EXAM 1

PLEASE FILL IN THE INFORMATION BELOW

Name (printed):

Name (signed):

Student ID Number

Discussion Instructor:

Chad  Jon Paul  Maria  Peter
Data: Use these constants (where it states, for example, 1 ft, the 1 is exact for significant figure purposes).

1 ft = 12 in (exact)  
1 m = 3.28 ft  
1 mile = 5280 ft (exact)  
1 hour = 3600 sec = 60 min (exact)  
1 day = 24 hr (exact)  
g_{\text{earth}} = 9.80 \text{ m/s}^2 = 32.2 \text{ ft/s}^2  
g_{\text{moon}} = 1.67 \text{ m/s}^2 = 5.48 \text{ ft/s}^2  
1 year = 365.25 days  
1 kg = 0.0685 slug  
1 N = 0.225 pound  
1 horsepower = 550 ft\text{-pounds/s} (exact)  

M_{\text{earth}} = 5.98 \times 10^{24} \text{ kg}  
R_{\text{earth}} = 6.38 \times 10^3 \text{ km}  
M_{\text{sun}} = 1.99 \times 10^{30} \text{ kg}  
R_{\text{sun}} = 6.96 \times 10^8 \text{ m}  
M_{\text{moon}} = 7.35 \times 10^{22} \text{ kg}  
R_{\text{moon}} = 1.74 \times 10^3 \text{ km}  

G = 6.67 \times 10^{-11} \text{ N\cdot m}^2/\text{kg}^2  
k = 8.99 \times 10^9 \text{ N\cdot m}^2/\text{C}^2  
\varepsilon_0 = 8.85 \times 10^{-12} \text{ F/m}  
\varepsilon_{\text{electron charge}} = -1.60 \times 10^{-19} \text{ C}  
m_{\text{electron}} = 9.11 \times 10^{-31} \text{ kg}  
\mu_0 = 4\pi \times 10^{-7} \text{ T\cdot m/A} (\text{exact})  

N(\text{Avogadro's No.}) = 6.02 \times 10^{23} \text{ atoms/gm-mole}  
= 6.02 \times 10^{26} \text{ atoms/kg-mole}  

1 \text{ Tesla} = 10,000 \text{ gauss} (\text{exact})  
\rho(\text{H}_2\text{O}) = 1000 \text{ kg/m}^3  
\cos(a \pm b) = \cos a \cos b \mp a \sin b  
\sin(a \pm b) = \sin a \cos b \pm \sin b  
m_{\text{proton}} = 1.67 \times 10^{-27} \text{ kg}  
h = 6.64 \times 10^{-34} \text{ J}  
\pi = 3.14  
c = 3.00 \times 10^8 \text{ m/s}
Show all work!! Report all numbers to three (3) significant figures.

A.  [17 pts.] A car (mass $m = 1000 \text{ kg}$ and charge $q = +7.2 \text{ C}$) is at rest in a driveway. A uniform electric field (strength $E = 5000 \text{ N/C}$) is turned on to propel the car toward the street, a distance $x = 10 \text{ m}$ from the car’s starting point. Find the car’s speed $v$ when it reaches the street. Assume that the car acts like a point charge.

B.  [16 pts.] A simple model of the hydrogen atom consists of an electron in a circular orbit of radius $r = 5.29 \times 10^{-11} \text{ m}$ about a stationary proton. Find $v$, the speed of the electron around the proton.
A. [16 pts.] Find the electric field vector $\mathbf{E}$, evaluated at point P $[(x,y) = (1,1) \text{ m}]$, that arises from the point charges shown in the figure.

B. [16 pts.] A straight wire segment of length L, aligned on the y-axis and centered at the origin, has a linear charge density is $\lambda(y) = C \left( y^2 + a^2 \right)^{3/2}$, where $C$ is a constant. Find the strength of the electric field at a point located distance $a$ from the wire on the x axis.
An infinitely long, straight coaxial cable has a thin wire running along its axis surrounded by a conducting cylindrical pipe of inner radius $r_i$ and outer radius $r_o$. The pipe is electrically neutral, while the wire carries a uniform charge, with linear charge density $\lambda$.

(a) [7 pts.] Write the E field strength just outside the outer surface of the conducting pipe $(r \rightarrow r_o)$ in terms of the surface charge density $\eta$.

(b) [8 pts.] Find the strength of the electric field $E$ outside of the coaxial cable at a distance $r > r_o$ from the cable’s axis.

(c) [9 pts.] Find the surface charge density $\eta$ on the pipe’s outer surface in terms of radius $r_o$ and $\lambda$.

(d) [10 pts.] Find the electric field $E'$ outside the pipe $(r > r_o)$ if the wire was removed and the pipe was filled entirely with a medium of uniform charge density $\rho$. 

Show all work!! Report all numbers to three (3) significant figures.