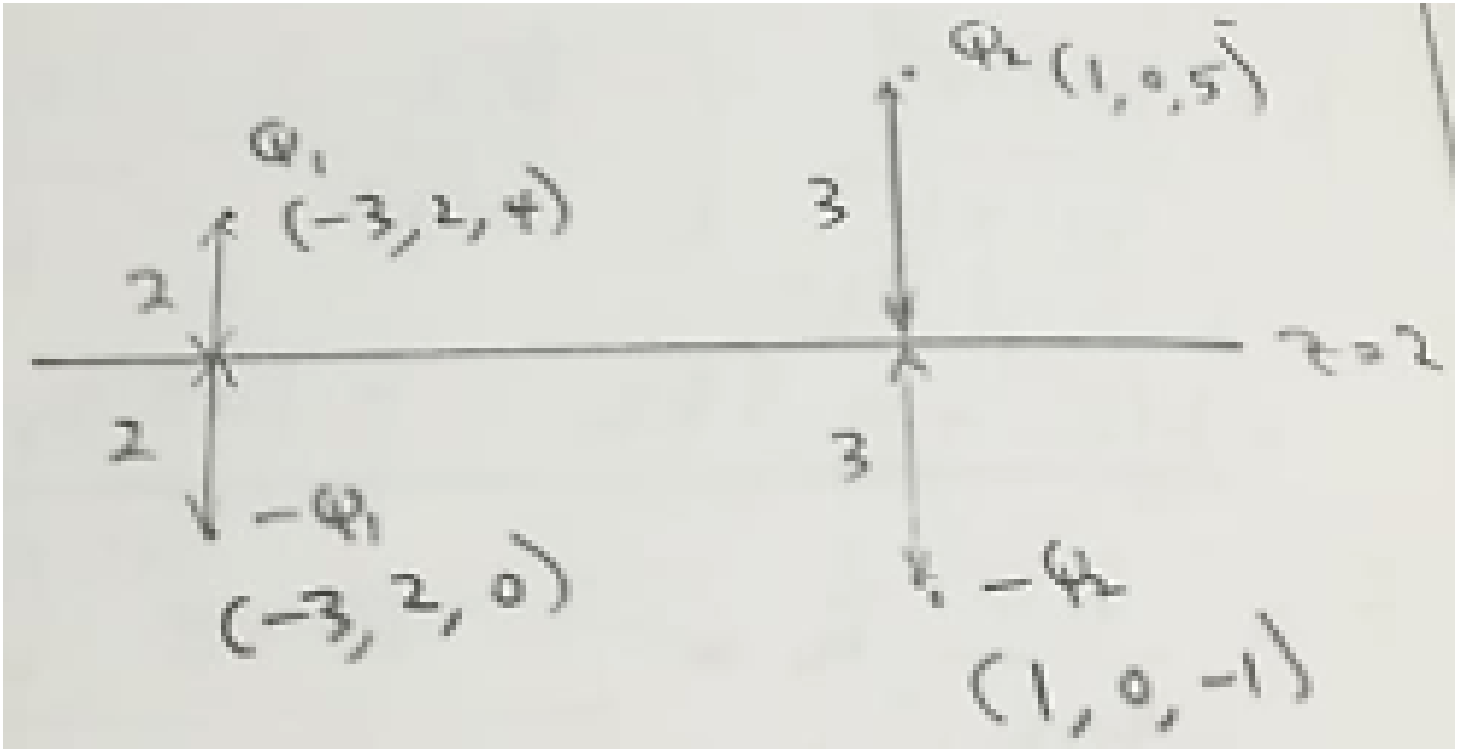
Quiz 2 Answer

1- Two point charges of 5 nC and -20 nC are located at (-3, 2, 4) and (1, 0, 5) above a grounded conducting plane z = 2. Calculate **D** at (3,4,8) and (1, 1, -1).



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At (3, 4, 8):

$$D = \frac{50}{4\pi}\left[\frac{(6,2,4)}{(36+4+16)^{\frac{3}{2}}} - \frac{(6,2,8)}{(36+4+64)^{\frac{3}{2}}}\right] - \frac{20}{4\pi}\left[\frac{(2,4,3)}{(4+16+9)^{\frac{3}{2}}} - \frac{(2,4,9)}{(4+16+81)^{\frac{3}{2}}}\right]$$

$$= \frac{25}{\pi}\left[\frac{(3,1,2)}{(56)^{\frac{3}{2}}} - \frac{(3,1,4)}{(104)^{\frac{3}{2}}}\right] - \frac{5}{4\pi}\left[\frac{(2,4,3)}{(29)^{\frac{3}{2}}} - \frac{(2,4,9)}{(101)^{\frac{3}{2}}}\right]$$

$$= (34.46, 18.24, 7.974) - (17.25, 34.53, 16.46)$$

$$= 17.21\ \mathbf{a}_x - 16.29\ \mathbf{a}_y - 8.486\ \mathbf{a}_z \quad \text{pC/m}^2$$

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$$= 17.21\ \mathbf{a_x} - 16.29\ \mathbf{a_y} - 8.486\ \mathbf{a_z}\quad \mathrm{pC/m^2}$$

At (1, 1, 1):

D = 0

Since (1, 1, 1) is below the grounded plane.

Quiz 2 Answer

2- A negative point charge $Q_1 = -100\,[\mathrm{mC}]$ is placed at a distance d = 50 [cm] in front of a grounded metallic sphere of radius a = 25 [cm].

Find:

- The value of its image Q_2 and its place with respect to the sphere center.
- The force acting on the charge Q_1 due to the conducting sphere.

$$Q_2 = -Q_1 \frac{a}{d} = -(-100)\left(\frac{25}{50}\right) = 50 \text{ mC}$$

$$b = \frac{a^2}{d} = \frac{(25)^2}{50} = 12.5 \text{ cm}$$

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$$Q_2 = -\,Q_1 \frac{a}{d} = -\,(-100)\left(\frac{25}{50}\right) = 50 \text{ mC}$$

$$b = \frac{a^2}{d} = \frac{(25)^2}{50} = 12.5 \text{ cm}$$

$$\mathbf{F} = \frac{K\,Q_1 Q_2}{|\mathbf{R}|^3}\,(\mathbf{R}) = \frac{K\,Q_1 Q_2}{|\mathbf{R}|^2}\,(\hat{Z})$$

$$= \frac{(9 \times 10^9)(-100 \times 10^{-3})(50 \times 10^{-3})}{(50\,x\,10^{-2} - 12.5\,x\,10^{-2})^2}$$

$$= \frac{-45\,x\,10^6}{(0.50-0.125)^2} = \frac{-45\,x\,10^6}{0.14} = -320\,x\,10^6 \text{ Newton}$$

(attractive force)