Physics 152 Summary I

1) Coulomb's Law: $|\vec{F}| = \frac{q_1 q_2}{4\pi\varepsilon_0 r^2}$ { repulsive for like charges; attractive for opposite sign charges

2) Electric field $\vec{E} = \vec{F}/q_{test}$

$\vec{F}$ = force on "test charge" q_{test}

(test charge means we assume q_{test} does not change the electric field)

3) Point charges as sources of E-field.

$\vec{E} = \frac{q}{4\pi\varepsilon_0 r^2}\hat{r}$ where $\hat{r}$ points from the charge to the location we calculate the field.

4) For multiple charges, discrete or continuous, we add the field from each charge (vector addition, i.e. superposition).

you should know how to set up the addition (i.e. integrate)

5) $\varepsilon_0 = 8.854 \times 10^{-12}\ C^2/N\cdot m^2$

6) Lines of $\vec{E}$ are sometimes used to represent electric fields. Know how to draw lines of $\vec{E}$ for simple charge distributions.

⑦ Gauss's Law

$$\oint \vec{E} \cdot d\vec{A} = \frac{q_{in}}{\varepsilon_0}$$

q_{in} = net charge inside the surface

$\vec{E}$ = electric field at the surface

$d\vec{A}$ = outward surface area vector

8) know how to use Gauss's Law for

i) point charge

ii) spherical symmetry

iii) cylindrical symmetry & line charge

iv) infinite plane

9) Sometimes $q_{in} = 0$, but $\vec{E} \neq 0$. Be sure you can explain why.

10) Conductors:

i) $E = 0$ inside conductors. Why?

ii) all net charge resides on surface of conductor

iii) at surface, $\vec{E} \perp$ surface and $|\vec{E}| = \sigma/\varepsilon_0$

11) Potential Difference between two points, A & $B = V_B - V_A$

$V_B - V_A$ = work done by external force in moving a unit (+) charge ($q = 1$) from point A to point B

12) Potential energy of charge q, where the electric potential is V, is $PE = qV$

13) $V = \frac{1}{4\pi\epsilon_0} \sum \frac{q_i}{r_i}$ or $\frac{1}{4\pi\epsilon_0} \int \frac{dq}{r}$

integrate over all the charge.

(Note: these assume charge does not extend to ∞, i.e. $V_\infty = 0$)

14) $V_b - V_a = -\int_a^b \vec{E} \cdot d\vec{s}$

15) Be able to calculate V for different charge distributions.

16) Know how to find and draw equipotential surfaces.
- how might you find the direction of E from an equipotential surface?