1) $Q = 4\pi R^2 \cdot \sigma = 4\pi \cdot (2,7 \cdot 10^{-2})^2 \cdot (3 \cdot 10^{-8}) \cong \boxed{2,7 \cdot 10^{-10}\, C}$

2) $E = \dfrac{\sigma}{2 \cdot \varepsilon_0} \Rightarrow \sigma = 2E\varepsilon_0 = 2 \cdot 75 \cdot (8,85 \cdot 10^{-12}) \cong \boxed{1,3 \cdot 10^{-9} \dfrac{C}{m^2}}$

3) $E = \dfrac{\lambda}{2\pi\varepsilon_0 d} \Rightarrow d = \dfrac{\lambda}{2\pi\varepsilon_0 \cdot E} = \dfrac{2,4 \cdot 10^{-5}}{2\pi \cdot (8,85 \cdot 10^{-12}) \cdot (7,2 \cdot 10^{6})} \Rightarrow$

$\boxed{d \cong 6 \cdot 10^{-2}\, m}$

4) $E = \dfrac{\lambda}{2\pi\varepsilon_0 d} \Rightarrow \lambda = 2\pi\varepsilon_0 d E \Rightarrow$

$\lambda = 2\pi (8,85 \cdot 10^{-12}) \cdot (2,3 \cdot 10^{-3}) \cdot (8,5 \cdot 10^{2}) \cong \boxed{1,1 \cdot 10^{-10}\, C/m}$

$\dfrac{E}{4} = \dfrac{\lambda}{2\pi\varepsilon_0 d} \cdot \dfrac{1}{4} \Rightarrow \dfrac{E}{4} = \dfrac{\lambda}{2\pi\varepsilon_0 (4d)}$;

la distanza richiesta è $= 4d = 4 \cdot (2,3 \cdot 10^{-3}\, m) = \boxed{9,2 \cdot 10^{-3}\, m}$.

5) $Q = 4\pi r^2 \cdot \sigma = 4\pi \cdot (5 \cdot 10^{-2})^2 \cdot (2 \cdot 10^{-6}) \cong 6,3 \cdot 10^{-8}\, C$.

$E = k \cdot \dfrac{Q}{d^2} \Rightarrow E = 9 \cdot 10^9 \cdot \dfrac{6,3 \cdot 10^{-8}}{(1,4 \cdot 10^{-1})^2} \cong \boxed{2,9 \cdot 10^{4}\, N/C}$.

6) La risposta corretta è b) $\rightarrow$ indipendente dalla distanza

7) $E = \dfrac{\sigma}{2\varepsilon_0} = \dfrac{6 \cdot 10^{-8}}{2 \cdot (8,85 \cdot 10^{-12})} \cong \boxed{3390\, N/C}$ (risposta b)).

8) $E = \dfrac{\sigma}{2\varepsilon_0} \Rightarrow \sigma = 2\varepsilon_0 \cdot E \Rightarrow \sigma = 2 \cdot (8,85 \cdot 10^{-12}) \cdot 30 \Rightarrow$

$\boxed{\sigma = 5,31 \cdot 10^{-10}\, C/m^2}$; il campo elettrico NON VARIA, QUINDI

la risposta corretta è $\boxed{30\, N/C}$.

9) $\sigma = 2\varepsilon_0 \cdot E = 2 \cdot (8,85 \cdot 10^{-12}) \cdot (5 \cdot 10^{-3}) = \boxed{8,85 \cdot 10^{-14}\, C/m^2}$

il campo elettrico NON VARIA, QUINDI la risposta corretta

è $\boxed{5 \cdot 10^{-3}\, N/C}$.

10) $\Phi = |\vec{E}| \cdot |\vec{n}| \cdot S \cdot \cos(30°) = (4 \cdot 10^3) \cdot 1 \cdot (3 \cdot 10^{-4}) \cdot \dfrac{\sqrt{3}}{2} \cong \boxed{1,04\, \dfrac{N}{C} \cdot m^2}$.

