# Phys 112 HW3

Garrett Helms

No.

Date

Qs 1,5 Ps 1, 2, 4, 5, 7, 13, 17, 18, 19, 22, 28, 33, 39, 45, 52

1) (a) $\Phi = \vec{E} \cdot \vec{A} = (8\hat{i} + 0\hat{j})$ (b) $\Phi = \vec{E} \cdot \vec{A} = (0\hat{i} + 12\hat{j})$ $\vec{E} = 4\hat{i} / 4\hat{j}$ $\vec{A} = (2\hat{i} + 3\hat{j})$

5) $\varepsilon = \frac{\sigma}{2\varepsilon_0}$ $ma = \varepsilon \cdot q$ $\varepsilon_1 = \frac{2\sigma}{\varepsilon_0} + \frac{2\sigma}{\varepsilon_0} = \frac{4\sigma}{\varepsilon_0}$ $\varepsilon_2 = \frac{\sigma}{2\varepsilon_0} + \frac{\sigma}{2\varepsilon_0} = \frac{4\sigma}{\varepsilon_0}$ $\varepsilon_3 = \frac{3\sigma}{2\varepsilon_0} + \frac{5\sigma}{2\varepsilon_0} = \frac{4\sigma}{\varepsilon_0}$

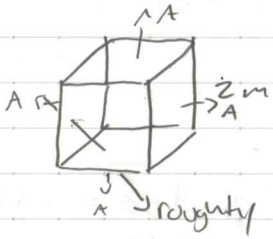
$\varepsilon_1 = \varepsilon_2 = \varepsilon_3$ so a is same for all.

1) $\varepsilon = 1800\ N/C$ $s = 3.2\ mm$ $\theta = 35°$ $\Phi = -\varepsilon \cdot A \cdot \cos(35) = -1.51e{-}2\ Nm^2/C$

$A = s^2 = 1.024e{-}5\ m$

$\Phi = -1.51e{-}2\ Nm^2/C$

2) $\vec{\varepsilon} = 4\hat{i} - 3(y^2+z)\hat{j}$




$A = 4m^2$ $A_T = 0\hat{i} + 4\hat{j}$ $A_{Bot} = 0\hat{i} - 4\hat{j}$ $A_{left} = -4\hat{i} + 0\hat{j}$

a) Top has constant y so $\vec{\varepsilon}_{Top} = 4\hat{i} - 18\hat{j}$ $\Phi_T = \vec{\varepsilon}_T \cdot \vec{A}_T = 0\hat{i} - 72\hat{j}$

b) Bottom has constant y so $\vec{\varepsilon}_{Bot} = 4\hat{i} - 6\hat{j}$ $\Phi_{Bot} = \vec{\varepsilon}_{Bot} \cdot \vec{A}_{Bot} = 0\hat{i} + 24\hat{j}$

c) A has no y component so doesn't matter $\Phi = \vec{\varepsilon} \cdot \vec{A}_1 = -16\hat{i} + 0\hat{j}$

d) no lines in z-axis so $\Phi_{back} = 0$

e) $\Sigma\Phi = \vec{\Phi}_T + \vec{\Phi}_{Bot} + \vec{\Phi}_1 + \vec{\Phi}_r + \vec{\Phi}_F + \vec{\Phi}_{Back}$ (cancel) (0) (0)

$= (0\hat{i} - 72\hat{j}) + (0\hat{i} + 24\hat{j})$

$\Phi_{total} = (0\hat{i} - 48\hat{j})$

a) $-72\ Nm^2/C$
b) $24\ Nm^2/C$
c) $-16\ Nm^2/C$
d) $0\ Nm^2/C$
e) $-48\ Nm^2/C$

$\Phi_1 = -\Phi_r$

4) $\varepsilon = 3e{-}3\ N/C$ $a = 11cm$

$A = \pi r^2 = 3.8e{-}2\ m^2$

$\Phi = \varepsilon \cdot A = 1.14e{-}4\ Nm^2/C$

$\Phi = 1.14e{-}4\ Nm^2/C$

5) $q = +e$


$A = d^2$

$\Phi = \varepsilon \cdot A = \frac{q}{\varepsilon_0}$ one face is $\frac{1}{6}$ so $\frac{q}{6\varepsilon_0} = 3.02e{-}9\ Nm^2/C$

$3.02e{-}9\ Nm^2/C$

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7) $\Phi = \frac{q}{\epsilon_0}$ $q = 1.8\mu C$ $\Phi = \frac{1.8\mu C}{\epsilon_0} = \boxed{2.0e5 Nm^2/C}$

13) @ 300m $\mathcal{E} = 60 N/C$ @ 200m $\mathcal{E} = 100 N/C$  $A = 10000 m^2$ $\Phi = \frac{q}{\epsilon_0}$ $\Phi \cdot \epsilon_0 = q$

Field is vertical so front, back and sides are 0

$\Phi_T = \mathcal{E}_T \cdot A = -60 N/C \cdot 10000 m^2 = -6e5 Nm^2/C$

$\Phi_B = \mathcal{E}_B \cdot A = -100 N/C \cdot -10000 m^2 = 1e6 Nm^2/C$

$q_T = \Phi_T \cdot \epsilon_0 = -5.3e-6C$ $\boxed{q_{Tot} = q_T + q_B = 3.54e-6C}$

$q_B = \Phi_B \cdot \epsilon_0 = 8.85e-6C$

17) $\sigma = 8.1e-6 C/m^2$ $d = 1.2m$ $r = 0.6m$

a) $A = 4\pi r^2 = 4.5 m^2$ $\boxed{q = A \cdot \sigma = 3.66e-5C}$

b) $\Phi = \frac{q}{\epsilon_0} = \boxed{4.14e6 Nm^2/C}$

18) $\Phi = \mathcal{E}A = \frac{q}{\epsilon_0}$ $\sigma = \frac{q}{A}$ $\mathcal{E} \cdot \epsilon_0 = \frac{q}{A} = \sigma$ $\mathcal{E} = 2.3e5$

