PHYS 102: General Physics 2 KOÇ UNIVERSITY Fall Semester 2015

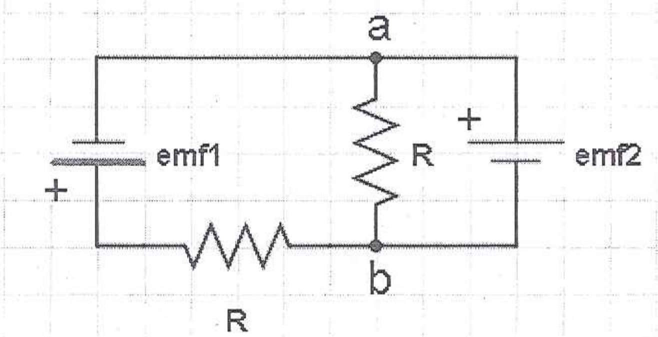
College of Arts and Sciences

Section 3 Quiz 5 November 6, 2015

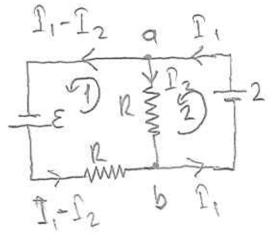
Closed book. No calculators are to be used for this quiz.
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

In the circuit shown, emf1 = ε, emf2 = 2ε. Batteries are ideal. Find the power used between the junction nodes a and b in terms of ε and R.



First, we need to find V_{ab} and currents of the circuit.



Loop 1 in c.c.w direction:

$$\varepsilon - (I_1 - I_2)R + I_2 R = 0$$

$$\varepsilon - I_1 R + 2 I_2 R = 0 \qquad (1)$$

Loop 2 in c.c.w direction:

$$2\varepsilon - I_2 R = 0$$

$$I_2 = \frac{2\varepsilon}{R} \qquad (2)$$

Replacing for I_2 in equation (1):

$$\varepsilon - I_1 R + 2 \frac{2\varepsilon}{R} R = 0$$

$$I_1 = \frac{5\varepsilon}{R}$$

$$I_1 - I_2 = \frac{3\varepsilon}{R}$$

$$V_{ab} = I_2 R = 2\varepsilon$$

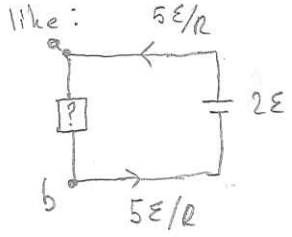
We could find Vab going from other paths as well:

$$V_a + \varepsilon - (I_1 - I_2)R = V_b$$

$$V_a - V_b = V_{ab} = (I_1 - I_2)R - \varepsilon$$

$$= 2\varepsilon$$

Now we know what our circuit looks like:



$$P_{ab} = 2\varepsilon \frac{5\varepsilon}{R} = \frac{10\varepsilon^2}{R}$$

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Section 2 Quiz 5 November 6, 2015

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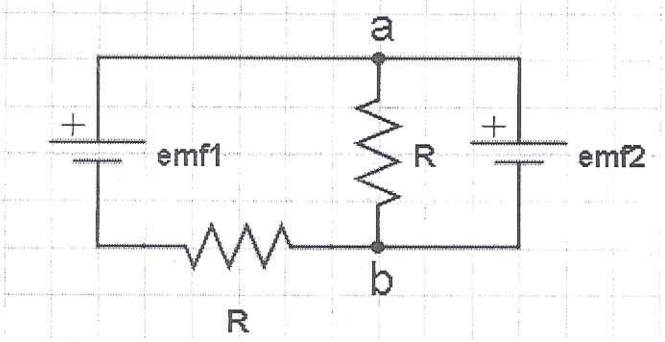
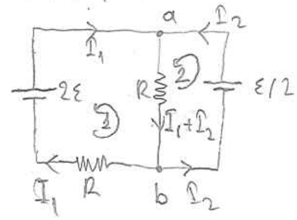
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

In the circuit shown, emf1 = 2ε, emf2 = $\varepsilon/2$. Batteries are ideal. Find the power used between the junction nodes a and b in terms of ε and R.



First, we need to find V_{ab} and currents of the circuit.



Loop 1 in c.c.w direction:

$$-2\varepsilon + I_1 R + (I_1 + I_2)R = 0$$

$$2I_1 R + I_2 R = 2\varepsilon \quad (1)$$

Loop 2 in c.c.w direction:

$$\frac{\varepsilon}{2} - (I_1 + I_2)R = 0$$

$$I_1 R + I_2 R = \frac{\varepsilon}{2} \quad (2)$$

Substracting eq. (2) from eq. (1) we get:

$$I_1 R = \frac{3\varepsilon}{2} \rightarrow I_1 = \frac{3\varepsilon}{2R}$$

From eq. (2):

$$\frac{3\varepsilon}{2R} R + I_2 R = \frac{\varepsilon}{2}$$

$$I_2 = -\frac{\varepsilon}{R}$$

$$I_1 + I_2 = \frac{\varepsilon}{2R}$$

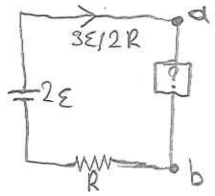
$$V_{ab} = (I_1 + I_2)R = \frac{\varepsilon}{2}$$

We could find V_{ab} going from other paths as well. Example:

$$V_b - I_1 R + 2\varepsilon = V_a$$

$$V_a - V_b = 2\varepsilon - \frac{3\varepsilon}{2R} R = \frac{\varepsilon}{2}$$

Our circuit looks like:



$$P_{ab} = V_{ab} I_1 = \frac{\varepsilon}{2} \frac{3\varepsilon}{2R} = \frac{3\varepsilon^2}{4R}$$

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Section 1 Quiz 5 November 6, 2015

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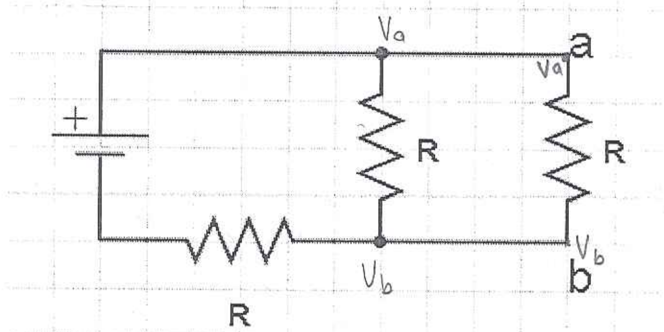
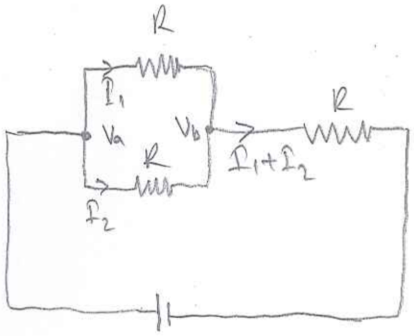
Quiz duration: 10 minutes

Name: **Student ID:** **Signature:**

In the circuit shown, the power dissipated (used) between the nodes a and b is P. Determine the power delivered by the battery in terms of P.





$I_1 = I_2$ since resistors are parallel and their resistance is equal.

$P_{ab} = I_1^2 R = P$

$P_{battery} = I_1^2 R + I_2^2 R + (I_1 + I_2)^2 R$

$= 6 I_1^2 R = 6P$