11) $\Phi = \underbrace{10^5 \cdot 1 \cdot (5 \cdot 10^{-6})}_{5 \cdot 10^{-1}} \cdot \underbrace{\cos(60°)}_{\frac{1}{2}} = \boxed{2{,}5 \cdot 10^{-1}\ \frac{N}{C} \cdot m^2}$.

12) $$k \cdot \frac{q_1}{x^2} = k \cdot \frac{q_2}{(d-x)^2} \Rightarrow \frac{q_1}{x^2} = \frac{q_2}{(d-x)^2} \Rightarrow \frac{(d-x)^2}{x^2} = \frac{q_2}{q_1} \Rightarrow$$

$$\frac{d-x}{x} = \overset{A}{\sqrt{\frac{q_2}{q_1}}} \Rightarrow d-x = x \cdot A \Rightarrow x = \frac{d}{A+1} \Rightarrow$$

$$x = \frac{d}{\sqrt{\frac{q_2}{q_1}}+1} \Rightarrow x = \frac{2}{\sqrt{\frac{1{,}8 \cdot 10^{-4}}{2 \cdot 10^{-5}}}+1} = \boxed{0{,}5\ m} \rightarrow \text{distanza da } q_1.$$

13) $$k \cdot \frac{Q_1}{(l/9)^2} = k \cdot \frac{Q_2}{\left(l - \frac{l}{9}\right)^2} \Rightarrow \frac{Q_1}{\left(\frac{l}{9}\right)^2} = \frac{Q_2}{\left(\frac{8}{9}l\right)^2} \Rightarrow$$

$$\frac{Q_1}{Q_2} = \frac{(l/9)^2}{(8/9\, l)^2} \Rightarrow \frac{Q_1}{Q_2} = \left(\frac{l}{9}\right)^2 \cdot \left(\frac{9}{8l}\right)^2 \Rightarrow \frac{Q_1}{Q_2} = \left(\frac{l}{9} \cdot \frac{9}{8l}\right)^2 \Rightarrow$$

$$\frac{Q_1}{Q_2} = \left(\frac{1}{8}\right)^2 \Rightarrow \boxed{\frac{Q_1}{Q_2} = \frac{1}{64}}.$$

14) $$s = 0 + \overset{v_{\text{INIZIALE}}}{0} \cdot t + \frac{1}{2} \cdot a \cdot t^2 \quad \text{DOVE} \quad a = \frac{q \cdot E}{M};$$

$$s = \frac{1}{2} \cdot \frac{(1{,}6 \cdot 10^{-19}) \cdot 140}{1{,}67 \cdot 10^{-27}} \cdot (2{,}8 \cdot 10^{-6})^2 \cong \boxed{5{,}3 \cdot 10^{-2}\ m}$$

$$v_f = v_i + a \cdot t \Rightarrow v_f = 0 + \frac{q \cdot E}{M} \cdot (2{,}8 \cdot 10^{-6}) \cong \boxed{3{,}8 \cdot 10^4\ m/s}.$$

15) $$E = \frac{\sigma}{2\varepsilon_0}; \quad a = -\frac{q \cdot E}{M}; \quad v_i = 4\ m/s; \quad v_f = 0\ m/s.$$

$$0^2 - 4^2 = 2 \cdot \left(-\frac{q \cdot E}{M}\right) \cdot (s_f - 0) \Rightarrow s_f = \frac{-16}{-2 \cdot qE/M} \cong \boxed{0{,}98\ m}$$

LA DISTANZA MINIMA DALLA LASTRA È $= (2{,}0 - 0{,}98)\ m = \boxed{1{,}02\ m}$

$$s = 0 + 4 \cdot t + \frac{1}{2} \cdot \left(-\frac{qE}{M}\right) \cdot t^2$$

$$0 = 0 + 4 \cdot t + \frac{1}{2} \cdot \left(-\frac{qE}{M}\right) \cdot t^2 \Rightarrow t = \begin{cases} 0\ s \\ \boxed{0{,}98\ s} \end{cases}$$

