I. VECTOR ANALYSIS

1. $\boldsymbol{a}\cdot(\boldsymbol{b}\times\boldsymbol{c})=\boldsymbol{b}\cdot(\boldsymbol{c}\times\boldsymbol{a})=\boldsymbol{c}\cdot(\boldsymbol{a}\times\boldsymbol{b})$
2. $\boldsymbol{a}\times(\boldsymbol{b}\times\boldsymbol{c})=\boldsymbol{b}(\boldsymbol{a}\cdot\boldsymbol{c})-\boldsymbol{c}(\boldsymbol{a}\cdot\boldsymbol{b})$
3. $\nabla(fg)=f\nabla g+g\nabla f$
4. $\nabla\cdot(f\boldsymbol{F})=f\nabla\cdot\boldsymbol{F}+\boldsymbol{F}\cdot\nabla f$
5. $\nabla\times(f\boldsymbol{F})=f\nabla\times\boldsymbol{F}-\boldsymbol{F}\times\nabla f$
6. $\nabla(\boldsymbol{F}_1\cdot\boldsymbol{F}_2)=(\boldsymbol{F}_1\cdot\nabla)\boldsymbol{F}_2+(\boldsymbol{F}_2\cdot\nabla)\boldsymbol{F}_1+\boldsymbol{F}_1\times(\nabla\times\boldsymbol{F}_2)+\boldsymbol{F}_2\times(\nabla\times\boldsymbol{F}_1)$
7. $\nabla\cdot(\boldsymbol{F}_1\times\boldsymbol{F}_2)=\boldsymbol{F}_2\cdot(\nabla\times\boldsymbol{F}_1)-\boldsymbol{F}_1\cdot(\nabla\times\boldsymbol{F}_2)$
8. $\nabla\times(\boldsymbol{F}_1\times\boldsymbol{F}_2)=(\boldsymbol{F}_2\cdot\nabla)\boldsymbol{F}_1-(\boldsymbol{F}_1\cdot\nabla)\boldsymbol{F}_2+\boldsymbol{F}_1\nabla\cdot\boldsymbol{F}_2-\boldsymbol{F}_2\nabla\cdot\boldsymbol{F}_1$
9. $\nabla\times\boldsymbol{R}=0$, $\nabla\cdot\boldsymbol{R}=\partial_xR_x+\partial_yR_y+\partial_zR_z$
   $\nabla R=\boldsymbol{R}/R$, $\nabla R^n=nR^{n-2}\boldsymbol{R}$, $\nabla(\boldsymbol{c}\cdot\boldsymbol{R})=\boldsymbol{c}$
   $\nabla\times(\boldsymbol{R}/R)=0$
10. $\nabla((\boldsymbol{c}\cdot\boldsymbol{R})/R)=(R^2\boldsymbol{c}-(\boldsymbol{c}\cdot\boldsymbol{R})\boldsymbol{R})/R^3$.
11. Gauss's theorem: $\int_V(\nabla\cdot\boldsymbol{a})\,\mathrm{d}V=\oint_{\partial V}\boldsymbol{a}\cdot\mathrm{d}\boldsymbol{S}$
12. Stokes's theorem: $\int_S(\nabla\times\boldsymbol{a})\cdot\mathrm{d}\boldsymbol{S}=\oint_{\partial S}\boldsymbol{a}\cdot\mathrm{d}\boldsymbol{l}$
13. Green's theorem:
    $\oint_{\partial V}(\varphi\nabla\psi-\psi\nabla\varphi)\cdot\mathrm{d}\boldsymbol{S}=\int_V(\varphi\Delta\psi-\psi\Delta\varphi)\,\mathrm{d}V$

