Name ______________________________ Date ______________

PH 102 Quiz 2: SOLN

$$\vec{\mathbf{F}} = k_e \frac{q_1 q_2}{r_{12}^2}\,\hat{\mathbf{r}}_{12} \qquad k_e = 8.9875\times 10^9\,\frac{\mathrm{N\cdot m^2}}{\mathrm{C^2}} \qquad \vec{\mathbf{E}} = \frac{\vec{\mathbf{F}}}{q_0} \qquad |\vec{\mathbf{E}}| = k_e\frac{|q|}{r^2}$$

1. Two charges of $+1\,\mu$C each are separated by 1 cm. What is the force between them?

- ◯ 0.89 N
- ⊗ 90 N
- ◯ 173 N
- ◯ 15 N

Just plug in the numbers ...

$$F = k_e\frac{q_1q_2}{r_{12}^2} = (9\times 10^9\,\frac{\mathrm{N\cdot m^2}}{\mathrm{C^2}})\frac{(+1\times 10^{-6}\,\mathrm{C})(+1\times 10^{-6}\,\mathrm{C})}{(10^{-2}\,\mathrm{m})^2} = (9\times 10^9)\frac{1\times 10^{-12}}{10^{-4}}\,\mathrm{N} \approx 90\,\mathrm{N}$$

2. The electric field *inside* an isolated conductor is

- ◯ determined by the size of the conductor
- ◯ determined by the electric field outside the conductor
- ⊗ always zero
- ◯ always larger than an otherwise identical insulator

Re-read the course notes or Serway & Faughn to remind yourself *why* this must be true.

3. Which statement is false?

- ⊗ Charge deposited on conductors stays localized
- ◯ Charge distributes itself evenly over a conductor
- ◯ Charge deposited on insulators stays localized
- ◯ Charges in a conductor are mobile, and move in response to an electric force

Re-read the course notes or Serway & Faughn to remind yourself *why* this must be true.

4. Which of the following is true for the electric force, but not the gravitational force?

- ◯ The force propagates at a speed of c
- ◯ The force acts at a distance without any intervening medium
- ◯ The force between two bodies depends on the square of the distance between them
- ⊗ The force between two bodies can be repulsive as well as attractive.

Both the electric and gravitational forces propagate at the speed of light, both act through empty space, and both are inverse-square laws. The only difference is that gravity can only be attractive, since there is no such thing as negative mass.

5. Two charges of $+1\,\mu$C are separated by 1 cm. What is the magnitude of the electric field halfway between them?

- ◯ 9×10^7 N/C
- ◯ 4.5×10^7 N/C
- ⊗ 0
- ◯ 1.8×10^8 N/C

Halfway between, the magnitude of the field from each individual charge is the same, but *they act in opposite directions*. Therefore, exactly in the middle, they cancel, and the field is zero. This is the same as the field exactly at the midpoint of an electric dipole. It might be easier to convince yourself the field is zero if you draw a picture including the electric field lines.