26. (*a*) With the distance measured from the center of the dipole, we find the potential from each charge:

$V_O = kQ_O/r_O$
$= (9.0 \times 10^9\ \mathrm{N \cdot m^2/C^2})(-6.6 \times 10^{-20}\ \mathrm{C})/(9.0 \times 10^{-10}\ \mathrm{m} - 0.6 \times 10^{-10}\ \mathrm{m})$
$= -0.707\ \mathrm{V}.$

$V_C = kQ_C/r_C$
$= (9.0 \times 10^9\ \mathrm{N \cdot m^2/C^2})(+6.6 \times 10^{-20}\ \mathrm{C})/(9.0 \times 10^{-10}\ \mathrm{m} + 0.6 \times 10^{-10}\ \mathrm{m})$
$= +0.619\ \mathrm{V}.$

Thus the total potential is

$V = V_O + V_C = -0.707\ \mathrm{V} + 0.619\ \mathrm{V} = \boxed{-0.088\ \mathrm{V}.}$

(*b*) The percent error introduced by the dipole approximation is

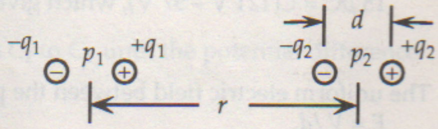
% error = $(100)(0.089\ \mathrm{V} - 0.088\ \mathrm{V})/(0.088\ \mathrm{V}) = \boxed{1\%.}$

27. Because $p_1 = p_2$, from the vector addition we have

$p = 2p_1 \cos(\frac{1}{2}\theta) = 2qL \cos(\frac{1}{2}\theta);$

$6.1 \times 10^{-30}\ \mathrm{C \cdot m} = 2q(0.96 \times 10^{-10}\ \mathrm{m}) \cos[\frac{1}{2}(104°)]$, which gives $q = \boxed{5.2 \times 10^{-20}\ \mathrm{C}.}$

28. We find the potential energy of the system by considering each of the charges of the dipole on the right to be in the potential created by the other dipole. The potential of the dipole on the left along its axis is



$V_1 = (kp_1 \cos\theta)/r^2 = kp_1/r^2.$

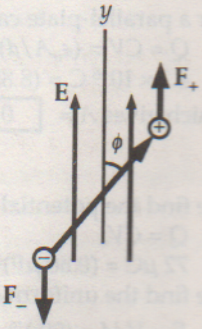
If r is the distance between centers of the dipoles, the potential energy is

$\mathrm{PE} = (q_2)[kp_1/(r + \frac{1}{2}d)^2] + (-q_2)[kp_1/(r - \frac{1}{2}d)^2]$
$= q_2kp_1\{[1/(r + \frac{1}{2}d)^2] - [1/(r - \frac{1}{2}d)^2]\} = (q_2kp_1/r^2)\big(\{1/[1 + (d/2r)]^2\} - \{1/[1 - (d/2r)]^2\}\big).$

Because $d \ll r$, we can use the approximation $1/(1 \pm x)^2 \approx 1 \mp 2x$, when $x \ll 1$:

$\mathrm{PE} \approx (q_2kp_1/r^2)\{[1 - (d/r)] - [1 + (d/r)]\} = -2q_2dkp_1/r^3 = -2kp_1p_2/r^3.$

29. Because the field is uniform, the magnitudes of the forces on the charges of the dipole will be equal:



$F_+ = F_- = QE.$

If the separation of the charges is ℓ, the dipole moment will be $p = Q\ell$.
If we choose the center of the dipole for the axis of rotation, both forces create a CCW torque with a net torque of

$\tau = F_+(\frac{1}{2}\ell)\sin\phi + F_-(\frac{1}{2}\ell)\sin\phi = 2QE(\frac{1}{2}\ell)\sin\phi = pE\sin\phi.$

Because the forces are in opposite directions, the net force is $\boxed{\text{zero.}}$
If the field is nonuniform, there would be a torque produced by the average field. The magnitudes of the forces would not be the same, so there would be a $\boxed{\text{resultant force}}$ that would cause a translation of the dipole.

30. From $Q = CV$, we have

$2500\ \mu\mathrm{C} = C(950\ \mathrm{V})$, which gives $C = \boxed{2.6\ \mu\mathrm{F}.}$

31. From $Q = CV$, we have

$95\ \mathrm{pC} = C(120\ \mathrm{V})$, which gives $C = \boxed{0.79\ \mathrm{pF}.}$

32. From $Q = CV$, we have

$16.5 \times 10^{-8}\ \mathrm{C} = (7500 \times 10^{-12}\ \mathrm{F})V$, which gives $V = \boxed{22.0\ \mathrm{V}.}$