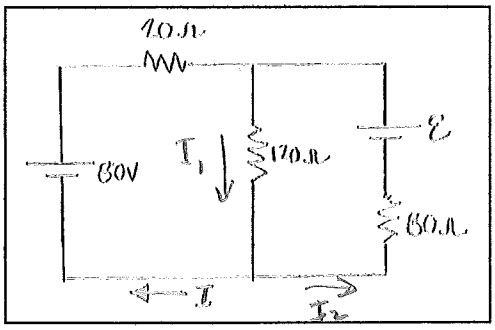
ON REAL EXAM, THE 2-LOOP CIRCUIT MAY DIFFER.

SOLUTIONS

Physics 161 Fall 2010 Exam 5
Numbers and possibly circuit details will be changed on the real exam. Closed book closed notes calculators OK.



SEE FOLLOWING PAGE

1&2. The current *I* is 1 A. What is the unknown EMF?

3&4. What is the power (in watts) dissipated in the 20 ohm resistor?

5&6. In the circuit shown below, what is the current through the battery immediately after closing the switch? EMF = 100V, R_2=R_3=10 ohms, R_1=20 ohms.

7&8. What is the current through the battery a long time after the switch is closed?

9. To measure the current through the battery, an ammeter should be connected:
A] touching points a and b
B] touching points a and g
C] touching points c and d
D] the circuit must be broken at point a and the meter inserted
E] the circuit must be broken at point c and the meter inserted
F] the circuit must be broken at point e and the meter inserted
G] none of these will work

10. To measure the voltage across resistor R_1 , a voltmeter must be connected: (choose from the answers to Q9). C

11&12. The capacitor is a parallel plate air-gap capacitor with area = 0.1 m^2 and a plate separation of 0.1 mm. A long time after the switch is closed, what is the electric field in the capacitor?

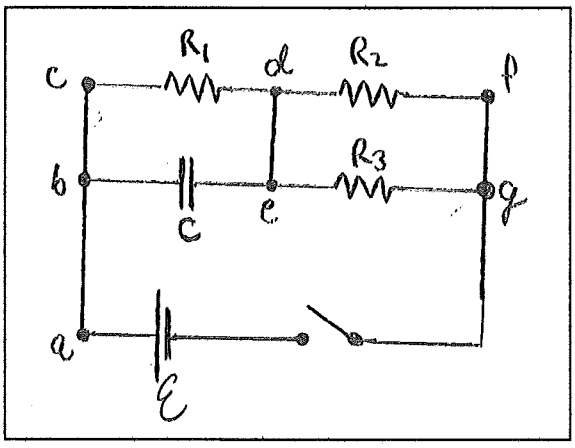
$E = V/d$ $V = IR_1 = 4 \cdot 20 = 80V.$
$E = 80 \times 10^4$ V/m.

13&14. What is the charge on the capacitor, in microcoulombs?

15&16. How much energy (in microJoules) is stored in the capacitor?

$C = \frac{\epsilon_0 A}{d} = \frac{8.85\times10^{-12} \cdot 0.1}{0.1\times10^{-3}}$
$= 8.85\times10^{-9}$

$CV = Q$
$= 8.85\times10^{-9} \cdot 80V$
$= 708\times10^{-9}$
$= 0.7\ \mu C.$



15&16] $U = \frac{1}{2}CV^2 = 28\times10^{-5}$ J $\approx 30\ \mu J.$

182) Kirchoff Loop Laws $80 - 20I - 120I_1 = 0$

$\mathcal{E} - 120I_1 - 80I_2 = 0$

$I_1 = I + I_2$

unknowns $I_1, I_2, \mathcal{E}$. $I = 1A$.

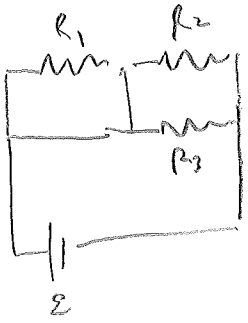
$\begin{cases} 80 - 20 - 120\,I_1 = 0 \\ \mathcal{E} - 120I_1 - 80(I_1 - 1) = 0 \end{cases}$ $\Longrightarrow$ $I_1 = 1/2\,A.$

$\mathcal{E} - 200\,I_1 + 80 = 0$

$\mathcal{E} - 100 + 80 = 0$

$\mathcal{E} = 20\,V.$

314) $P = I^2R = 1^2 \cdot 20 = 20\,W.$



516) $\dashv\vdash$ = $|$ at short times

= $!$ at long times

At short times, R_1 doesn't matter, R_2 & R_3 $\Rightarrow$ $\frac{1}{R_{eff}} = \frac{1}{R_2} + \frac{1}{R_3}$ $R_{eff} = 5\Omega.$

$I = 100V/5\Omega = 20\,Amps$

728] Cap = open circuit. So $R_{eff} = R_1 + R_{eff} = 20\Omega + 5\Omega = 25\Omega$

$I = 100V/25\Omega = 4\,Amps$