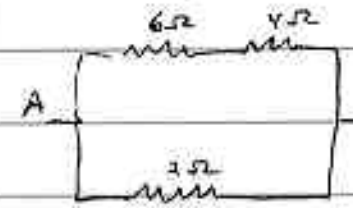
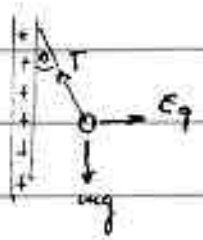
1. $|\mathcal{E}| = \frac{\Delta\phi}{\Delta t} = \frac{0.4}{0.1} = 4\,V$ $\quad I = \frac{V}{R} = 1.33\,A.$

2. 

$\frac{1}{10} + \frac{1}{2} = \frac{6}{10} \quad \therefore R = \frac{4+10}{6} = 5.7\,\Omega$

3. Flux through coil proportional to $\sin\theta$, for angle θ between field and plane of coil.

4. $B = \frac{\mu_0 I}{2\pi r} = \frac{4\pi \times 10^{-7} \times 1}{2\pi \times .005} = 4 \times 10^{-5}$ $\quad$ Bamboo cylindrical conductor is zero.

5. 

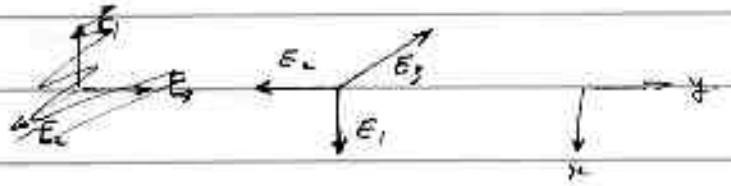
$\tan\theta = \frac{E_q}{mg}$ $\quad$ For a thin sheet $E = \frac{\sigma}{2\varepsilon_0}$

$\text{then } \tan\theta = \frac{1.82 \times 10^{-2} \times 5.4 \times 10^{-9}}{2\pi \times 8.85 \times 10^{-12} \times 0.2 \times 9.8} = 2.83 \quad \theta = 70.56°.$

6. $10\mu C$ $\quad w = .15$ $\quad -15\mu C$

$h = .1$

$-15\mu C$ $\quad 10\mu C$



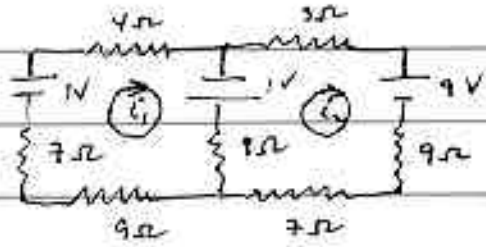
$E_x = \frac{k \cdot 10^{-6}}{10^{-4}} \left(\frac{20}{100} - \frac{15}{325} \cdot \frac{10}{\sqrt{325}} \right) = 10^{-2} \cdot k \cdot 0.174$

$E_y = \frac{k \cdot 10^{-6}}{10^{-4}} \left(\frac{10}{225} - \frac{15}{325} \cdot \frac{15}{\sqrt{325}} \right) = 10^{-2} \cdot k \cdot 0.006.$

$\therefore E_{tot}$ is approximately vertically downward.

7. See next page.

7.



$+1V - 4i_1 + 1V - 8i_1 - 9i_1 - 7i_1 + 8i_2 = 0$

$-1V + 3i_2 - 9V - 9i_2 - 7i_2 - 8i_2 + 8i_1 = 0$

$28i_1 - 8i_2 = 2 \qquad i_2 = \frac{8i_1 - 10}{27}$

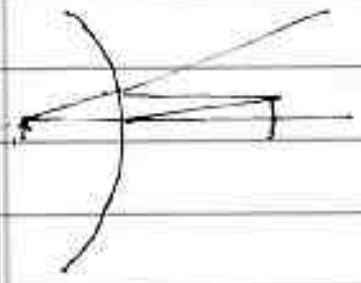
$8i_1 - 27i_2 = 10 \qquad i_1\left(28 - \frac{64}{27}\right) = 2 - \frac{80}{27}$

