1a. Initially, the capacitor has capacitance $C_0$, say. Then the voltage is $V_0 = Q/C_0$.
   In the tank of oil, the capacitance becomes $C = KC_0$ and the voltage $V = Q/C = V_0/K$.
   Therefore, the voltage decreases and so does the electric field, because it is proportional to the voltage.

1b. The current is proportional to the speed $v$. Since the current is constant through the resistor, so is the speed $v$. The kinetic energy of an electron is $\frac{1}{2}mv^2$. If $v$ doesn’t change, no kinetic energy is lost.
   As the electron goes through the resistor, it loses potential energy $eV$. The heat $IV$ in the resistor is due to the loss of potential energy.

1c. The power is $P = V^2/R$, so $P \propto 1/R$. The 60-W bulb has twice the resistance of the 120-W bulb.

1d. Yes, if you shortcircuit the terminals of the battery.

2a. The capacitors between $a$ and $d$ are connected in parallel, so the capacitance between $a$ and $d$ is
   \[ C_{ad} = C_1 + C_2 = 20 \text{ nF} \]
   The capacitors between $b$ and $d$ are connected in series, so the capacitance between $b$ and $d$ is
   \[ C_{bd} = \frac{1}{\frac{1}{C_3} + \frac{1}{C_4}} = 4.8 \text{ nF} \]
   $C_{ad}$ and $C_{bd}$ are connected in series, so the capacitance between $a$ and $b$ is
   \[ C_{ab} = \frac{1}{\frac{1}{C_{ad}} + \frac{1}{C_{bd}}} = 3.87 \text{ nF} \]

2b. The charge on $C_{ab}$ is
   \[ Q = C_{ab}V_{ab} = 1.16 \mu C \]
   This is also the charge on $C_{ad}$ and $C_{bd}$, because they are connected in series.
   $C_{bd}$ is made of $C_3$ and $C_4$ in series, so $C_3$ and $C_4$ have charge $Q$ (same as $C_{bd}$).
   $C_{ad}$ is made of $C_1$ and $C_2$ in parallel, so $C_1$ has charge $Q_1$ and $C_2$ has charge $Q_2$. They all have the same voltage, so
   \[ V_{ad} = \frac{Q}{C_{ad}} = \frac{Q_1}{C_1} = \frac{Q_2}{C_2} \]
   so
   \[ Q_1 = C_1 \frac{Q}{C_{ad}} = 0.464 \mu F \] \[ Q_2 = C_2 \frac{Q}{C_{ad}} = 0.696 \mu F \]

2c. $V_{ad} = Q/C_{ad} = 58$ V.
2d.
\[ U_1 = \frac{Q^2}{2C_1} = 1.3 \times 10^{-5} J \quad U_2 = \frac{Q^2}{2C_2} = 2.0 \times 10^{-5} J \]
\[ U_3 = \frac{Q^2}{2C_3} = 8.4 \times 10^{-5} J \quad U_4 = \frac{Q^2}{2C_4} = 5.6 \times 10^{-5} J \]

3a. The wire through c has two resistors in series and resistance
\[ R_c = 2 + 4 = 6 \Omega \]
The wire through d has two resistors in series and resistance
\[ R_d = 4 + 2 = 6 \Omega \]

\( R_c \) and \( R_d \) are in parallel, so the total resistance is
\[ R = \frac{1}{\frac{1}{R_c} + \frac{1}{R_d}} = 3 \Omega \]

3b. The current through a and b is
\[ I_a = I_b = \frac{\mathcal{E}}{R} = 8 A \]
Since \( R_c = R_d \), this current splits into two equal currents,
\[ I_c = I_d = \frac{8 A}{2} = 4 A \]

3c.
\[ V_{ab} = \mathcal{E} = 24 V \]
\[ V_{cd} = V_{cb} + V_{bd} = 4I_c - 2I_d = 8 V \]