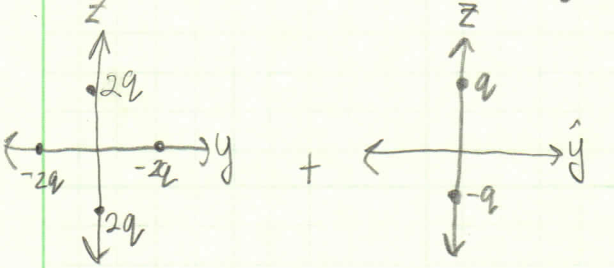
3.29 We can think of the arrangement shown in Figure 31 as the addition of the following 2 arrangements:



. All charges are the same distance from the origin.

The first configuration is clearly a quadrupole, while the second is a dipole. For a simple approximation we may consider only the dipole terms and hence the quadrupole's potential is approx. zero.

The dipole is given by eq.'s 99 & 100 as

$$V_{dip}(\vec{r}) = \frac{1}{4\pi\varepsilon_0}\frac{\vec{p}\cdot\hat{r}}{r^2}\ ; \qquad \vec{p} = 2qa\,\hat{z}\ ;$$

$\hat{r}\cdot\hat{z} = \cos\theta$ so in polar coordinates,

$$V_{dip}(\vec{r}) = \frac{1}{4\pi\varepsilon_0}\frac{2qa\cos\theta}{r^2}.$$

Note, though it requires more elbow grease, $\vec{p}$ may be found directly from Figure 31 by summing the 4 individual dipoles as follows:

$$\vec{p} = -2q(a\hat{y}) + 3q(a\hat{z}) - 2q(-a\hat{y}) + q(-a\hat{z}) = 2qa\hat{z}$$