12 Januarie 2022

1. ‖ What are the strength and direction of the electric field at the position indicated by the dot in FIGURE EX26.1? Specify the direction as an angle above or below horizontal.

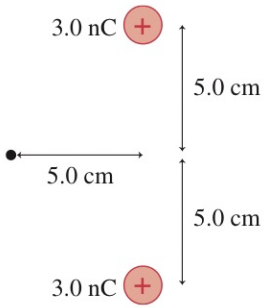


FIGURE EX26.1

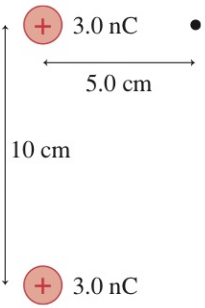
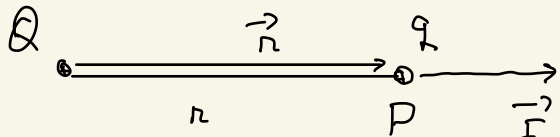


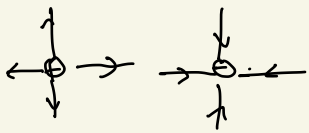
FIGURE EX26.2

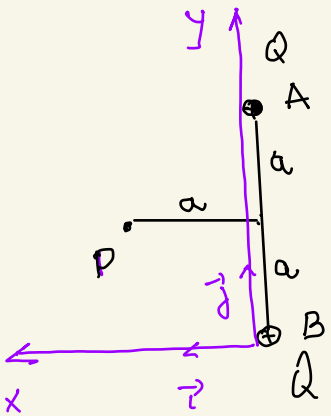
$$\vec{F} = q\vec{E} \quad , \quad \vec{E} = \frac{\vec{F}}{q} \quad , \quad \langle E \rangle_{SI} = \frac{N}{C}$$



$$\vec{F} = k\frac{Qq}{|\vec{r}|^3}\vec{r} = k\frac{Qq}{r^3}\vec{r}$$

$$\vec{E}_P = \frac{\vec{F}}{q} = k\frac{Q}{r^3}\vec{r}$$





$$\vec{E}_P = \vec{E}_{AP} + \vec{E}_{BP}$$

$$= k\frac{Q}{AP^3}\vec{AP} + k\frac{Q}{BP^3}\vec{BP}$$

$$\vec{AP} = +a\vec{i} - a\vec{j}$$

$$|\vec{AP}| = AP = \sqrt{a^2 + (-a)^2} = a\sqrt{2}$$

$$\vec{BP} = a\vec{i} + a\vec{j}$$

$$BP = a\sqrt{2}.$$

$$\vec{E}_P = k\frac{Q}{(a\sqrt{2})^3}(a\vec{i} - a\vec{j}) + k\frac{Q}{(a\sqrt{2})^3}(a\vec{i} + a\vec{j})$$

$$= \frac{kQ}{2\sqrt{2}a^3}(a\vec{i} - a\vec{j} + a\vec{i} + a\vec{j}) = \frac{kQ}{\sqrt{2}a^2}\vec{i} = E_{P,x}\vec{i}$$

$$E_{P,x} = \frac{kQ}{\sqrt{2}a^2} > 0$$

$$|\vec{E}_P| = |E_{P,x}\vec{i}| = |E_{P,x}| = \frac{kQ}{\sqrt{2}a^2} =$$

$$= \frac{9\cdot 10^9 \cdot 3\cdot 10^{-9}}{\sqrt{2}\cdot(5\cdot 10^{-2})^2}\frac{N}{C} = \frac{27}{\sqrt{2}\cdot 25\cdot 10^{-4}}\frac{N}{C} = \frac{27\cdot 100\cdot 100}{\sqrt{2}\cdot 25}\frac{N}{C}$$

$$= \frac{4 \cdot 27 \cdot 100}{\sqrt{2}} \frac{N}{C} = \frac{4 \cdot 27 \cdot 100\sqrt{2}}{2} \frac{N}{C} = 2 \cdot 27 \cdot 100\sqrt{2} \frac{N}{C}$$

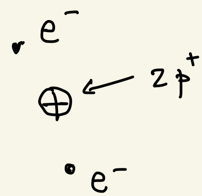
$$= 54 \cdot \sqrt{2} \cdot 100 \frac{N}{C} \simeq 54 \cdot 1{,}41 \cdot 100 \frac{N}{C} = 54 \cdot 141 \frac{N}{C}$$

