Physics 104 **QUIZ #2** **Fall 2006**

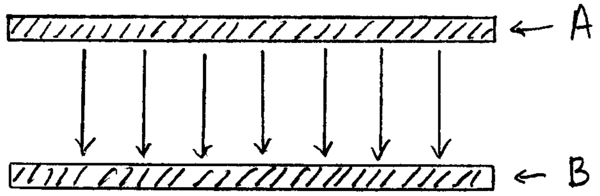
NAME: SOLUTIONS

SECTION # : ______

TA: ______

$$\vec{F} = q\vec{E}$$
$$\Delta V = -E\,\Delta x$$
$$\Delta \text{PE} = q\,\Delta V$$
$$\Phi_E = Q_{\text{inside}}/\epsilon_0$$
$$\epsilon_0 = 8.85 \times 10^{-12}\ \text{C}^2/\text{N}\cdot\text{m}^2$$
$$\text{KE} = \tfrac{1}{2}mv^2$$
$$\Phi_E = EA\cos\theta$$

Two large conducting plates are separated by a distance of 3 cm and carry equal and opposite charges. The electric field between the plates is 7500 N/C.



(*a*) Find the magnitude of the voltage difference between the two plates.

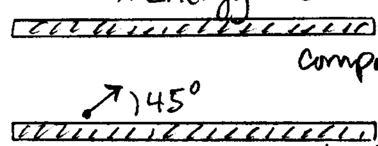
E is constant so we can just take $E \cdot \Delta x = E \cdot d$

$\Delta V = (7500\ \text{N/C})(0.03\ \text{m}) =$ **225 volts**

(*b*) Which plate is at the higher (more positive) potential.

Electric field always points "downhill" from higher to lower V $\Rightarrow$ **A is higher**

(*c*) A proton (mass 1.67×10^{-27} kg, charge $+1.602 \times 10^{-19}$ C) is shot upward from plate B at an angle of 45° as shown. The initial speed of the proton is 4×10^5 m/s. What speed does it have when it hits the upper plate? Ignore gravity. *Energy conservation $\Rightarrow$ no components



The PE difference between plate A and plate B is $\Delta PE = q\,\Delta V = (1.6 \times 10^{-19}\,C)\cdot(225\ \text{volts})$
$= 3.6 \times 10^{-17}\,J$. The proton moves against E so it will slow down.

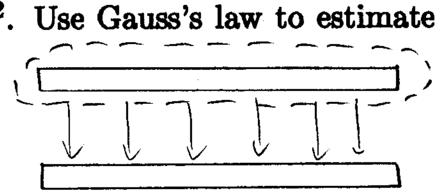
$\frac{1}{2}mv_f^2 = \frac{1}{2}mv_i^2 - 3.6 \times 10^{-17}\,J \Rightarrow$

$v_f^2 = v_i^2 - 2(3.6 \times 10^{-17}\,J)/1.67 \times 10^{-27}\,kg$

$v_f = 3.42 \times 10^5$ m/s

(*d*) Assume that each plate has a surface area of 0.4 m². Use Gauss's law to estimate the amount of charge on the upper plate.

surface $\longrightarrow$



$\Phi_E = E \cdot A = (7500\ \text{N/C})(0.4\ \text{m}^2)$

$Q_{in} = \epsilon_0 \Phi_E = \left(8.85 \times 10^{-12} \frac{C^2}{N m^2}\right)\left(7500 \frac{N}{C}\right)(.4\ m^2) =$ **2.65×10^{-8} C**