**Physics 102.13**
**Quiz# 9&10**
**Chapters 26 & 27**

Instructor: Dr. A. Mekki

Name: Key Id:

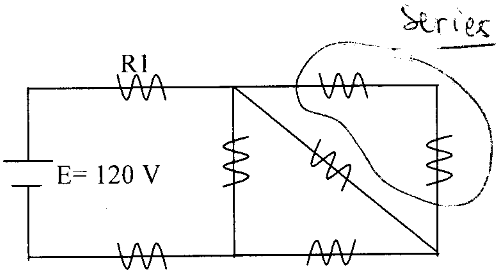
1. A tungsten light bulb has a resistance of 12 Ω when cold (20 °C) and 100 Ω when on (hot). Calculate the temperature of the filament when it is on. The temperature coefficient of resistance is 0.0045 /°C.

$$R = R_0(1 + \alpha \Delta T) \Rightarrow \frac{R}{R_0} = 1 + \alpha \Delta T$$

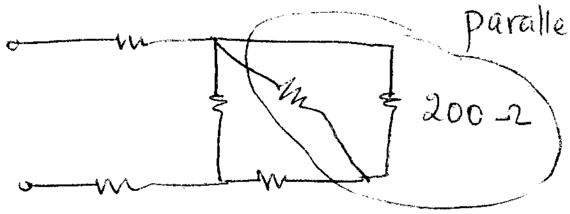
$$\Rightarrow \Delta T = \frac{\frac{R}{R_0} - 1}{\alpha} = \frac{8.33 - 1}{0.0045} = 1629.6\ ^\circ C$$

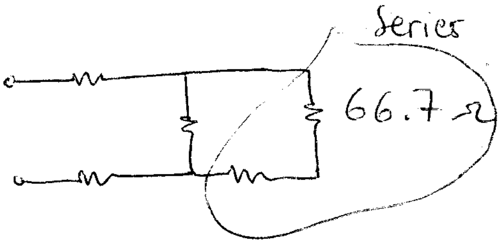
$$T_f - 20 = 1629.6\ ^\circ C \Rightarrow \boxed{T_f \simeq 1650\ ^\circ C}$$

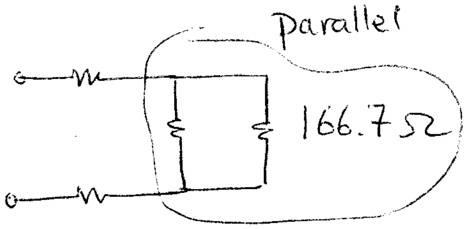
2. In the circuit shown, each resistance is 100 Ω.
   (a) Find the equivalent resistance.
   (b) Find the voltage drop across R1.

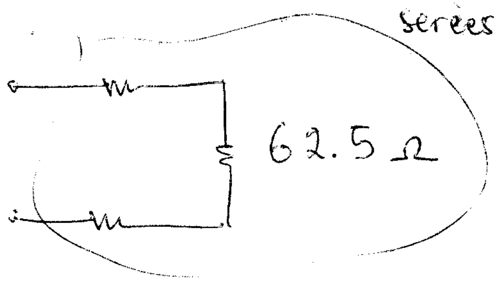


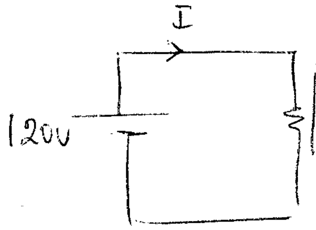

a)



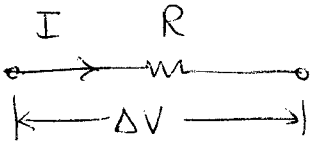




$\boxed{R_{eq} = 262.5\ \Omega}$

b) $I = \frac{120}{262.5} = \boxed{0.457\ A}$




$$\Delta V = I R$$

$$= 0.457 \times 100$$

$$\boxed{\Delta V = 45.7\ V}$$

Physics 102.14
Quiz #9&10
Chapter 26&27

Instructor: Dr. A. Mekki

Name: Key Id:

1. A wire with a resistance of 10 Ω is lengthened to 1.25 times its original length by pulling it through a small hole. Find the resistance of the wire after it is stretched.

$$R_0 = \rho \frac{L_0}{A_0} = 10\ \Omega$$

Since $V$ = Constant

$$A_0 L_0 = AL = A \times 1.25 L_0$$

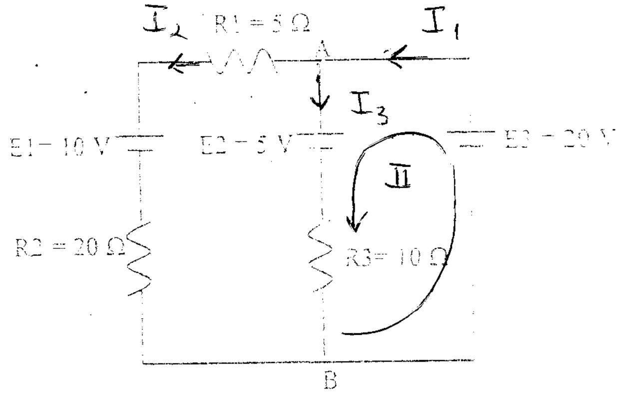
$$A = \frac{A_0}{1.25}$$

$$R = \rho \frac{L}{A} = \rho \frac{1.25 L_0}{A}$$

$$R = \rho \frac{1.25 L_0}{\frac{A_0}{1.25}} = (1.25)^2 \rho \frac{L_0}{A_0},$$

$$= (1.25)^2 R_0 = (1.25)^2 \times 10 = \boxed{15.6\ \Omega}$$

2. Consider the circuit shown in the figure.
   (a) Calculate the current $I_3$ passing through $R_3$.
   (b) Calculate $V_B - V_A$ using two different paths.




a) loop II :

$$20 - 5 - 10 I_3 = 0$$

$$\Rightarrow \boxed{I_3 = 1.5\ A}$$

b) $V_B - V_A = -20\ V$ (through $E_3$)

$V_B - V_A = -5 - I_3 R_3 = -5 - 1.5 \times 10 = -20\ V$

(through the midde branch).

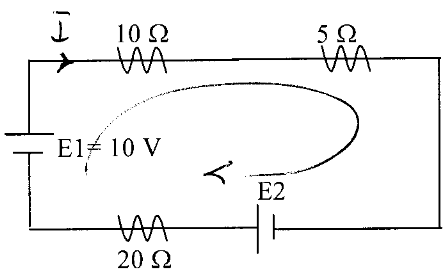
**Physics 102.15**
**Quiz# 9&10**
**Chapter 27**

Instructor: Dr. A. Mekki

Name: Key Id:

1. The current through the 10 Ω resistor is 1 A to the right, What is the value of E2?

$E_1 - 10I - 5I + E_2 - 20I = 0$




$10 + E_2 - 35I = 0$

$10 + E_2 - 35 = 0$

$E_2 = 35 - 10 = \boxed{25\ V}$

2. A resistance of 15 kΩ is connected to an emf of 24 V and to a capacitor of capacitance C. If the time constant is measured to be 55 μs, calculate

(a) the capacitance of the capacitor

$\tau = RC \Rightarrow C = \frac{\tau}{R} = \boxed{3.67 \times 10^{-9}\ F}$

(b) the time it takes for the voltage across the resistor to reach 16 V.

The voltage accross the capacitor is $24 - 16 = 8\ V$

$V_c = V_0 \left(1 - e^{-t/RC}\right) \Rightarrow$

$8 = 24\left(1 - e^{-\frac{t}{55 \times 10^{-6}}}\right)$

$0.33 = 1 - e^{-\frac{t}{55 \times 10^{-6}}}$

$e^{-\frac{t}{55 \times 10^{-6}}} = 0.67$

$t = -55 \times 10^{-6} \ln(0.67) = \boxed{2.2 \times 10^{-5}\ s}$