

$$\vec{F} = k \frac{q_1 q_2}{r^2} \hat{r}_{12} = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2} \hat{r}_{12}$$

$$\phi_E = \oint \vec{E} \cdot d\vec{A}$$

$$\oint \vec{E} \cdot d\vec{A} = \frac{Q_{enc}}{\epsilon_0}$$

$$E_S = -dV/ds$$

$$V = W/q$$

$$V_{prchg} = \frac{kq}{R}$$

$$\vec{E} = \int_{vol} \frac{k dQ}{r^2} dr \hat{r}$$

$$V = \int_{vol} \frac{k dQ}{r}$$

Sphere: $A = 4\pi r^2$
 $V = \frac{4}{3}\pi r^3$

Cylinder: $A = 2\pi rL + 2\pi r^2$
 $V = \pi r^2 L$



$$\sin \theta = \frac{h}{h}$$

$$\cos \theta = \frac{a}{h}$$

$$\tan \theta = h/a$$

$$\text{Const. Accel.} \begin{cases} v = v_0 + at \\ x = x_0 + v_0 t + \frac{1}{2} at^2 \\ v^2 = v_0^2 + 2a(x - x_0) \\ x^2 = x_0 + \frac{1}{2}(v_0 + v)t \end{cases}$$

$$a_c = \frac{mv^2}{R}$$

$$S = R\theta$$

$$KE = \frac{1}{2} m v^2$$

$$PE_{spring} = \frac{1}{2} k x^2$$

$$\int u^n du = \frac{u^{n+1}}{n+1}$$

$$\int \frac{du}{u} = \ln|u|$$

$$\int e^u du = e^u$$

$$\int \frac{x dx}{x^2 + a^2} = \sqrt{x^2 + a^2}$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \dots$$

$$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} + \dots \quad -1 < x < 1$$

$$\ln x = \frac{x-1}{x} + \frac{1}{2} \left(\frac{x-1}{x}\right)^2 + \dots \quad x \geq \frac{1}{2}$$

$$(1+x)^{-1} = 1 - x + x^2 - x^3 + \dots \quad -1 < x < 1$$

$$(1+x)^{-2} = 1 - 2x + 3x^2 - \dots \quad -1 < x < 1$$

$$(1+x)^{1/2} = 1 + \frac{1}{2}x - \frac{x^2}{8} + \dots \quad -1 < x < 1$$