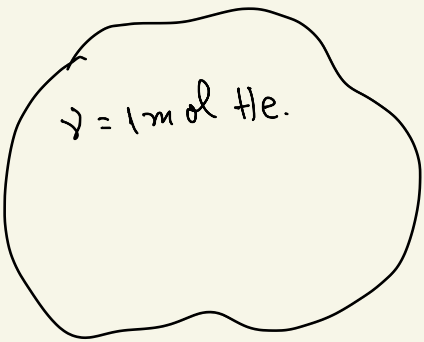
$$\simeq 7600 \frac{N}{C} = 7{,}6 \frac{kN}{C}.$$

5. ‖ What is the total charge of all the protons in 1.0 mol of He gas?

[redacted]

$${}^{Z}_{A}He \qquad Z = 2 \qquad A = 4$$





$$\nu = \frac{N}{N_A} = \frac{m}{\mu} = \frac{V}{V_\mu}$$

$$\nu = \frac{N}{N_A} \Rightarrow N = \nu \cdot N_A$$

Fiecare atom de He conține 2 protoni =>

$$\Rightarrow N_{protoni} = N \cdot 2 = 2\nu N_A$$

$$Q_{protoni} = N_{protoni} \cdot e = 2\nu N_A \cdot e$$

$$= 2 \cdot 1 \cdot 6{,}02 \cdot 10^{23} \cdot 1{,}6 \cdot 10^{-19}\ C \simeq$$

$$\simeq 2 \cdot 6 \cdot 1{,}6 \cdot 10^{4}\ C = 2 \cdot 9{,}6 \cdot 10^{4}\ C = 19{,}2 \cdot 10^{4} C$$

$$= 1{,}92 \cdot 10^{5} C\ !!!$$

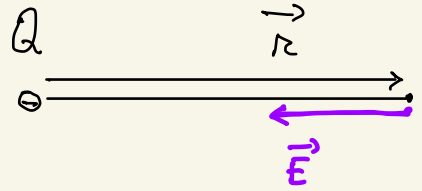
23. | What are the strength and direction of the electric field 4.0 cm from a small plastic bead that has been charged to −8.0 nC?

[redacted]

$Q = -8\ nC$

$r = 4\ cm$

$\vec{E} = ?$



$$\vec{E}_P = k \frac{Q}{r^3} \vec{r}$$

$$|\vec{E}_P| = \left| k \frac{Q}{r^3} \vec{r} \right| = k \frac{|Q|}{r^3} r$$

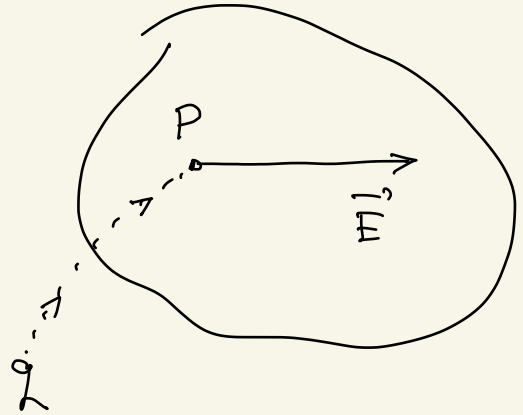
$$= \frac{k|Q|}{r^2} = \frac{9 \cdot 10^{9} \cdot 8 \cdot 10^{-9}}{(4 \cdot 10^{-2})^2} \frac{N}{C}$$

$$= \frac{72}{16 \cdot 10^{-4}} \frac{N}{C} = \frac{36}{8} \cdot 10^{4} \frac{N}{C} = \frac{18}{4} \cdot 10^{4} \frac{N}{C} = \frac{9}{2} \cdot 10^{4} \frac{N}{C}$$

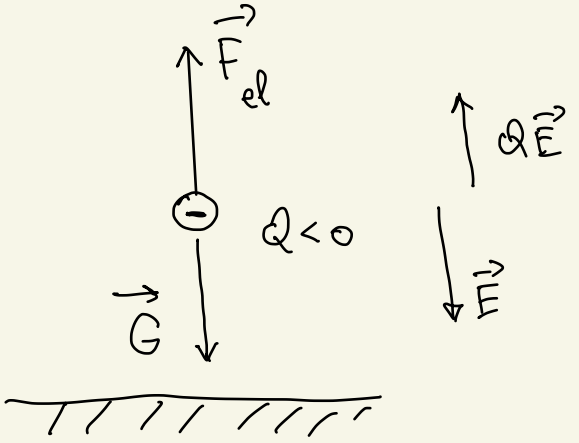
$$= 4{,}5 \cdot 10^{4} \frac{N}{C}$$

charge?