16) a) $E = \dfrac{\rho}{3 \cdot \varepsilon_0} \cdot d \Rightarrow E = \dfrac{4{,}6 \cdot 10^{-6}}{3 \cdot (8{,}85 \cdot 10^{-12})} \cdot (3 \cdot 10^{-2}) \Rightarrow$

$\boxed{E \cong 5{,}2 \cdot 10^{3}\ N/C}$

b) $E = \dfrac{\rho \cdot R^3}{3 \cdot \varepsilon_0 \cdot d^2} \Rightarrow E = \dfrac{(4{,}6 \cdot 10^{-6}) \cdot (7 \cdot 10^{-2})^3}{3 \cdot (8{,}85 \cdot 10^{-12}) \cdot (9 \cdot 10^{-2})^2} \cong \boxed{7{,}3 \cdot 10^{3}\ N/C}$.

17) $Q = (4\pi R^2) \cdot \sigma = 4\pi \cdot (3 \cdot 10^{-2})^2 \cdot (4 \cdot 10^{-6}) \cong 4{,}5 \cdot 10^{-8}\ C.$

$E = k \dfrac{Q}{d^2} \rightarrow \boxed{6{,}3 \cdot 10^{4}\ N/C}$; $F = k \dfrac{Q \cdot e}{d^2} = 9 \cdot 10^9 \cdot \dfrac{(4{,}5 \cdot 10^{-8}) \cdot (1{,}6 \cdot 10^{-19})}{(8 \cdot 10^{-2})^2} \Rightarrow$

$\boxed{F \cong 1{,}01 \cdot 10^{-14}\ N}$; $\Phi = \dfrac{Q_{INT}}{\varepsilon_0} = \dfrac{4{,}5 \cdot 10^{-8}\ C}{8{,}85 \cdot 10^{-12}\ C^2/N \cdot m^2} \Rightarrow$

$\boxed{\Phi \cong 5{,}1 \cdot 10^{3}\ \dfrac{N}{C} \cdot m^2}$.

18) $k \dfrac{Q_1}{h^2} - k \dfrac{Q_2}{(d-h)^2} = -2 \cdot 10^5$; (il SEGNO NEGATIVO DERIVA DAL FATTO CHE IL CAMPO ELETTRICO RISULTANTE È DIRETTO VERSO SINISTRA)

$\dfrac{Q_1}{(5 \cdot 10^{-2})^2} - \dfrac{Q_2}{(9 \cdot 10^{-2})^2} = -\dfrac{2 \cdot 10^5}{k} \Rightarrow$ (RICAVIAMO Q_2)

$Q_2 = \left[\dfrac{Q_1}{(5 \cdot 10^{-2})^2} + \dfrac{2 \cdot 10^5}{k}\right] \cdot (9 \cdot 10^{-2})^2 \cong 2{,}77 \cdot 10^{-7}\ C$

$Q_2 = (4\pi r_2^2) \cdot \sigma_2 \Rightarrow \sigma_2 = \dfrac{Q_2}{4\pi r_2^2} = \dfrac{2{,}77 \cdot 10^{-7}}{4\pi \cdot (4 \cdot 10^{-2})^2} \Rightarrow$

$\Rightarrow \boxed{\sigma_2 \cong 1{,}38 \cdot 10^{-5}\ C/m^2}$

19) la risposta corretta è a).

