}{9.1 \times 10^{-31}}}$$

$$= 1.677 \times 10^6 \text{ (m/s)}$$

The potential at B is higher, and  $\vec{E}$  points from B to A.

