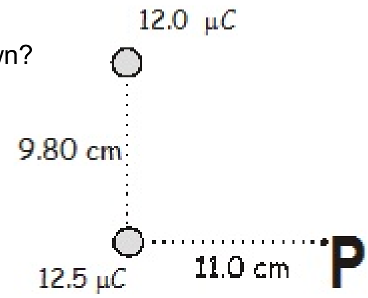
Name: ______________________




**1.** What is the voltage at point P which is close up to the two charges as shown?

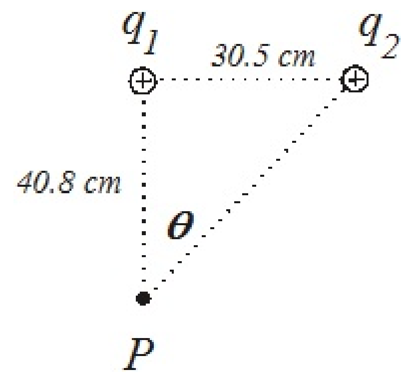
$r_1 = ((11.0\ cm)^2 + (9.80\ cm)^2)^{\frac{1}{2}} = 14.73227749\ cm$

$V = k(q_1/r_1 + q_2/r_2)$

$= 9.0x10^9\ N{\cdot}m^2/C^2(12.0\ \mu C/0.1473227749\ m + 12.5\ \mu C/0.11\ m)$

$= 1\,755\,811.482\ V = \boxed{1.76x10^6\ V\ \text{or}\ 1.76\ MV}$

**2.** Two charges are situated near point P. The angle ***θ*** is 29.0°. $q_1$ = 1.35 μC. The potential difference at point ***P*** is 6.75x10[4] V. Find the charge $q_2$.




$r_2 = ((30.5\ cm)^2 + (40.8\ cm)^2)^{\frac{1}{2}} = 50.9400628\ cm$

$V = k(q_1/r_1 + q_2/r_2)$

$q_2 = (V/k - q_1 r_1) \cdot r_2$

$= (6.75x10^4\ V/9.0x10^9\ N{\cdot}m^2/C^2 - 1.35\ \mu C \cdot 0.408\ m) \cdot 0.509400628\ m$

$= 3.5399268x10^{-6}\ C = \boxed{3.54\ \mu C}$

**3.** An electric field has a value of 9.50x10[6] N/C. A positive test charge of 22.5 μC is placed in the field. What force does the charge experience?

$F = qE = 22.5x10^{-6}\ C \cdot 9.50x10^6\ N/C = 213.75\ N = \boxed{214\ N}$

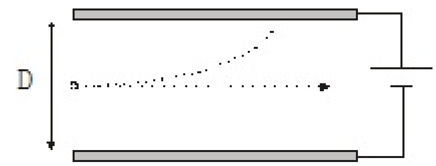
**4.** Through what potential difference would an electron need to accelerate to achieve a velocity of 1.00x10[7] m/s?

$\Delta U_E = \Delta KE$

$qV = \frac{1}{2} mv^2$

$V = \frac{1}{2} mv^2/q = 0.5 \cdot 9.11x10^{-31}\ kg \cdot (1.00x10^7\ m/s)^2/1.6x10^{-19}\ C = 284.6875\ V = \boxed{285\ V}$

**5.** An electron is fired into the midpoint of a field between two charged plates. The initial velocity of the electron is $3.6 \times 10^6$ m/s. The plates are a distance of 1.60 mm apart. The potential difference for the plates is 120.0 V. Determine where the electron will hit on the upper plate.




$E = V/d = 120.0\ V/0.00160\ m = 75\ 000\ V/m$

$F = qE = 1.6 \times 10^{-19}\ C \cdot 75\ 000\ N/C = 1.20 \times 10^{-14}\ N$

$a = F/m = 1.20 \times 10^{-14}\ N/9.11 \times 10^{-31}\ kg = 1.3172338 \times 10^{16}\ m/s^2$

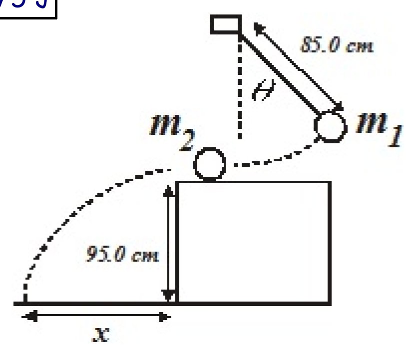
$d_y = 1/2at^2$

$t = (2d/a)^{\frac{1}{2}} = (2 \cdot 0.0008\ m/1.3172338 \times 10^{16}\ m/s^2)^{\frac{1}{2}} = 3.4852 \times 10^{-10}\ s$

$d_x = v \cdot t = 3.6 \times 10^6\ m/s \cdot 3.4852 \times 10^{-10}\ s$

$= 0.00124567\ m =$ **0.00125 m or 1.25 mm into the space between the plates**

**6.** Two masses are set up as shown. The angle $\theta$ that $m_1$ makes with the vertical is 38.0°. $m_1$ is 552 g, $m_2$ is 455 g. $m_1$ is released, swings down and collides with the other mass. At the point of impact, the string holding up $m_1$ is vertical and it hits the other ball head on. $m_1$ ends up with a velocity to the right of 0.500 m/s. Find: (a) the potential energy of $m_1$ relative to the top of the table, (b) the speed of $m_2$ after the collision, (c) the distance $x$ that the ball travels before it hits the deck, and (d) the kinetic energy of $m_2$ just before it hits the deck.




a. $h = \ell_{string} - \ell_{string} \cdot \cos\theta = 85.0\ cm - 85.0\ cm \cdot \cos(38.0°) = 18.019086\ cm$

$PE = mgh = 0.552\ kg \cdot 9.8\ m/s^2 \cdot 0.18019086\ m = 0.9747605\ J =$ **0.975 J**

b. $\Delta KE = \Delta PE$

$\frac{1}{2} m_1 \Delta v_1^2 = m_1 g \Delta h$

$v_1 = (2gh)^{\frac{1}{2}} = (2 \cdot 9.8\ m/s^2 \cdot 0.18019086\ m)^{\frac{1}{2}} = 1.879293\ m/s$

$m_1 v_1 = m_1 v_1' + m_2 v_2$

$552\ g \cdot (-1.879293\ m/s) = 552\ g \cdot 0.500\ m/s + 455\ g \cdot v_2$

$v_2 = 552\ g \cdot (-2.379293\ m/s)/455\ g = -2.886527\ m/s = -2.89\ m/s$

speed $= |v| = |-2.89\ m/s| =$ **2.89 m/s**

c. $d_y = \frac{1}{2} at^2$

$t = (2d_y/a)^{\frac{1}{2}} = (2 \cdot 0.950\ m/9.8\ m/s^2)^{\frac{1}{2}} = 0.440315\ s = 0.440\ s$

$d_x = v \cdot t = 2.886527\ m/s \cdot 0.440315\ s = 1.27098\ m =$ **1.27 m**

d. $KE_{final} = KE_{initial} + PE = \frac{1}{2} mv^2 + mgh$

$= 0.5 \cdot 0.455\ kg \cdot (2.886527\ m/s)^2 + 0.455\ kg \cdot 9.8\ m/s^2 \cdot 0.95\ m$

$= 6.1315886\ J =$ **6.13 J**