$i_1 = \frac{-26}{28.27 - 64} = -.0176\,A.$

8. $\mathcal{E} = \frac{\Delta\Phi}{\Delta t} = 100 \times 15\times10^{-4} \cdot \frac{(B(30) - B(0))}{30} = IR = 0.7 \times 0.5$

$B(0) = 0 \qquad B(30) = \frac{0.035 \times 30}{100 \times 0.00/5} = 70T$

9.



$\frac{1}{p} + \frac{1}{q} = \frac{1}{f} = \frac{-2}{R} \quad \therefore \quad \frac{1}{q} = \frac{-2}{R} - \frac{1}{p} = \frac{-5}{3}$

$M = -\frac{q}{p} = \frac{3}{5} \quad \therefore h_i' = 1.2\,cm$, upright.

10. $v = f\lambda \qquad n = \frac{c}{v} = \frac{c}{f\lambda} = 3.75$

11.

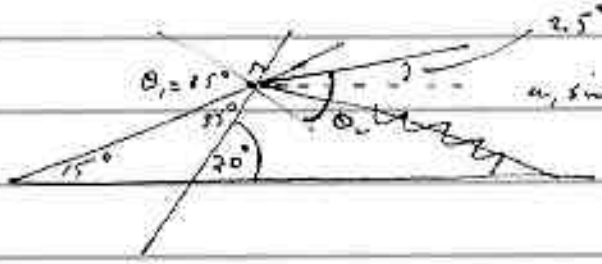
$E = \frac{V}{d} \quad \therefore \quad V = E \cdot d = \frac{mg \cdot d}{q} = \frac{2\times10^{4} \times 1.67\times10^{-27} \times 9.8 \times 0.5}{1.6\times10^{-19}} = .102\,V$

12. $f = \frac{c}{\lambda} = 89.8\,MHz.$

13. $I = \frac{1}{2} I_0 \cdot \cos^2\theta \cdot \cos^2\theta = 0.1\, I_0 \qquad \therefore \cos^4\theta = 0.2, \ \cos\theta = .669$

$\therefore \theta = 48°.$

14. $\frac{P}{A} = \frac{E_m^2 \varepsilon_0 c}{2} \quad \therefore \quad E_m^2 = \frac{2P}{4\pi r^2 \varepsilon_0 c} = 0.0666 \quad \therefore \quad E_m = 0.257\ V/m.$



$n_1 \sin\theta_1 = n_2 \sin\theta_2$ $\quad \theta_2 = \sin^{-1}\left(\frac{n_1 \sin\theta_1}{n_2}\right) = 22.5°$

$\therefore$ angle above horizon is $2.5°$.

16. Speed of light (in vacuum) is same for all wavelengths.

17. $V_{point} = \frac{kq}{r}$ $\quad \therefore V_{tot} = \frac{kq}{10^{-2}}\left(\frac{3.2}{10} - \frac{4.3}{20}\right) = 0$

18. q_1 and $q_2 < 0$ by right hand rule. $\left|\frac{q_1}{q_1}\right| > \left|\frac{q_2}{q_2}\right|$ by conjugate vector lengths.

19. $\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$ $\quad \frac{1}{p} = 4 - (-2) = 6$ $\quad \therefore \frac{-q}{p} = \frac{-\left(-\frac{1}{2}\right)}{\left(\frac{1}{6}\right)} = 3.$

20. $I = \frac{1}{2} I_0 \cos^2 35° = 0.3\ W/m^2 \therefore I_0 = \frac{0.6}{\cos^2 35°} = 0.894\ W/m^2$

$I = \frac{1}{2} I_0 \cos^2 5° \cdot \sin^2 35° = 0.176\ W/m^2$.