(5 pts) 1. The charge $Q$ in the figure is $Q = +12 \text{nC}$. What is the magnitude of the force $F$ on the charge $Q$?

(a) $1.4 \times 10^{-4} \text{ N}$
(b) $8.6 \times 10^{-5} \text{ N}$
(c) $1.1 \times 10^{-4} \text{ N}$
(d) $1.6 \times 10^{-4} \text{ N}$

(5 pts) 2. Which statements about the circuit shown in the figure are correct? (there might be more than one answer). All meters are considered to be ideal, the connecting leads have no resistance and the battery has no internal resistance.

(a) The reading of the ammeter $A_1$ is greater than the reading in $A_2$ because current is lost in the resistor.
(b) The two ammeters have exactly the same readings.
(c) The voltmeter reads less than 25V because some voltage is lost in the resistor.
(d) The voltmeter reads exactly 25V.

(5 pts) 3. If the magnetic field due to a long straight current-carrying wire has a magnitude $B$ at the distance $R$ from the wire’s center, how far must you be (in terms of $R$) for the magnitude of the field to decrease to $B/3$?
4. In a series R-L-C ac circuit at resonance,
   (a) The impedance is zero.
   (b) The impedance has its maximum value.
   (c) The reactance is equal to $R$.
   (d) The total impedance has its minimum value, which is equal to $R$.
   (e) None of the above.

5. A beam of light takes time $t$ to travel a distance $L$ in a certain liquid. If we now add water to the liquid to reduce its index of refraction by half, the time for the beam to travel the same distance will be
   (a) $2t$
   (b) $\sqrt{2} \ t$
   (c) $t/\sqrt{2}$
   (d) $t/2$

6. A certain thin lens has a focal length $f$. If you double both of its radii of curvature, but change nothing else, its focal length will now be
   (a) $4f$
   (b) $2f$
   (c) $f/2$
   (d) $f/4$

On the following problems show all your work. Partial credit will be given if earned.

7. For the capacitor network shown in the figure the potential difference across $ab$ is 36V. Find
   (a) the total charge stored in this network (4pts)
   (b) the charge on each capacitor (4pts)
   (c) the total energy stored in the network (4pts)
   (d) the energy stored in each capacitor (4pts)
   (e) the potential difference across each capacitor. (4pts)
8. An inductor with an inductance of 2.50\,\text{H} and a resistor with a resistance of 8\,\Omega are connected to the terminals of a battery with an emf of 6.0\,\text{V} and a negligible internal resistance. Find
(a) The initial rate of increase of the current in the circuit (5pts)
(b) the initial potential difference across the inductor (5pts)
(c) the current 0.313\,\text{s} after the circuit is closed (5pts)
(d) the maximum current (5pts)

9. Two plane mirrors intersect at right angles. A laser beam strikes the first of them at a point 11.5\,\text{cm} from the point of intersection (as shown in the figure). For what angle of incidence at the first mirror will this ray strike the midpoint of the second mirror (which is 28.0\,\text{cm} long) after reflecting from the first mirror?

10. The figure shows an object and its image formed by a thin lens.
(a) What is the focal length of the lens and what type of lens (converging or diverging) is it? (10pts)
(b) What is the high of the image? Is it real or virtual? (10pts)