29.63. Model: The potential at any point is the superposition of the potentials due to all charges. Outside a uniformly charged sphere, the electric potential is identical to that of a point charge Q at the center.
Visualize: Please refer to Figure P29.63. Sphere A is the sphere on the left and sphere B is the one on the right.
Solve: The potential at point a is the sum of the potentials due to the spheres A and B:

$$V_a = V_{\text{A at a}} + V_{\text{B at a}} = \frac{1}{4\pi\varepsilon_0}\frac{Q_A}{R_A} + \frac{1}{4\pi\varepsilon_0}\frac{Q_B}{0.70\text{ m}}$$
$$= \left(9.0\times10^9 \text{ N m}^2/\text{C}^2\right)\frac{100\times10^{-9}\text{ C}}{0.30\text{ m}} + \left(9.0\times10^9\text{ N m}^2/\text{C}^2\right)\frac{25\times10^{-9}\text{ C}}{0.70\text{ m}}$$
$$= 3000\text{ V} + 321\text{ V} = 3321\text{ V}$$

Similarly, the potential at point b is the sum of the potentials due to the spheres A and B:

$$V_b = V_{\text{B at b}} + V_{\text{A at b}} = \frac{1}{4\pi\varepsilon_0}\frac{Q_B}{R_B} + \frac{1}{4\pi\varepsilon_0}\frac{Q_A}{0.95\text{ m}}$$
$$= \left(9.0\times10^9\text{ N m}^2/\text{C}^2\right)\left(\frac{25\times10^{-9}\text{ C}}{0.05\text{ m}} + \frac{100\times10^{-9}\text{ C}}{0.95\text{ m}}\right)$$
$$= 4500\text{ V} + 947\text{ V} = 5447\text{ V}$$

Thus, the potential at point b is higher than the potential at a. The difference in potential is $V_b - V_a = 5447\text{ V} - 3321\text{ V} = 2126\text{ V}$.
Assess: $V_{\text{A at a}} = 3000$ V and the sphere B has a potential of 225 V at point a. The spherical symmetry dictates that the potential on a sphere's surface be the same everywhere. So, in calculating the potential at point a due to the sphere B we used the center-to-center separation of 1.0 m rather than a separation of 100 cm – 30 cm = 70 cm from the center of sphere B to the point a. The former choice leads to the same potential everywhere on the surface whereas the latter choice will lead to a distribution of potentials depending upon the location of the point a. Similar reasoning also applies to the potential at point b.