Chapter 16 *(Bueche & Jerde)* ***Electric Force and Fields***

P04 $F_g = GM_p^2/r^2$ & $F_e = ke^2/r^2$. $F_g = F_e$ $\Rightarrow$ $M_p = e(k/G)^{1/2} = 1.86\times10^{-9}$ kg .

P11 $m = 60$ g: $kq^2/r^2 = Gm^2/r^2$ gives $q = m(k/G)^{1/2} = 5.17\times10^{-12}$ C .

P15 Let x be the position of the 4 nC charge. It can not be located between the two charges, –5 nC and 6 nC, because both exert forces in the same direction. $F_4 = k(4.00)(-5.00)/x^2 + k(4.00)(6.00)/(x-1)^2 = 0$ leads to $-5.00/x^2 + 6.00/(x-1)^2 = 0$ or $x^2 + 10.0x - 5.00 = 0$. Solving this we obtain $x = -5.00 - 30.0^{1/2} = -10.5$ (m) .

P19 Because the charges are identical and located at the corners of an equilateral triangle, by symmetry, all of them experience the force of same magnitude equal to $F = 2\,k(5.00\times10^{-6})^2 \cos30.0°/(0.100)^2 = 39.0$ (N) along the bisector of the angle, directed outward .

P20 $q_1 = q_2 = q_3 = q_4 = q = 4.0\ \mu$C, $a =$ 40 cm, and $b = 60$ cm. $F_{2x} = F_{21} + F_{41}(b/r)$, $F_{2y} = F_{31} + F_{41}(a/r)$, where $r^2 = a^2+b^2$, $F_{21} = kq^2/a^2$, $F_{31} = kq^2/b^2$, and $F_{41} = kq^2/r^2$. $F_{2x} = 0.630$ N and $F_{2y} = 1.05$ N.

P24 $L = 40$ cm, $\theta = 30° = 2\alpha$ & $m = 1.0$ g. $F_e = T\sin\alpha$ & $mg = T\cos\alpha$. $Fe = mg\tan\alpha = kq^2/(2L\sin\alpha)^2$, $q = 2L(mg\sin^3\alpha/k\cos\alpha)^{1/2} = 1.12\times10^{-7}$ C .

P38 $F_e = F_g$ or $qE = mg$ $\Rightarrow$ $E = mg/q$.

P41 $T\cos\theta = mg$ & $T\sin\theta = qE$ $\Rightarrow$ $E = mg\tan\theta/q$.

P47 (**a**) $F_e = k(9.00\times10^{-6})(5.00\times10^{-6})/(0.500)^2 = 1.62$ (N); (**b**) After being touched, $q_1 = q_2 = 2.00\ \mu$C, $F_e = 0.144$N .

P48 (**a**) $F_e = ke^2/r^2 = k(1.60\times10^{-19})^2/(0.530\times10^{-10})^2 = 8.20\times10^{-8}$ (N); (**b**) $m_e v^2/r = F_e$, so $v = (F_e\, r/m_e)^{1/2} = 2.18\times10^6$ m/s .

P51 The net electric field at the center is zero due to the symmetry of charge distribution .

P55 (**a**) $a_y = -eE/m_e$, $y = at^2/2 = -eEt^2/2m_e$; (**b**) $t = x/v_{xo}$, $y = (eE/2mev^2_{xo})\,x^2$.

P58 (**a**) By symmetry, $E_y = 0$ & $E_x = 2(kq/r^2)\cos\theta$, where $\cos\theta = b/(b^2 + y^2)^{1/2}$. $E_x = 2kqb/(b^2 + y^2)^{1/2}$; (**b**) As $y >> b$, $E_x = 2kqb/y^3$.

P60 $E_y = 0$ & $E_x = kq/(x + b)^2 - kq/(x - b)^2$. Using $1/(x + b)^2 = (1 - 2b/x)/x^2$ & $1/(x - b)^2 = (1+2b/x)/x^2$ for $b/x << 1$, we obtain $E_x = 4kqb/x^3$.

第**16**章　(Bueche & Jerde)　**電力與電場**

庫侖定律(Coulomb's Law)：法人庫侖(1736–1806)於 1785 年提出

兩點電荷間的作用力與兩點電荷乘積成正比，與兩點電荷間距離平方成反比，作用力方向為沿兩點電荷之連線方向，$\vec{F}_{21} = k_e q_1 q_2 \hat{r}_{12} / r_{12}^2$。

殼層定理：(***A***).對一電荷均勻分佈之球殼而言，其與殼內電荷之靜電力作用為零。(***B***).對一電荷均勻分佈之球(球殼)而言，其與球(球殼)外電荷之靜電力作用儼然整個球(球殼)之電荷均集中於球(殼)心。(***C***).對一電荷均勻分佈之球而言，其與球內點電荷之電力作用與到球心距離成正比。

電場(力)線性質：

1.靜電場線從正電荷出發，而結束於負電荷；***2***.從電荷發出或結束於電荷之場線數正比於電荷大小；***3***.場線的切線方向表示空間該點電場之方向；***4***.電場強度正比於場線密度(通過單位截面積之場線數目)；***5***.場線決不相交。　*注意:* 場線並非帶電質點之運動路徑。

高斯定律：通過任一封閉曲面的電通量等於該封閉曲面所包圍的淨電荷除以ε_0

$$\oint \vec{E} \cdot d\vec{A} = q_{net}/\varepsilon_0 \text{。}$$

在電場中之導體：(***A***)在靜電情況下，導體內部的電場為零。(***B***)在靜電情況下，導體內部沒有多餘(淨)電荷；如有多餘電荷必留駐於導體表面。(***C***)在靜電情況下，導體表面處的電場垂直於導體表面，而電場大小為σ/ε_0，σ為表面電荷密度。