P3323 Reading Quiz 4-2
September 14, 2016
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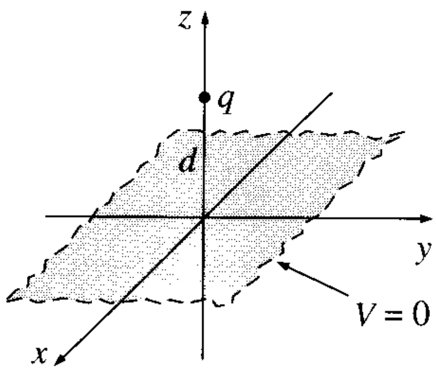
1. A point charge a is held a distance d above an infinite grounded conducting plane. (See figure) Suppose we know the potential $V(x, y, z)$ everywhere in space. The surface charge density σ on the plane is given by



A)

$$\sigma(x, y) = -\epsilon_0 \frac{\partial V}{\partial n}|_{z=0} \text{ where } n \text{ is normal to the surface of the plane}$$

B)

$$\sigma(x, y) = \frac{-qd}{2\pi(x^2 + y^2 + d^2)^{3/2}}$$

C)

$$\sigma(r) = \frac{-qd}{2\pi(r^2 + d^2)^{3/2}}$$

D) All of the above

2. The total charge induced on the plane in the last problem is

A)

$$-q$$

B)

$$q$$

C)

$$0$$

3. Potential $V_0(\theta)$ is specified on the surface of a sphere of radius R. The potential $V(r,\theta)$ outside the sphere is

A)

$$V(r,\theta) = \sum_{l=0}^{\infty} \frac{B_l}{r^{l+1}} P_l(\cos\theta)$$

where

$$B_l = \frac{2l+1}{2} R^{l+1} \int_0^{\pi} V_0(\theta) P_l(\cos\theta) \sin\theta d\theta$$

B)

$$V(r,\theta) = \sum_{l=0}^{\infty} A_l r^l P_l(\cos\theta)$$

where

$$A_l = \frac{2l+1}{2R^l} \int_0^{\pi} V_0(\theta) P_l(\cos\theta) \sin\theta d\theta$$

C)

$$V_0(\theta)\frac{R}{r}$$

4. Potential $V_0(\theta)$ is specified on the surface of a sphere of radius R. The potential $V(r,\theta)$ inside the sphere is

A)

$$V(r,\theta) = \sum_{l=0}^{\infty} \frac{B_l}{r^{l+1}} P_l(\cos\theta)$$

where

$$B_l = \frac{2l+1}{2} R^{l+1} \int_0^{\pi} V_0(\theta) P_l(\cos\theta) \sin\theta d\theta$$

B)

$$V(r,\theta) = \sum_{l=0}^{\infty} A_l r^l P_l(\cos\theta)$$

where

$$A_l = \frac{2l+1}{2R^l} \int_0^{\pi} V_0(\theta) P_l(\cos\theta) \sin\theta d\theta$$

C)

$$V_0(\theta)\frac{R}{r}$$

5. In the last problem, suppose $V_0(\theta) = V_0$, so that the sphere is an equipotential surface. Then the coefficients $A_l =$?

   A)

   $$A_0 = V_0,\ A_l = 0 \text{ for } l \neq 0$$

   B)

   $$A_1 = \frac{3}{2R} V_0,\ A_l = 0 \text{ for all } l \neq 1$$

   C)

   $$A_l = 0 \text{ for all } l$$