II. ELECTROSTATICS

1. Coulomb's law: $\boldsymbol{F}=\frac{1}{4\pi\epsilon}\frac{Q_1Q_2}{r^3}\boldsymbol{r}$, $\Pi=\frac{1}{4\pi\epsilon}\frac{Q_1Q_2}{r}$, Kepler's law are applicable
2. Intensity and potential of el. field
   $\boldsymbol{E}=\frac{1}{4\pi\epsilon}\frac{Q}{r^3}\boldsymbol{r}$, $\varphi=\frac{1}{4\pi\epsilon}\frac{Q}{r}$, $\boldsymbol{E}=-\nabla\varphi$
3. Gauss's law: $\oint_{\partial V}\boldsymbol{E}\cdot\mathrm{d}\boldsymbol{S}=Q/\epsilon_0$, $\nabla\cdot\boldsymbol{E}=\rho/\epsilon_0$
4. Conservative force: $\oint_{\partial S}\boldsymbol{E}\cdot\mathrm{d}\boldsymbol{l}=0$
5. There is no stable system of charges in the vacuum.
6. Poisson equation: $\nabla\varphi=-\rho/\epsilon_0$,
   Laplace equation free space $\nabla\varphi=0$.
7. $\varphi(\boldsymbol{r})=\frac{1}{4\pi\epsilon_0}\int_{V'}\frac{\rho(\boldsymbol{r'})}{|\boldsymbol{r}-\boldsymbol{r'}|}\mathrm{d}V'$
   $\boldsymbol{E}(\boldsymbol{r})=\frac{1}{4\pi\epsilon_0}\int_{V'}\frac{(\boldsymbol{r}-\boldsymbol{r'})\rho(\boldsymbol{r'})}{|\boldsymbol{r}-\boldsymbol{r'}|^3}\mathrm{d}V'$
8. Multipole expansion:
   $$\varphi(\boldsymbol{r})=\frac{1}{4\pi\epsilon_0}\frac{1}{r}\sum_{i=1}^{\infty}\int_{V'}\left[\frac{r'}{r}\right]^i\rho(\boldsymbol{r'})P_i(\cos\alpha)\mathrm{d}V'$$
   where $P_i(x)$ is i-th Legendre polynomial and $\cos\alpha$ is the angle between $\boldsymbol{r'}$ and $\boldsymbol{r}$.
9. Electric dipole moment $\boldsymbol{p}=Q\boldsymbol{l}=\sum Q_i\boldsymbol{r}_i$
10. El. dipole: $\varphi(\boldsymbol{r})=\frac{1}{4\pi\epsilon}\frac{\boldsymbol{p}\cdot\boldsymbol{r}}{r^3}$
    $\boldsymbol{E}(\boldsymbol{r})=\frac{1}{4\pi\epsilon}\left[\frac{3\boldsymbol{r}(\boldsymbol{p}\cdot\boldsymbol{r})}{r^5}-\frac{\boldsymbol{p}}{r^3}\right]$
11. z-axis of dipole, $\tan\theta=x/z$:
    $E_x=\frac{P}{4\pi\epsilon_0}\frac{3\sin\theta\cos\theta}{r^3}$, $E_z=\frac{P}{4\pi\epsilon_0}\frac{3\cos^2\theta-1}{r^3}$
12. Energy of dipole: $W=-\boldsymbol{p}\cdot\boldsymbol{E}$
13. Force acting on a dipole: $F_i=p_j\partial_iE_j$,
    $\boldsymbol{F}=(\boldsymbol{p}\cdot\nabla)\boldsymbol{E}$, for constant dipole $\boldsymbol{F}=\nabla(\boldsymbol{p}\cdot\boldsymbol{E})$
14. Torque acting on a dipole: $\boldsymbol{\tau}=\boldsymbol{p}\times\boldsymbol{E}$

III. ELECTRIC FIELDS IN MATTER

1. $\rho_{total}=\rho_{free}+\rho_{bounded}$
2. Polarization $\boldsymbol{P}=N\boldsymbol{p}=N\overleftrightarrow{\beta}\boldsymbol{E}=\epsilon_0\overleftrightarrow{\chi}\boldsymbol{E}$
3. Tensor of suspecibility $\overleftrightarrow{\chi}=N\overleftrightarrow{\beta}/\epsilon_0$
   where $\overleftrightarrow{\beta}$ is atomic polarizability

	izotrop.	unizotrop.
homogenous	χ	$\overleftrightarrow{\chi}$
non-homog.	$\chi(\boldsymbol{r})$	$\overleftrightarrow{\chi}(\boldsymbol{r})$

4. Electric induction: $\boldsymbol{D}=\epsilon_0\boldsymbol{E}+\boldsymbol{P}=\overleftrightarrow{\epsilon}\boldsymbol{E}$, where $\overleftrightarrow{\epsilon}=\epsilon_0(1+\overleftrightarrow{\chi})$
5. $\nabla\cdot\boldsymbol{P}=-\rho_b/\epsilon_0$, $\oint_{\partial V}\boldsymbol{P}\cdot\mathrm{d}\boldsymbol{S}=-Q_b/\epsilon_0$
6. BOunded charge: $Q_b=\boldsymbol{P}\cdot\boldsymbol{S}$, $\sigma_b=\boldsymbol{p}\cdot\boldsymbol{n}$
7. Gauss's law: $\oint_{\partial V}\boldsymbol{D}\cdot\mathrm{d}\boldsymbol{S}=Q_{free}$, $\nabla\cdot\boldsymbol{D}=\rho_{free}$
8. Conservative force: $\oint_{\partial S}\boldsymbol{E}\cdot\mathrm{d}\boldsymbol{l}=0$
9. Boundary of dielectrics:
   $E_{2t}=E_{1t}$, $D_{2n}-D_{1n}=\sigma_{free}$, where σ_{free} is free charge surface density on the boundary.
10. Inside a conductor $\boldsymbol{E}=0$.
11. Outside of conductor the electric field lines are perpendicular to the surface, beggining or ending at charges on the surface.
12. Induced charges resides entirely on the surface of the conductor and the total charge is usually zero. It is nonzero if conductor is grounded or infinite.
13. Whatever be the charge and field configuration outside, any cavity in a conductor remains shielded from outside electric influence.
14. Method of image charges.
15. Clausiuss-Mossotti eq. $\frac{\epsilon-1}{\epsilon+2}=\frac{N\alpha}{3\epsilon_0}=\frac{\chi}{\chi+3}$, where α is molecular polarizability.

IV. MAGNETOSTATICS

V. MAGNETIC FIELDS IN MATTER

VI. MAGNETOSTATICS

VII. ELECTRIC CURRENT

II. CONVERSATION LAWS

VIII. NONSTATIONARY FIELDS

IX. TRANSPORTNI JEVY

X. ELECTROMAGNETIC WAVES

XI. RADIATION