20) $E = k \cdot \dfrac{Q}{d^2} \Rightarrow E = 9 \cdot 10^9 \cdot \dfrac{3{,}2 \cdot 10^{-7}}{(2 \cdot 10^{-1})^2} = \boxed{7{,}2 \cdot 10^{4}\ N/C}$

21) $Q = (4\pi R^2) \cdot \sigma \Rightarrow Q = 4\pi \cdot (8 \cdot 10^{-1})^2 \cdot (2 \cdot 10^{-9}) \cong$

$1{,}6 \cdot 10^{-8}\ C.$

(CONTINUA l'es. n° 21)

$$E = k \cdot \frac{Q}{d^2} \Rightarrow F = k \cdot \frac{Q \cdot e}{d^2} \Rightarrow F = 9 \cdot 10^9 \cdot \frac{(1,6 \cdot 10^{-8}) \cdot (1,6 \cdot 10^{-19})}{(1,5)^2} \Rightarrow$$

$$\boxed{F \cong 1,02 \cdot 10^{-17}\,N}.$$

22) $$\Phi = \frac{10^{-6} + 2 \cdot 10^{-6} - 5 \cdot 10^{-6}}{\varepsilon_0} = \frac{-2 \cdot 10^{-6}}{8,85 \cdot 10^{-12}} \cong \boxed{-2,3 \cdot 10^{5}\,\frac{N}{C} \cdot m^2}$$

23) $$\Phi = \frac{q_1 + q_2 + q_3}{\varepsilon_0} \Rightarrow \varepsilon_0 \cdot \Phi = q_1 + q_2 + q_3 \Rightarrow$$

$$q_3 = \varepsilon_0 \cdot \Phi - q_1 - q_2 \Rightarrow q_3 = 7 \cdot 10^{5} \cdot \varepsilon_0 - 2 \cdot 10^{-6} + 4 \cdot 10^{-6} \Rightarrow$$

$$\boxed{q_3 \cong 8,2 \cdot 10^{-6}\,C}$$

24) $$\Phi = \frac{Q_1 + Q_2}{\varepsilon_0} = \frac{3 \cdot 10^{-6} + 4 \cdot 10^{-8}}{8,85 \cdot 10^{-12}} \cong \boxed{3,4 \cdot 10^{5}\,\frac{N}{C} \cdot m^2}$$

25) $$|\vec{E_1}| = k \cdot \frac{Q_1}{r_1^2} = 6,75 \cdot 10^5\,N/C\,; \quad |\vec{E_2}| = k \cdot \frac{Q_2}{r_2^2} = 6,75 \cdot 10^5\,\frac{N}{C}$$

PONGO $|\vec{E_1}| = |\vec{E_2}| = E$; si ha (UTILIZZANDO COORDINATE CARTESIANE):

$$\vec{E_1} = \begin{pmatrix} 0 \\ -E \end{pmatrix}; \quad \vec{E_2} = \begin{pmatrix} -E/\sqrt{2} \\ -E/\sqrt{2} \end{pmatrix} \Rightarrow \vec{E_1} + \vec{E_2} = \begin{pmatrix} -E/\sqrt{2} \\ -E - E/\sqrt{2} \end{pmatrix}$$

$$|\vec{E_1} + \vec{E_2}| = \sqrt{\left(-\frac{E}{\sqrt{2}}\right)^2 + \left(-E - \frac{E}{\sqrt{2}}\right)^2} \cong \boxed{1,25 \cdot 10^6\,N/C}$$

OPPURE:

$$|\vec{E_1} + \vec{E_2}| = 2 \cdot E \cdot \cos\left(\frac{45°}{2}\right) = 2 \cdot (6,75 \cdot 10^5) \cdot \cos(22,5°)$$

$$\Rightarrow |\vec{E_1} + \vec{E_2}| \cong \boxed{1,25 \cdot 10^6\,N/C}.$$

26) la risposta corretta è $\boxed{D}$

27) la risposta corretta è $\boxed{E}$ $\left(\frac{Q}{\varepsilon_0} \cdot \frac{1}{6} = \frac{Q}{6\varepsilon_0}\right)$

28) $\Phi_{TOT} = 0$ (NULLO) ; $\Phi = 0$ ATTRAVERSO 4 FACCE (QUELLE $/\!/$ a $\vec{E}$)

$$\Phi = \pm (2)^2 \cdot (7,3 \cdot 10^3) = \boxed{\pm 2,92 \cdot 10^4\,\frac{N}{C} \cdot m^2}$$