$\boxed{\sigma = 2.21e-6 C/m^2}$

19) $\Phi = \mathcal{E}A = \frac{q}{\epsilon_0}$ $q = 2.4e-6C$ $r = 0.65m$ $A = 4\pi r^2 = 5.31 m^2$ $\sigma = \frac{q}{A}$

a) $\boxed{\sigma = 4.52e-7 C/m^2}$

b) $\mathcal{E} = \frac{q}{A\epsilon_0} = \frac{\sigma}{\epsilon_0} = \boxed{5.11e4 N/C}$

22) $q = e$ $\lambda = 6e-6 C/m$ $F_e = \mathcal{E} \cdot q = ma$ $\Phi = \mathcal{E}d = \frac{q}{\epsilon_0}$ $\lambda = \frac{q}{\ell}$

$\mathcal{E} = 2k \cdot \frac{6e-6}{0.06} = 1.798e6 N/C$  $\Phi = \mathcal{E}A = \frac{q}{\epsilon}$

mass of electron $= 9.11e-31$ kg $\mathcal{E} = 2k\frac{\lambda}{r}$

$F_e = \mathcal{E} \cdot q = ma$ $\frac{\mathcal{E} \cdot q}{m} = a$ $\boxed{a = 3.16 m/s^2}$

28) $\lambda = 2e-9 C/m$ $r_1 = 5cm$ $r_2 = 10cm$ $r_3 = 15cm$

a) $-\mathcal{E} = 2k\frac{\lambda}{r} = \boxed{239.7 N/C}$

b) $\mathcal{E} \cdot \epsilon_0 = \sigma$ $\mathcal{E}_i = 2k\frac{\lambda}{r} = 7.19e2$

$\boxed{\sigma = -6.37e-9 C/m^2}$

c) $\mathcal{E} \cdot \epsilon_0 = \sigma$ $\mathcal{E}_o = 2k\frac{\lambda}{r} = 3.596e2 N/C$

$\boxed{\sigma = 3.18e-9 C/m^2}$

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# Phys 112 HW 3 cont

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33) $\sigma = 7e\text{-}22 C/m^2$

a) it is [0] because the charges are on the inside

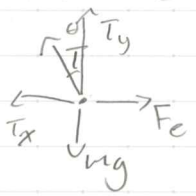
b) [0] Same reasonns

c) $\Phi = EA = \frac{q}{\epsilon_0}$ $E \cdot \epsilon_0 = \sigma$

$E = \frac{\sigma}{\epsilon_0}$

$\boxed{E = 7.91e\text{-}11 N/C}$ $E = 7.91e\text{-}11 N/C$

39) $m = 1mg$ $q = 2e\text{-}8C$ $\theta = 30$




$T_y = T\cos\theta$ $T = \frac{T_y}{\cos\theta}$

$T_x = T\sin\theta$ $T = 1.13e\text{-}5N$

$T_x = 5.66e\text{-}6N$

$T_x = F_e$ $T_y = mg$

$T_y = 1mg \cdot 9.8 m/s^2$

$T_y = 9.8e\text{-}6N$

$T_x = \frac{\epsilon \cdot q}{2\epsilon_0}$ $\epsilon = \frac{\sigma}{2\epsilon_0}$

$T_y = \frac{\sigma}{2\epsilon_0} q$

$\frac{2T_x \epsilon_0}{q} = \boxed{\epsilon = 5.01e\text{-}9}$

45) $\Phi = EA = \frac{q}{\epsilon_0}$ $r_1 = 10cm$ $r_2 = 15cm$ $r_3 = 12cm$ $r_4 = 20cm$ $Q_i = 4e\text{-}8$ $Q_o = 2e\text{-}8$

$A_1 = 4\pi r_i^2 = 0.126 m^2$ $A_2 = 4\pi r_2^2 = 0.283 m^2$

$\sigma_i = \frac{Q_i}{A_i} = 3.18e\text{-}7 C/m^2$ $\sigma_o = 7.07e\text{-}8 C/m^2$

a) $E = k\frac{Q_i}{r^2} = \boxed{2.50e4 N/C}$

b) $E = k\frac{Q_T}{r_4^2} = \boxed{1.35e4 N/C}$ $Q_T = Q_i + Q_o = 6e\text{-}8$

52) $\rho = 1.84e\text{-}9 C/m^3$ $a = 10cm$ $b = 20cm$

a) [0] with in shell

b) [0] Within the shell

c) [0] Still with in the shell

d) $r = 1.5a = 15cm$

d) $\boxed{7.31 N/C}$

$V = \frac{4}{3}\pi 0.15^3 - \frac{4}{3}\pi 0.1^3 = 9.95e\text{-}3 m^3$

$Q = \rho \cdot V = 1.83e\text{-}11 C$

$E = k\frac{Q}{r^2} = 7.31 N/C$

e) $r = b = 20cm$

$V = \frac{4}{3}\pi(r^3 - a^3) = 2.93e\text{-}2 m^3$

$Q = \rho \cdot V = 5.40e\text{-}11 C$

$E = k\frac{Q}{r^2} = \boxed{12.1 N/C}$ e

f) $r = 3b = 60cm$

$V = \frac{4}{3}\pi(b^3 - a^3) = 2.93e\text{-}2 m^3$

$Q = \rho \cdot V = 5.40e\text{-}11$

$E = k\frac{Q}{r^2} = \boxed{1.35 N/C}$ f