25. What are the strength and direction of an electric field that will balance the weight of a 1.0 g plastic sphere that has been charged to -3.0 nC?



$$\vec{F} = q\vec{E}$$



$$|\vec{F}_{el}| = |\vec{G}|$$

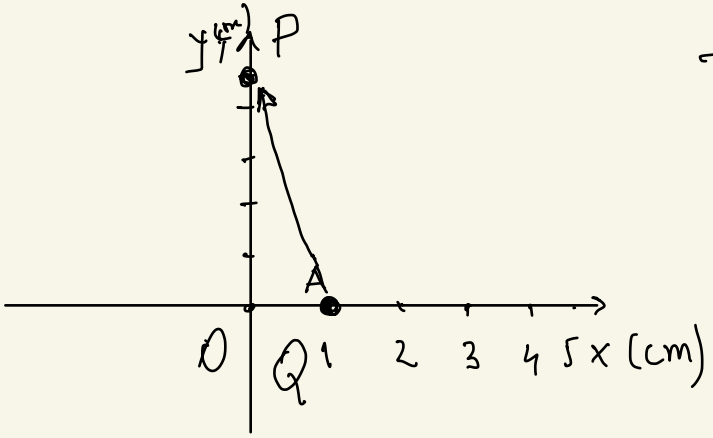
$$|\vec{G}| = mg$$

$$|\vec{F}_{el}| = |Q\vec{E}| = |Q| \cdot E \Big\} \Rightarrow$$

$$\Rightarrow mg = |Q|E \Rightarrow E = \frac{mg}{|Q|}$$

$$= \frac{10^{-3} \cdot 9{,}8}{3 \cdot 10^{-9}} \frac{N}{C} = \frac{9{,}8}{3} \cdot 10^{6} \frac{N}{C} \simeq 3{,}3 \cdot 10^{6} \frac{N}{C}$$

27. ‖ A –12 nC charge is located at $(x, y) = (1.0\text{ cm}, 0\text{ cm})$. What are the electric fields at the positions $(x, y) = (5.0\text{ cm}, 0\text{ cm})$, $(-5.0\text{ cm}, 0\text{ cm})$, and $(0\text{ cm}, 5.0\text{ cm})$? Write each electric field vector in component form.



$$\vec{E}_{AP} = k \frac{Q}{AP^3} \cdot \vec{AP}$$

$$\vec{AP} = -1 \cdot \vec{i} + 5\vec{j} \quad (\text{cm})$$

$$AP = \sqrt{1^2 + 5^2}\ \text{cm} = \sqrt{26}\ \text{cm} = \sqrt{26} \cdot 10^{-2}\ \text{m}.$$

$$\vec{E}_{AP} = k \frac{Q}{\left(\sqrt{26} \cdot 10^{-2}\right)^3} \cdot \left(-10^{-2}\vec{i} + 5 \cdot 10^{-2}\vec{j}\right)$$

$$= \frac{9 \cdot 10^{9} \cdot \left(-12 \cdot 10^{-9}\right)}{26\sqrt{26} \cdot 10^{-6}} \cdot 10^{-2}\left(-\vec{i} + 5\vec{j}\right) =$$

$$= \frac{-9 \cdot 12}{26\sqrt{26}} \cdot 10^4 \left(-\vec{i} + 5\vec{j}\right) =$$

$$= \frac{9 \cdot 12}{26\sqrt{26}} \cdot 10^4 \left(\vec{i} - 5\vec{j}\right) \simeq 0,81 \cdot 10^4 \left(\vec{i} - 5\vec{j}\right) =$$

$$= 8,1 \cdot 10^3 \left(\vec{i} - 5\vec{j}\right) = 8,1 \cdot 10^3 \vec{i} - 40,5 \cdot 10^3 \vec{j}$$

$$E_x = 8,1 \cdot 10^3 \frac{N}{C} > 0$$

$$E_y = -40,5 \cdot 10^3 \frac{N}{C} < 0$$