1) (25pts) In this figure, the resistances are $R_1=2.0 \, \Omega$ and $R_2=1.0 \, \Omega$, and the ideal batteries have emfs $\mathcal{E}_1=2.0 \, V$, $\mathcal{E}_2=5.0 \, V$, and $\mathcal{E}_3=4.0 \, V$. What are

a) size and direction (up or down) of current in battery 1

b) size and direction of current in battery 2

c) size and direction of current in battery 3

d) the potential difference $V_a-V_b$
2) (15 pts) In this figure, how much charge is stored on the parallel-plate capacitors by the 10 V battery? One is filled with air, and the other is filled with a dielectric for which $\kappa = 3.00$; both capacitors have a plate area of $2.0 \times 10^{-3}$ m$^2$ and a plate separation of 5.00 mm.

\[ Q_1 = \underline{\quad} \text{C} \]
\[ Q_2 = \underline{\quad} \text{C} \]
3) (20 pts) In this figure a 20 V battery is connected across capacitors of capacitances $C_1=C_6=2.00\,\mu F$ and $C_3=C_5=3.00\,\mu F$, and $C_2=C_4=5.00\,\mu F$.

![Circuit Diagram]

a) What is the equivalent capacitance, $C_{eq}$? $C_{eq}=$

b) What is the charge stored by $C_{eq}$? $Q_{eq}=$

c) $V_1=$

d) $Q_1=$

e) $V_2=$

f) $Q_2=$

g) $V_3=$

h) $Q_3=$
4) (10 pts) A student kept his 9.0 V, 10.0 W radio turned on at full volume from 9:00 PM until 1:00 AM. How much charge (in Coulombs) went through it?
5) (15 pts) This figure shows five 10Ω resistors. Find the equivalent resistance between points
(a) F and H and (b) F and G.

![Resistor Diagram]

a) \( R_{eq(F,H)} = \)________

b) \( R_{eq(F,G)} = \)________
6) (15 pts) A capacitor with an initial potential difference of 100 V is discharged through a resistor when a switch between them is closed at t=0. At t=10.0 s, the potential difference across the capacitor is 2 V. (a) What is the time constant of the circuit? (b) What is the potential difference across the capacitor at t=22 seconds?

a) time constant = ________________

b) V(t=22s) = ________________