Instructor: Dr. A. Mekki

Name: _____ Key _____ Id: _____

Consider a spherical shell of radius 10 cm and carrying a charge q1 = 20 nC concentric with another spherical shell of radius 15 cm and carrying a charge of q2 = -30 nC.
Find the electric potential at points
    (a) r = 20 cm
    (b) r = 15 cm
    (c) r = 10 cm
    (d) r = 5 cm from the center of the shells.

$r = 20$ cm

$$V = \frac{k(q_1 + q_2)}{r} = \frac{9 \times 10^9 \times 20 \times 10^{-9} + (-30 \times 10^{-9})}{0.2}$$

$$= -450 \text{ V}$$

$r = 1$ cm

$$V = \frac{k(q_1 + q_2)}{r_2} = \frac{9 \times 10^9 \times 20 \times 10^{-9} + (-30 \times 10^{-9})}{0.15}$$

$$= -600 \text{ V}$$

$r = 10$ cm

$$V = \frac{k q_1}{r_1} + \frac{k q_2}{r_2} = \frac{9 \times 10^9 \times 20 \times 10^{-9}}{0.1} + \frac{9 \times 10^9 \times (-30 \times 10^{-9})}{0.15}$$

$$= 1800 - 1800 = 0$$

$r = 5$ cm

$$V = \frac{k q_1}{r_1} + \frac{k q_2}{r_2} = 0$$

Instructor: Dr. A. Mekki
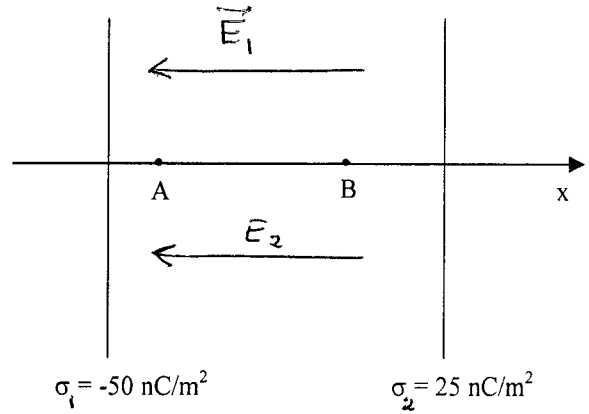
Name: _____ Key _____   Id: _____

Consider uniformly charges infinite non-conducting parallel plates as shown in the figure.

(a) What is the potential difference $V_B - V_A$ if the distance between the two points A and B is 2.0 cm?

(b) What is the work done to move an electron from point A to point B?

$\sigma_1 = -50 \text{ nC/m}^2$ $\sigma_2 = 25 \text{ nC/m}^2$

a) $V_B - V_A = \Delta V = - E \, d \cos\theta$

$$E = E_1 + E_2 = \frac{|\sigma_1|}{2\varepsilon_0} + \frac{|\sigma_2|}{2\varepsilon_0}$$

$$= \frac{50 \times 10^{-9}}{2 \times 8.85 \times 10^{-12}} + \frac{25 \times 10^{-9}}{2 \times 8.85 \times 10^{-12}} = 4237 \text{ N/C}$$

$\theta = 180° \implies V_B - V_A = E \, d = 4237 \times 0.02 = 84.7 \text{ V}$

b) $W = q \Delta V = (-1.6 \times 10^{-19})(84.7) = \boxed{-1.36 \times 10^{-17} \text{ J}}$