

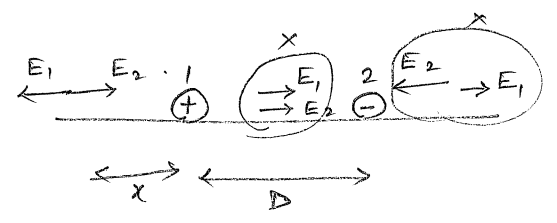
Solutions

Problem 1

$$|\vec{E}_1| = |\vec{E}_2|$$

$$\sqrt{\frac{k|q_1|}{x^2}} = \sqrt{\frac{k|q_2|}{(D+x)^2}}$$

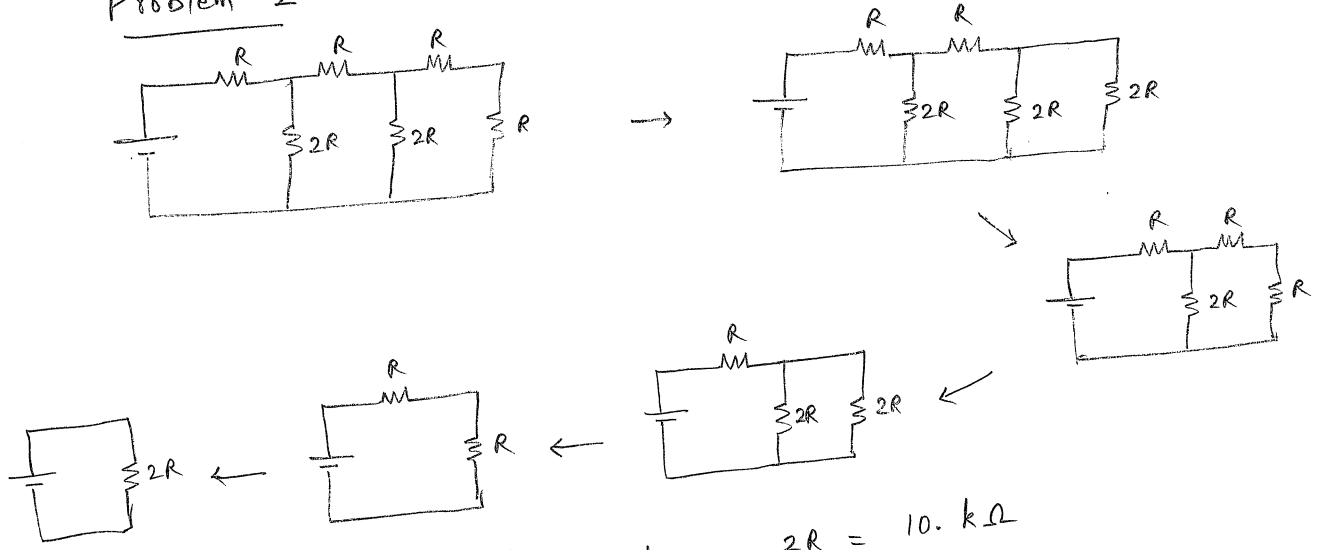
$$\frac{1.00}{x} = \frac{\sqrt{9.00}}{D+x}$$



$$D+x = 3.00x$$

$$x = \frac{D}{2.00}$$

Problem 2



Equivalent resistance =  $2R = 10. \text{ k}\Omega$

Problem 3

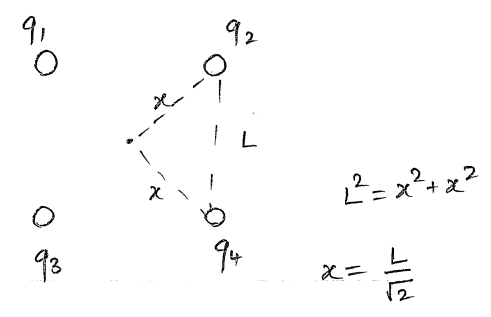
Yes.

Problem 4

Yes.

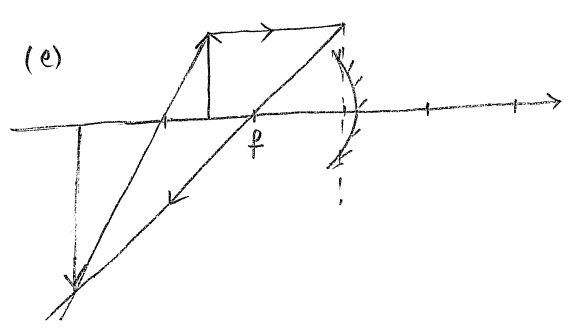
### Problem 5

$$\begin{aligned}
 V_{tot} &= \frac{kq_1}{x} + \frac{kq_2}{x} + \frac{kq_3}{x} + \frac{kq_4}{x} \\
 &= \frac{k}{x} (+1.0q + 2.0q - 3.0q - 4.0q) \\
 &= \frac{kq}{(L/\sqrt{2})} (-4.0) = -4.0\sqrt{2} \frac{kq}{L}
 \end{aligned}$$



### Problem 6

- (a)  $R = 2f = +20.0 \text{ cm}$
- (b)  $\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$       $\frac{1}{i} = \frac{1}{10.0} - \frac{1}{15}$   
 $\Rightarrow i = +30.0 \text{ cm}$   
 image is real.
- (c)  $m = -\frac{i}{o} = -\frac{(+30.0)}{(+15.0)} = -2.0$
- (d) inverted and magnified.



$$h_i = m h_o = -2.0 \text{ cm}$$

### Problem 7

- (a)  $\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$       $\frac{1}{i} = \frac{1}{10.0} - \frac{1}{20.0}$   
 $\Rightarrow i = +20.0 \text{ cm}$
- (b)  $m = -\frac{i}{o} = -\frac{(+20.0)}{(+20.0)} = -1.00$   
 $h_i = m h_o = (-1.00)(1.0 \text{ cm}) = -1.0 \text{ cm}$
- (c) inverted

