일반물리2 과제풀이 CH.20

27번.

$\vec{E}=k\frac{q}{r^2}\hat{r}$,

(a). q_1(+ 전하)과 왼쪽 5.0cm 사이 : $\vec{r_1}=(-5.0cm)\hat{i}+(2.5cm)\hat{i}=(2.5cm)\hat{i}$

q_2(- 전하)와 왼쪽 5.0cm 사이 : $\vec{r_2}=(-5.0cm)\hat{i}-(2.5cm)\hat{i}=(-7.5cm)\hat{i}$

$\vec{E}=k\frac{q_1}{r_1^2}\hat{r_1}+k\frac{q_2}{r_2^2}\hat{r_2}=k\left[\frac{2\times10^{-6}C}{(0.025m)^2}+\frac{-2\times10^{-6}C}{(0.075m)^2}\right]\hat{i}=(-26MN/C)\hat{i}$

(b). $\vec{r_1}=(5.0cm)\hat{j}+(2.5cm)\hat{i}$, $\vec{r_2}=(5.0cm)\hat{j}-(2.5cm)\hat{i}$

$\vec{E}=k\frac{q_1}{r_1^2}\hat{r_1}+k\frac{q_2}{r_2^2}\hat{r_2}=k\left[\frac{2\times10^{-6}C}{((0.025m)^2+(0.050m)^2)^{3/2}}+\frac{-2\times10^{-6}C}{((0.025m)^2+(0.050m))^{3/2}}\right](0.050)\hat{i}=(5.2MN/C)\hat{i}$

(c). $\vec{r_1}=(2.5cm)\hat{i}$, $\vec{r_2}=-(2.5cm)\hat{i}$

$\vec{E}=k\frac{q_1}{r_1^2}\hat{r_1}+k\frac{q_2}{r_2^2}\hat{r_2}=k\left[\frac{2\times10^{-6}C}{(0.025m)^2}+\frac{2\times10^{-6}C}{(0.025m)^2}\right]\hat{i}=(58MN/C)\hat{i}$

48번.

q_1 위치벡터 : $\vec{r_1}=(1m)\hat{j}$

q_2 위치벡터 : $\vec{r_2}=(2m)\hat{i}$

q_3 위치벡터 : $\vec{r_3}=(2m)\hat{i}+(2m)\hat{j}$

$\vec{F_3}=\vec{F_{13}}+\vec{F_{23}}$, $\vec{r_{13}}=\vec{r_3}-\vec{r_1}$, $\vec{r_{23}}=\vec{r_3}-\vec{r_2}$

$\vec{F_3}=k\left[\frac{q_1q_3(\vec{r_3}-\vec{r_1})}{|\vec{r_3}-\vec{r_1}|^3}+\frac{q_2q_3(\vec{r_3}-\vec{r_2})}{|\vec{r_3}-\vec{r_2}|^3}\right]$, 값들을 모두 대입하면 $\vec{F_3}=(1.6\hat{i}-0.33\hat{j})N$

49번.

(a).

$\hat{r_{31}}=\frac{\vec{r_1}-\vec{r_3}}{|\vec{r_1}-\vec{r_3}|}=-\frac{2}{\sqrt{5}}\hat{i}-\frac{1}{\sqrt{5}}\hat{j}$

$\hat{r_{21}}=\frac{\vec{r_1}-\vec{r_2}}{|\vec{r_1}-\vec{r_2}|}=-\frac{2}{\sqrt{5}}\hat{i}+\frac{1}{\sqrt{5}}\hat{j}$

$\vec{F_3}=k\left[\frac{q_1q_3(\vec{r_1}-\vec{r_3})}{|\vec{r_1}-\vec{r_3}|^3}+\frac{q_1q_2(\vec{r_1}-\vec{r_2})}{|\vec{r_1}-\vec{r_2}|^3}\right]=kq_1\left[\frac{q_2(-2\hat{i}+\hat{j})}{5^{3/2}m^2}+\frac{q_3(-2\hat{i}-\hat{j})}{5^{3/2}m^2}\right]$, $q_2=q_3$ 결과 도출

(b). $\vec{F_3}=k(25\times20\times10^{-6}C^2)(-4.0\hat{i})(5.0)^{-3/2}=(-1.6\hat{i})N$

54번.

$\vec{E}= k\frac{q}{(x-a)^2}\hat{i}-k\frac{q}{(x+a)^2}\hat{i}=kq\left[(x-a)^{-2}-(x-a)^{-2}\right]\hat{i}=\frac{kq}{x^2}\left[(1-\frac{a}{x})^{-2}-(1+\frac{a}{x})^{-2}\right]\hat{i}$

테일러 전개 $(1\pm\frac{a}{x})^{-2}\approx 1\mp 2\frac{a}{x}$

$\vec{E}= \frac{kq}{x^2}\left[(1+2\frac{a}{x})-(1-2\frac{a}{x})\right]\hat{i}=\frac{2kp}{x^3}i,\ p=qd=2qa$

79번.

전기장에 의해 질량 m인 잉크방울 힘 F가 생겨 가속 운동을 한다.

F=ma=qE

y 성분 이동 거리 : $y=\frac{1}{2}at^2=\frac{1}{2}(\frac{qE}{m})t^2$

잉크방울이 수평 방향으로 통과하는 데 걸린 시간 : $t=\frac{L}{v}$

t를 y에 대입하고, 최대 이동 y를 d/2라고 두면 $y=\frac{qEL^2}{2mv^2}=\frac{d}{2}$

따라서 $E_{\max}=\frac{mdv^2}{qL^2}[\frac{kg^*m^*(m/s)^2}{C^*m^2}=N/C]$