PHY152 - PRACTICE PROBLEM SET 2 SOLUTIONS

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1 WOLFSON 20.39

Let the magnitude of larger charge be Q, the smaller charge is $Q/2$, separation $r = 12.5cm$
$k\frac{Q*Q/2}{r^2} = 143N$
we can get: $Q = 22\mu C$
No, we can't know the sign of the larger charge.

2 WOLFSON 20.43

The distance between two positive charge Q is $2a$, negative charge $-q$ lies midway between them. The net force on the middle negative charge is always zero, since it lies in the midway between two identical charges. For the positive charges on one side, net force zero requires:
$k\frac{Qq}{a^2} = k\frac{Q^2}{(2a)^2}$
Therefor, we have $Q = 4q$

3 WOLFSON 20.69

Part a:
$\vec{E} = kq(\frac{1}{(x+a)^2} + \frac{1}{(x-a)^2} - \frac{2}{x^2})\hat{i} = 2kqa^2\frac{3x^2-a^2}{x^2(x^2-a^2)^2}\hat{i}$
Part b:
If $x >> a$, we need to use Taylor expansion to make the approximation:
$\vec{E} \approx 2kqa^2\frac{3x^2}{x^2(x^2-a^2)^2}\hat{i} \approx 2kqa^2\frac{3}{(x^2-a^2)^2}\hat{i} \approx \frac{6kqa^2}{x^4}\hat{i}$